SmartFocus™
An independent study

SmartFocus™ is clinically proven to improve speech intelligibility in noise

Understanding speech in noise is the number one complaint of hearing instrument wearers\(^1\). Despite the best efforts of the hearing instrument industry, individual adaptive features have only provided incremental gains in this area. In fact, all proven signal-to-noise ratio (SNR) benefits have been tied to directional microphones and FM technology. Until now.

The study conducted at two sites, University of Rochester and Louisiana Tech University, prove that the proprietary smartFocus™ approach of combining multiple adaptive features into one powerful algorithm is the single most effective technology in over a decade for improving speech intelligibility in noise.

Study at a glance

Eighty-eight hearing instrument wearers were fitted at two separate university clinics: 44 at the University of Rochester and another 44 at Louisiana Tech University. At each location 22 people with mild to moderate, flat to gently sloping sensorineural hearing loss (Cohort A- Figure 1) and 22 persons with mild to moderate, high-frequency sensorineural hearing loss (Cohort B – Figure 2) were fitted with hearing instruments. Cohort A participants were tested while wearing Passport Moda II BTEs with standard ear hooks and skeleton molds having 1.5 mm vents. Cohort B participants were tested while wearing Passport Moda II BTEs with slim tubes and open dome ear coupling. In other words the members of Cohort A were properly fitted with vented BTEs and Cohort B received proper open ear fittings.

Figure 1. Right air conduction audiogram – Cohort A     Figure 2. Right air conduction audiogram – Cohort B

All participants from both groups at both sites were given the HINT (Hearing in Noise Test) in 4 conditions.
HINT Reception Thresholds for Sentences (RTS) were obtained in the sound field shown in Figure 3. The HINT sentences were presented from directly in front of the listener 0° azimuth. The HINT noise was presented from 360° azimuth using a 4 speaker array. Noise was presented from 0° azimuth (co-located with the speech to negate directional benefit), from both sides 90° & 270° azimuth, and from behind the listener 180° azimuth.

The hearing instruments were set to each of four conditions:

1. **Gold Standard** - traditional fitting without smartFocus engaged, operating at the default settings of AutoPro4™
2. **Maximum Comfort** – same settings as Gold Standard except smartFocus control is engaged and set to the maximum comfort position
3. **Default Clarity** – same as Gold Standard but with smartFocus engaged and the control set to the start-up default position (approximately 60% in the clarity direction)
4. **Maximum Clarity** – same as Gold Standard but with smartFocus engaged and set at Maximum Clarity

HINT RTS scores were obtained for all 88 participants under each of the four smartFocus conditions. The results obtained for the three conditions where smartFocus was engaged were each compared to the Gold Standard condition. In other words, the HINT RTS in the Gold Standard condition was subtracted from the HINT RTS in each of the three smartFocus conditions for each participant provided a difference score. As is traditional with HINT results, lower scores are better even if they are negative numbers. Thus, a more negative score for any condition means the participant could understand and repeat sentences presented in a more unfavorable signal-to-noise ratio (SNR) for that condition.

**Results**

Statistical analysis of the results showed that there were no interaction effects between the two sites (University of Rochester and Louisiana Tech University) across the smartFocus conditions that were tested using the HINT. This means that any smartFocus condition that was significantly different from the Gold Standard at University of Rochester was also different from the Gold Standard at Louisiana Tech University. In other words, equivalent results were obtained at both sites.

Figures 4 & 5 show the HINT difference results for Cohorts A and B respectively.
In Figure 4, results from 22 participants at the University of Rochester are shown as light blue bars. The 22 participants from Louisiana Tech University are shown are navy bars and the combined results of all 44 participants are shown as gray bars.

In the case of Cohort A, HINT scores were significantly better at both sites for both the Default Clarity smartFocus setting and the Maximum Clarity setting, when compared to the Gold Standard fitting. The Gold Standard fitting demonstrated significantly better HINT results than the Maximum Comfort setting of smartFocus. This all means that setting smartFocus to Clarity yields improved speech perception in noise when compared a traditionally fitted hearing instrument. Adjusting smartFocus to Comfort, a setting designed to improve comfort in noise rather than speech perception, does not improve speech perception in noise.

**Converting HINT scores to percentage change**

In order to determine how big of a difference in speech intelligibility in noise the results represent, HINT RTS differences were converted into corresponding changes in speech intelligibility in noise. Every 1 dB of change on the HINT corresponds to an 8.9% change in speech intelligibility in noise. In Figure 5 we can see the effect of converting the dB values from Figure 4 into percentages of change in speech intelligibility in noise.

The results in Figure 5 have been inverted so that an improvement in speech intelligibility is shown as a positive percentage and a reduction in speech intelligibility relative to the Gold Standard is shown as a negative percentage.

The most important data can be seen in the combined results (gray bars). The combined results show the comparisons of each smartFocus setting to the Gold Standard for all 44 participants from both sites who were in
Cohort A (vented Passport Moda II BTEs). The largest combined percentage improvement for speech intelligibility in noise was 16.4% at the Default Clarity position.

**SmartFocus™ proven**

Figure 6 shows results from 22 participants at the University of Rochester as light blue bars. The 22 participants from Louisiana Tech University are shown as navy bars and the combined results of all 44 participants from both universities are shown as gray bars.

**Figure 6. HINT results for Cohort B**

![Figure 6](image)

The results shown in Figure 6 are of particular interest because these 44 participants were all tested with open fitted Passport Moda II BTEs. One of the persistent fallacies with respect to open fittings is that adaptive features such as Speech Enhancement and Directional Microphones are of limited benefit in noisy listening environments. It is commonly believed that most of the amplified sound is vented out of the ear canal in an open fitting and that loud noise following the direct path to the ear drum negates any processing applied to the signal passing through the hearing instrument. The 1.5 dB advantage at the Maximum Clarity (combined) smartFocus setting over the Gold Standard fitting clearly demonstrates that this is not the case. In fact, both the Default Clarity HINT scores and the Maximum Clarity HINT scores were significantly better than the HINT results from the Gold Standard condition. The one condition most impacted by the open fitting was the smartFocus Maximum Comfort setting. In the vented condition (Figure 4) the Gold Standard condition provided significantly better speech intelligibility in noise than Maximum comfort did. For these 44 participants there was no significant difference between the two conditions.

In Figure 7 the mean HINT scores from Figure 6 have been converted to percentage differences in speech intelligibility, following the same approach as used for Figure 4 and Figure 5. Compared to the Gold Standard condition there was a 10.8% improvement in speech intelligibility in noise at the smartFocus Default Clarity setting and a 13.4% improvement at Maximum Clarity. This is a 13.4% improvement for speech in noise performance over a premium hearing instrument employing a directional microphone in an open fit. The results clearly dispel the “open fit myth,” proving the SNR benefits observed in the vented group of smartFocus extend to open fit.
SmartFocus™ improves speech perception in noise, but what if wearers don’t like the sound?
To answer the question of user satisfaction a third study was undertaken at the University of Iowa. In that study 24 randomly selected participants were fitted with Passport BTEs that they took home with them for a minimum of 8 weeks. For four weeks they wore the instruments with smartFocus engaged; for the other four weeks they wore the same instruments without smartFocus (Gold Standard).

At the end of the study all participants rated their experiences in both conditions highly. However, when they were asked whether they would like to take home the hearing instruments with or without smartFocus, 22/24 participants (92%) chose the smartFocus condition.

Participants were then asked to explain why they had chosen the instruments that they did. The three most common reasons they provided for their decisions were as follows:

- Better clarity
- Comfort in noise
- Flexibility and control

Taken together, all three sites—University of Rochester, Louisiana Tech University and University of Iowa—demonstrate not only that smartFocus significantly improves speech intelligibility in noise, but that wearers overwhelmingly prefer their hearing instruments to have the type of meaningful control that smartFocus offers.

Bibliography
1 Kochkin, Sergei, "MarkeTrak VIII: Consumer satisfaction with hearing aids is slowly increasing." Hearing Journal 63, no. 1 (January 2010)

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