Accuracy of a Proprietary Fitting Algorithm and Comparison to NAL-NL2

Maddie M. Olson, Au.D.[1], Jackson Rose, B.S.[2], & Michelle Hicks, Ph.D.[1]

[1]Starkey, [2]University of Minnesota, Dept. of Speech-Language-Hearing Sciences

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INTRODUCTION

Audiology best practice guidelines recommend using Real Ear Measurements (REM) as part of the hearing aid fitting verification procedure. Prior to using REM, clinicians must determine which of several prescriptive targets or formulas will be used for a given patient. A variety of formulas have been developed that emphasize different aspects of hearing, such as equalizing loudness or maximizing speech intelligibility. Generic fitting formulas, such as NAL-NL2 and DSL[i/o] have been developed to use across hearing aid manufacturers, but it is common for manufacturers to develop and provide their own prescriptive targets based on: (1) specific features and processing of their devices, and (2) their unique approach to amplification (e.g., maximizing audibility or sound quality)[1].

Prior research has found that these proprietary formulas may differ from each other by as much at 10-20 dB and may differ significantly from generic formulas[2], raising questions as to the accuracy or appropriateness of these proprietary approaches. The following poster builds on a previous investigation that explored the differences between e-STAT and e-STAT 2.0, two generations of a proprietary formula[3].

The purpose of this study was to investigate the accuracy of a manufacturer's proprietary fitting formula at a first fitting and compare the results to a generic fitting formula, specifically NAL-NL2, using both simulated and on-ear REM.

METHODS

Test Box Methods

Devices:

- Starkey Evolv AI RIC and Edge AI RIC
- 115/50 matrix

Hearing Losses Tested[4]:

- N2 with open, N3 with occluded, and N4 with occluded earbud (Figure 1)

Procedure:

- International Speech Test Signal (ISTS) presented at 65 dB SPL
- Simulated REAR from Verifit II test box after Best Fit

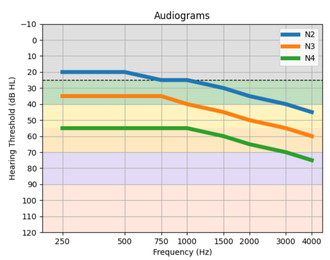


Figure 1. Standardized audiograms[4] used for test box measures.

Real Ear Methods

Real-ear measures completed on 48 participants

Devices:

- Starkey Edge AI RIC and custom hearing aids
- 115/50, 120/60, & 130/70 matrices

Procedure:

- ISTS presented at 50, 65, and 80 dB SPL
- REAR from Verifit II at Best Fit

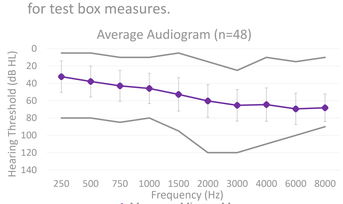
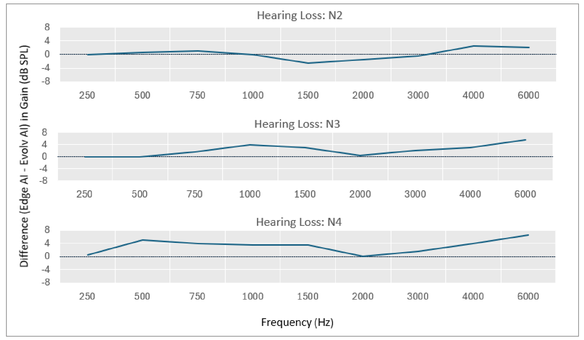


Figure 2. Average audiograms, collapsed across ears, used for real-ear measures.

RESULTS

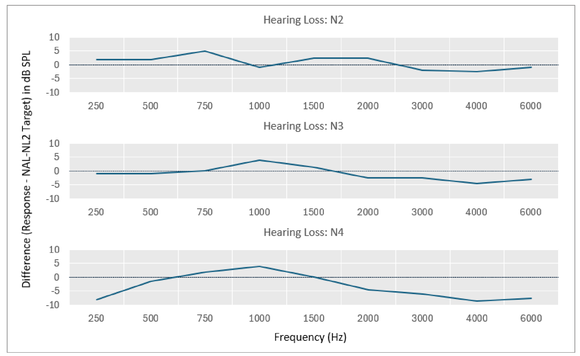
Test Box Measures Comparing e-STAT and e-STAT 2.0



The e-STAT 2.0 formula provides roughly 2-4 dB more gain from 750 Hz to 6 kHz for the N3 and N4 losses, compared to the e-STAT formula.

Figure 2. Difference in simulated REAR between an Evolv AI device set to e-STAT, and an Edge AI device set to e-STAT 2.0.

Test Box Measures Comparing e-STAT 2.0 Response to NAL-NL2 Targets



The e-STAT 2.0 formula provides similar gain to NAL-NL2 targets in the low and mid frequencies (250-3000 Hz), and slightly less gain than NAL-NL2 in the high frequencies (4-6 kHz).

Figure 3. Test box measures using Edge AI hearing aids programmed to e-STAT 2.0 fitting formula compared to NAL-NL2 targets, completed on N2, N3, and N4 standard hearing loss.

Best Fit Accuracy of e-STAT 2.0 using Real-Ear Measures

The average deviation between the real-ear responses at Best Fit and e-STAT targets across 96 ears is less than 4 dB from 250-6000 Hz, although as expected, there is individual ear variability. From 250-3000 Hz, 83.2% of ears are within +/- 5 dB, and from 4000-6000 Hz, 62.0% of ears are within +/- 5 dB.

These results indicate why real-ear measures are considered clinical best practice for accounting for individual ear canal differences.

Figure 4. Real-ear measurement differences between the hearing aid response and e-STAT 2.0 targets across all Edge AI hearing aid styles (RIC, ITE/ITC R, and CIC). Red reference lines depict a +/- 5 dB tolerance.

RESULTS (Contd.)

Real-Ear Measures Comparing e-STAT 2.0 Response and NAL-NL2 Target

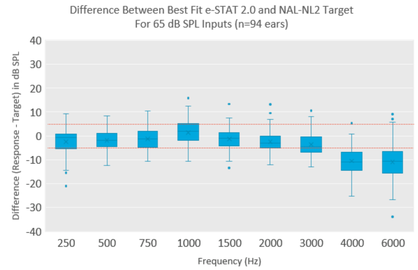


Figure 5. Real-ear measurement differences between the hearing aid response when programmed to e-STAT 2.0 and NAL-NL2 targets for 65 dB SPL inputs. Red reference lines depict a +/- 5 dB tolerance.

- Real-ear measures across 94 ears confirm the e-STAT 2.0 formula provides similar gain to NAL-NL2 targets for moderate inputs from 250-3000 Hz, with an average deviation < 4 dB, and provides less gain than NAL-NL2 targets above 4 kHz (Figure 5).
- The average deviation from target at any one input level (50, 65, or 80 dB SPL) varies by a maximum of 7.4 dB from 250-3000 Hz, and 14.1 dB from 4-8 kHz. Deviations are larger for soft inputs, than for moderate or loud inputs.

DISCUSSION and CONCLUSIONS

- Data in Figures 2 and 3 were collected using a coupler and test box and may not generalize to on-ear fittings due to individual ear canal shapes and sizes.
- Edge AI with e-STAT 2.0 provides around 2-4 dB more gain from 750-6000 Hz for the N3 and N4 losses, compared to Evolv AI with the e-STAT formula.
- The e-STAT 2.0 fittings, on average, deviate less than 4 dB from targets. Due to ear canal variability, real-ear verification remains the best practice for ensuring the appropriate gain for a given patient's ears.
- Fittings using e-STAT 2.0 can be verified using a variety of real-ear measurement systems, and some systems work directly with Pro Fit to get e-STAT 2.0 targets.
- e-STAT 2.0 provides similar gain for moderate inputs to NAL-NL2 in the low-mid frequencies, and slightly less gain than NAL-NL2 in the high frequencies, confirmed by test box measures using standard hearing losses and by real-ear measures across 94 ears.

REFERENCES

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