The Rotary Hearing Center of San Felipe: A Comparison of Hearing Aid Fitting Approaches for Developing Countries

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Disclosures

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This study was reviewed by the ASU IRB and the protocol was considered exempt pursuant to Federal Regulations 45CFR46 (4) Data, documents, or specimens on 6/11/2019

No other financial or non-financial relationships to disclose

Verification of Fit to Target Associated With:

- Improved audibility
- Improved listening outcomes
- Improved patient satisfaction
- Improved perceived quality of services
- Improved fitting efficiency (reduced fitting visits)

(Aarts & Caffee, 2004; Aarts & Caffee, 2005; Valente, 2006; Aazh & Moore, 2007; Mueller & Picou, 2010; Abrams et al, 2012; Aazh et al, 2012; Kochkin et al, 2010; Kochkin, 2011; Boymans & Dreschler, 2012; Tomblin, et al, 2014; Leavitt & Flexer, 2012; Sanders et al, 2015; Munro et al, 2016; Valente et al, 2018.

Challenges of Fitting Hearing Aids in Developing Countries

Clinician-based model ensures fitting precision but is not easily scaled to meet all needs

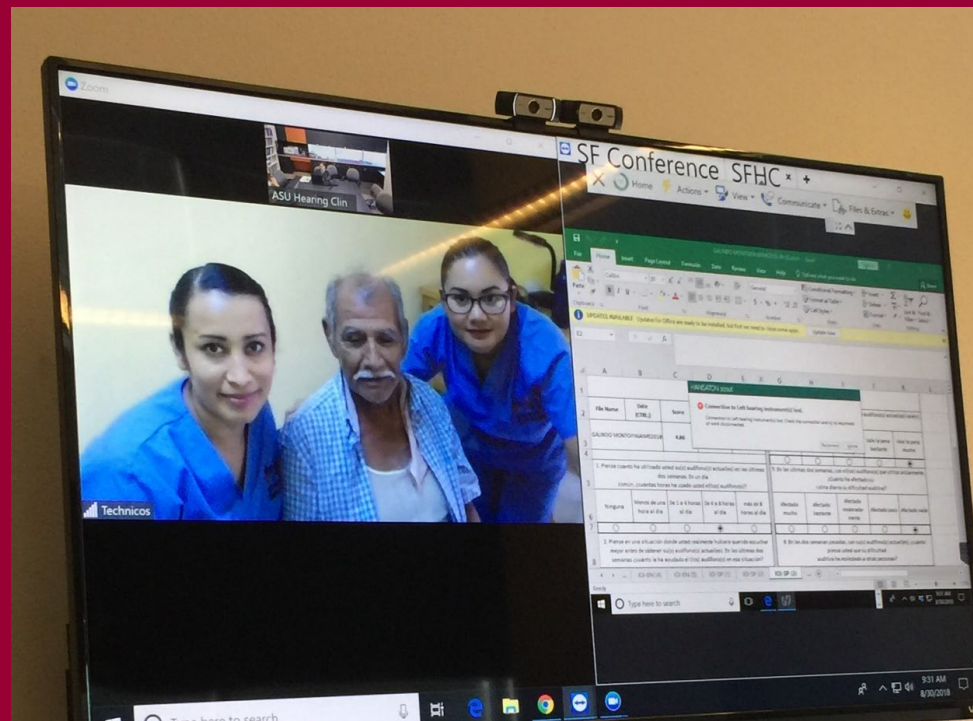
Fittings in the field

- Many outreach days have high demand that may not be met
- Requires verification equipment to be brought into the country
- Access to electricity is unpredictable at some locations and not available at others

Challenges of Fitting Hearing Aids in Developing Countries

Telehealth fittings

- Requires verification equipment with tele-fit capability
- Requires consistent high-speed internet connection
- Clinician-based fitting requires synchronous sessions
- Independent fitting by technicians is limited (asynchronous telehealth sessions)



Fitting Approach Comparisons

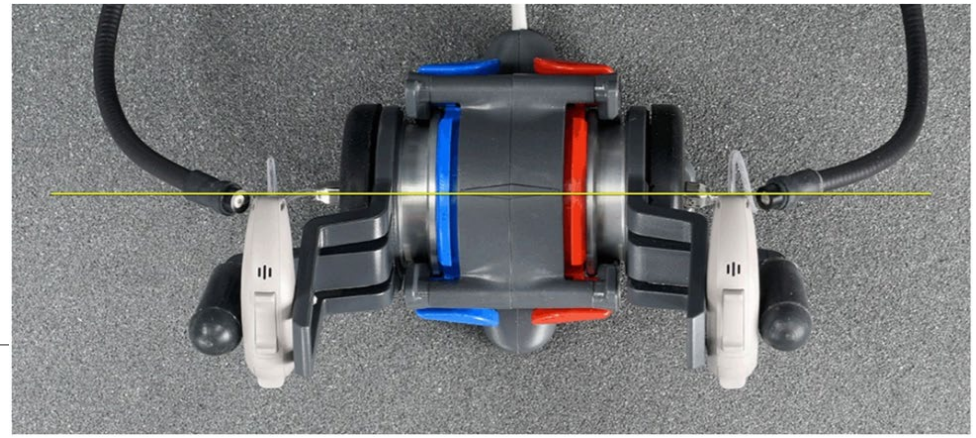
The primary aim of this project was to assess the efficiency and accuracy of four fitting approaches:

1. Standardized Fit
2. Manufacturer Fit
3. VerifitLINK Fit (AutoREMfit)
4. Clinician Fit

Technician-based Approaches

Clinician-based Approach

Study Methods



All four fitting methods were used per subject audiogram

Verification completed in the Verifit2 (VF2) test box using SREM

Outcome measures:

- Time to complete each method
- Hearing aid output at each input level (50, 65, 75 dB SPL) relative to target

Study Methods

Parameters set in Genie2 software were identical for each fitting method

- Fitting default rationale: NAL-NL1
- Acoustics: earpiece: micromold, vent: closed
- Test signal transducer: headphone
- RECD: predicted
- Acclimatization: 3
- Directionality set to omni; all advanced features turned off (REM settings)

Binaural Link feature of the VF2 was used

- Allowed simultaneous measurement of aids of a binaural pair

Study Methods

Used audiograms from patients tested at the Rotary San Felipe Hearing Center

42 individual audiograms were used

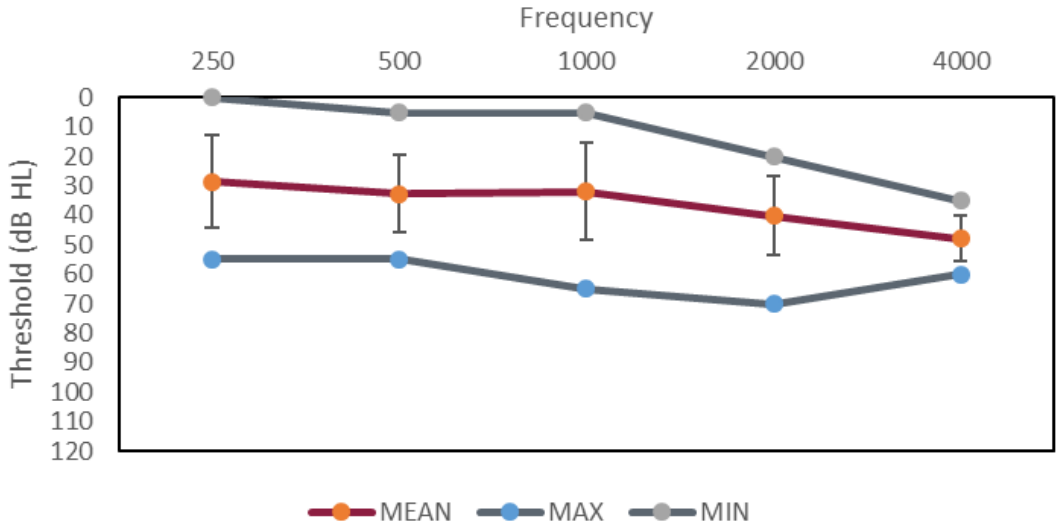
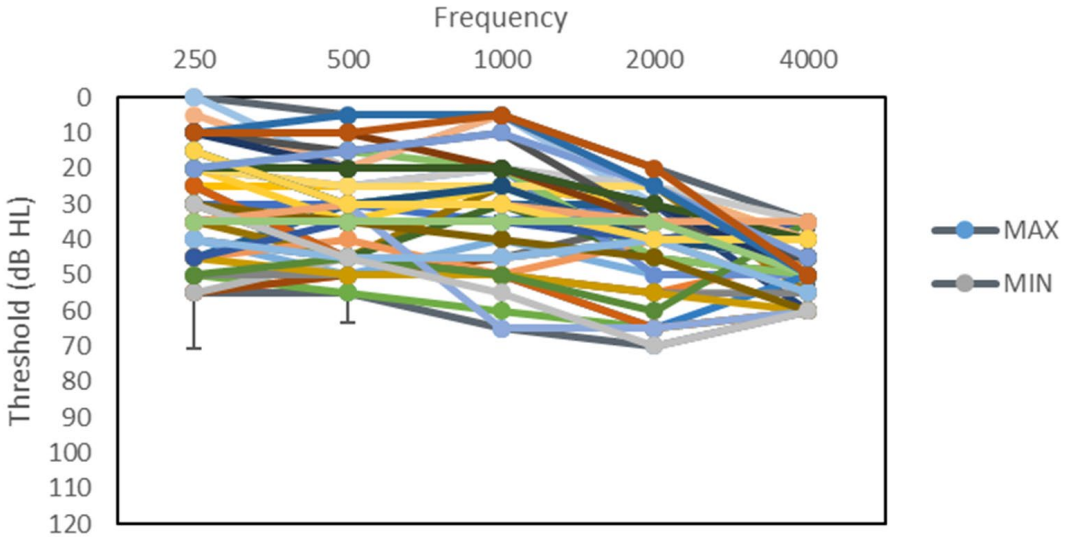


Figure: Average thresholds per frequency with minimum and maximum threshold values per frequency

Figure: Individual subject thresholds per frequency shown with minimum and maximum threshold values per frequency



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Fitting Methods

MANUFACTURER-FIT METHOD

- Connected aid and fit with manufacturer "1st-fit" prescription
- No manual adjustments made to programming

CLINICIAN-FIT METHOD

- Connected and fit aid manually
- Programming adjustments as needed to fit to amplification targets

Fitting Methods

STANDARDIZED-FIT METHOD

- Saved preset amplification settings for the selected standardized audiogram to aid
- No manual adjustments made to programming

VERIFITLINK-FIT METHOD

- Connected and autofit aid using VerifitLINK
- No manual adjustments made to programming

Standardized Method Described

Standardized audiograms were based on audiometric data previously collected by Robert Margolis, PH.D. on thousands of ears using automated audiometry (AMTAS)

AMCLASS, a method for classifying audiograms based on configuration, severity, and site of lesion, generated the standardized audiograms

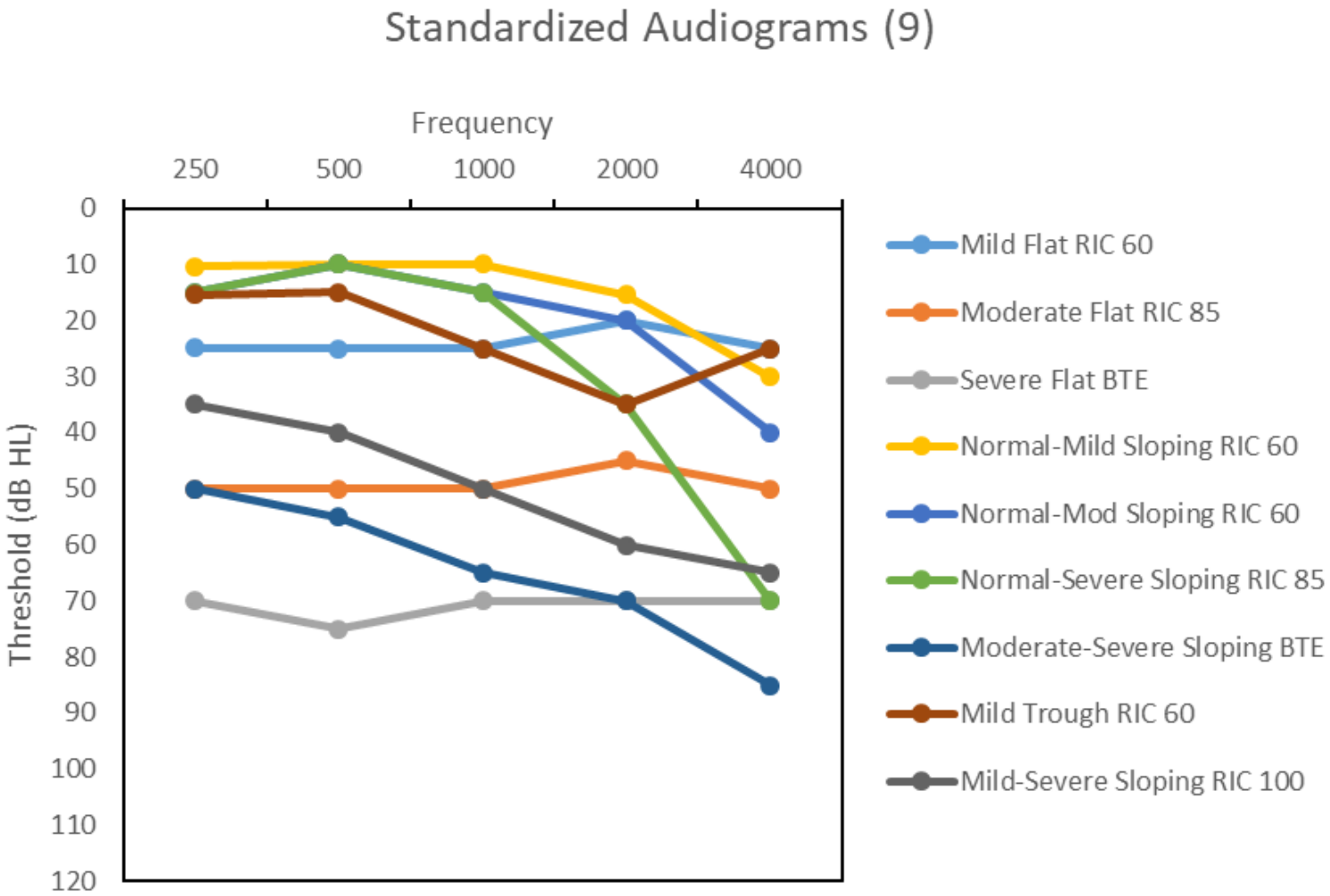
Only used audiograms without an air-bone gap (sensorineural only)

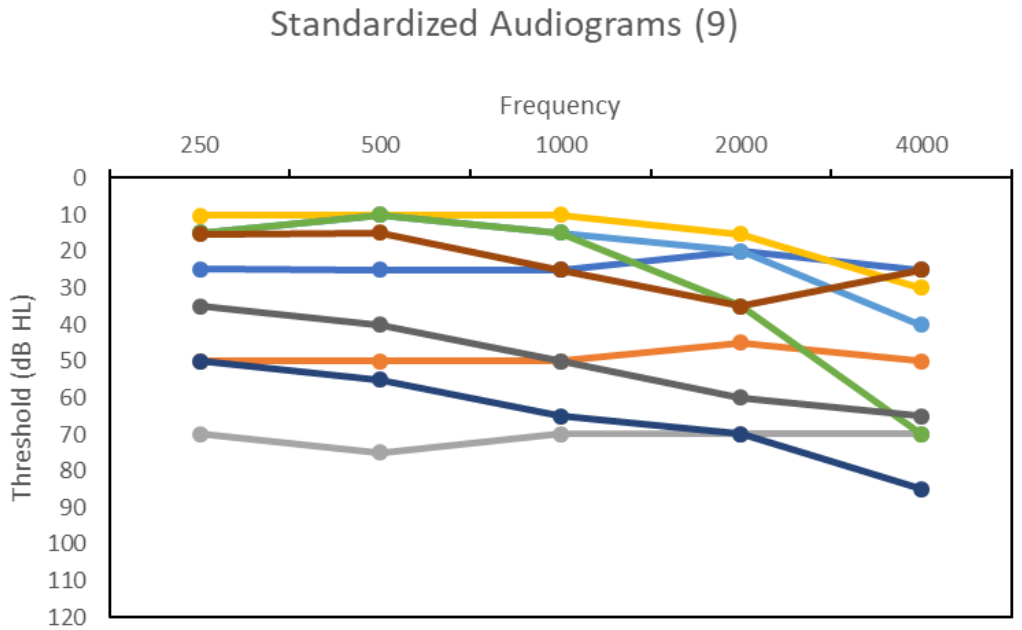
Standardized Method

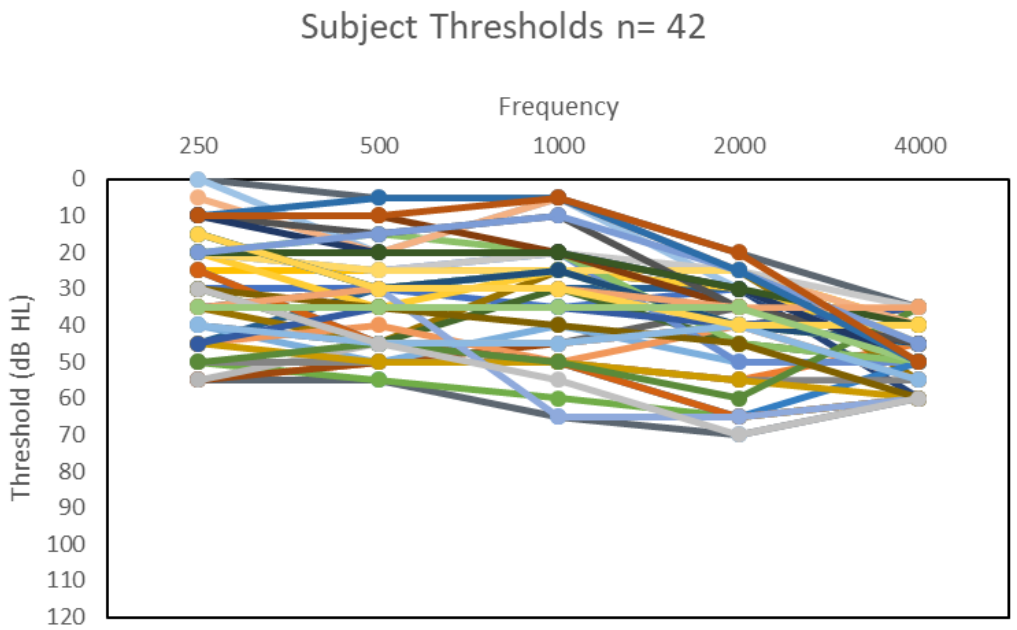
Each subject audiogram was compared to the standardized audiogram templates and the template with the best fit was selected

Out of 18 standardized audiograms; 9 were used

Graph: 9 standardized audiograms used with OPN1 style (RIC vs. BTE) and receiver power







Comparison of Subject Thresholds and Standardized Audiograms

Standardized Method Described

Pre-programmed Oticon OPN1 miniRITE and OPN1 BTE PP hearing aids for each standardized audiogram in the Oticon Genie software

Programmed to NAL-NL1 targets using the Audioscan Verifit2 (SREM) in test coupler

The preset aids met amplification targets within ±2 dB at all frequencies

Parameters in the Genie software were identical across all four fitting methods

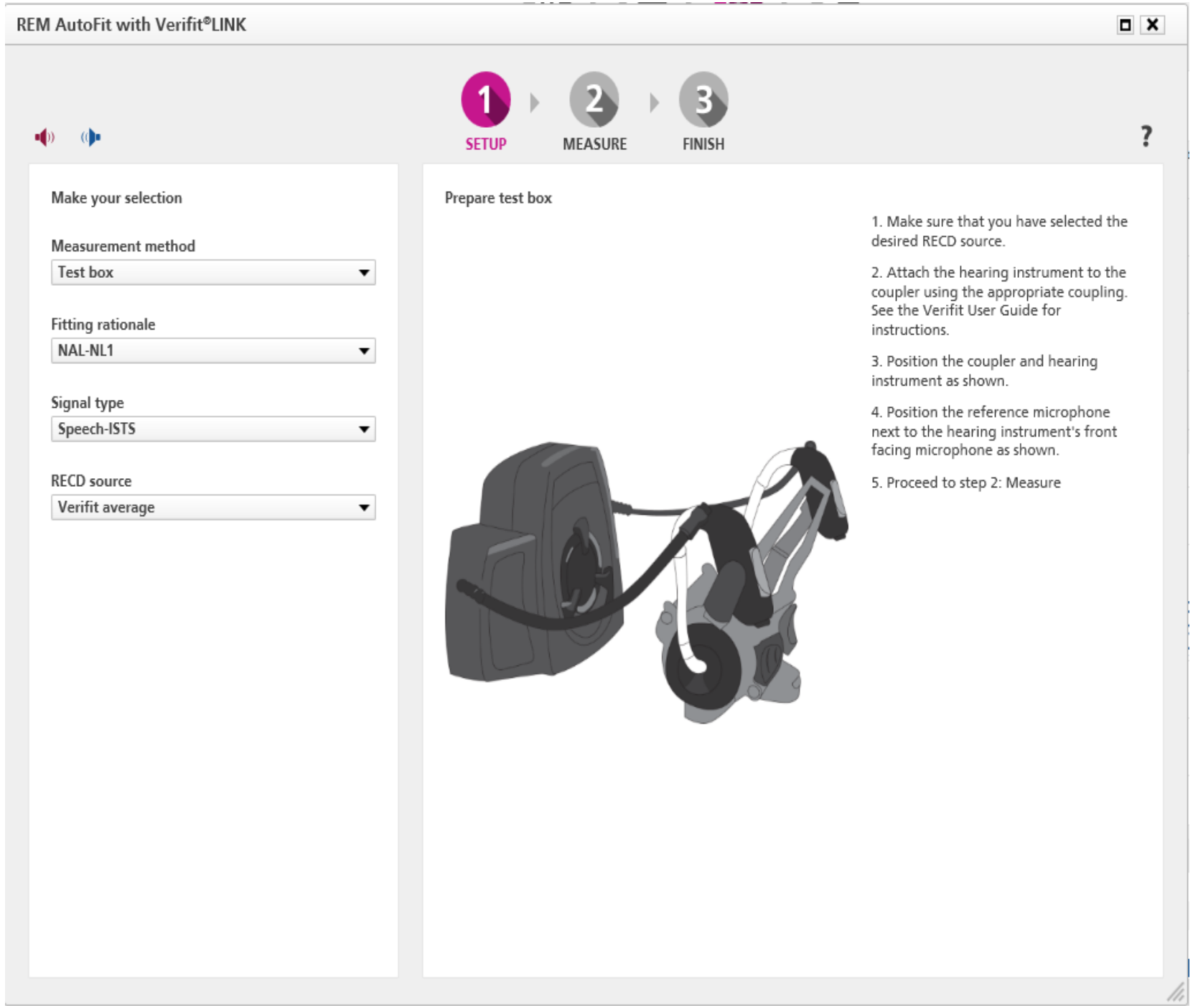
Audioscan VerfitLINK Method Described

3-stage procedure

- Set-up
- Measure
- Finish

VerifitLINK can be used with validated generic prescriptive methods: NAL-NL1-, NAL-NL2, DSLv5

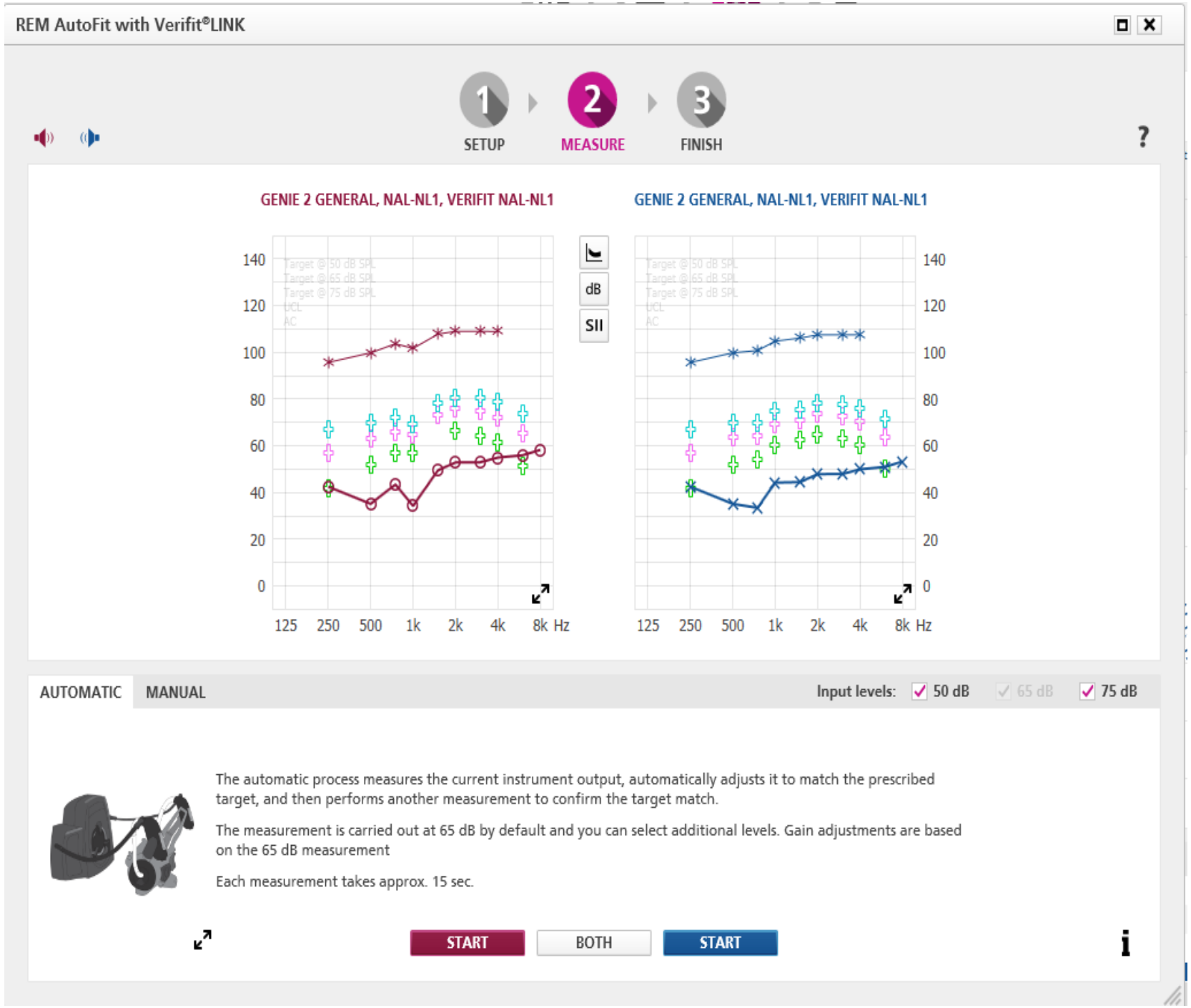
VerifitLINK can be used with REM or SREM (test box)



Audioscan VerfitLINK Method Described

Allows automatic adjustment of HA parameter settings in the fitting software to match the fitting formula targets supplied by the Audioscan equipment

Compares measured and requested output levels across frequencies

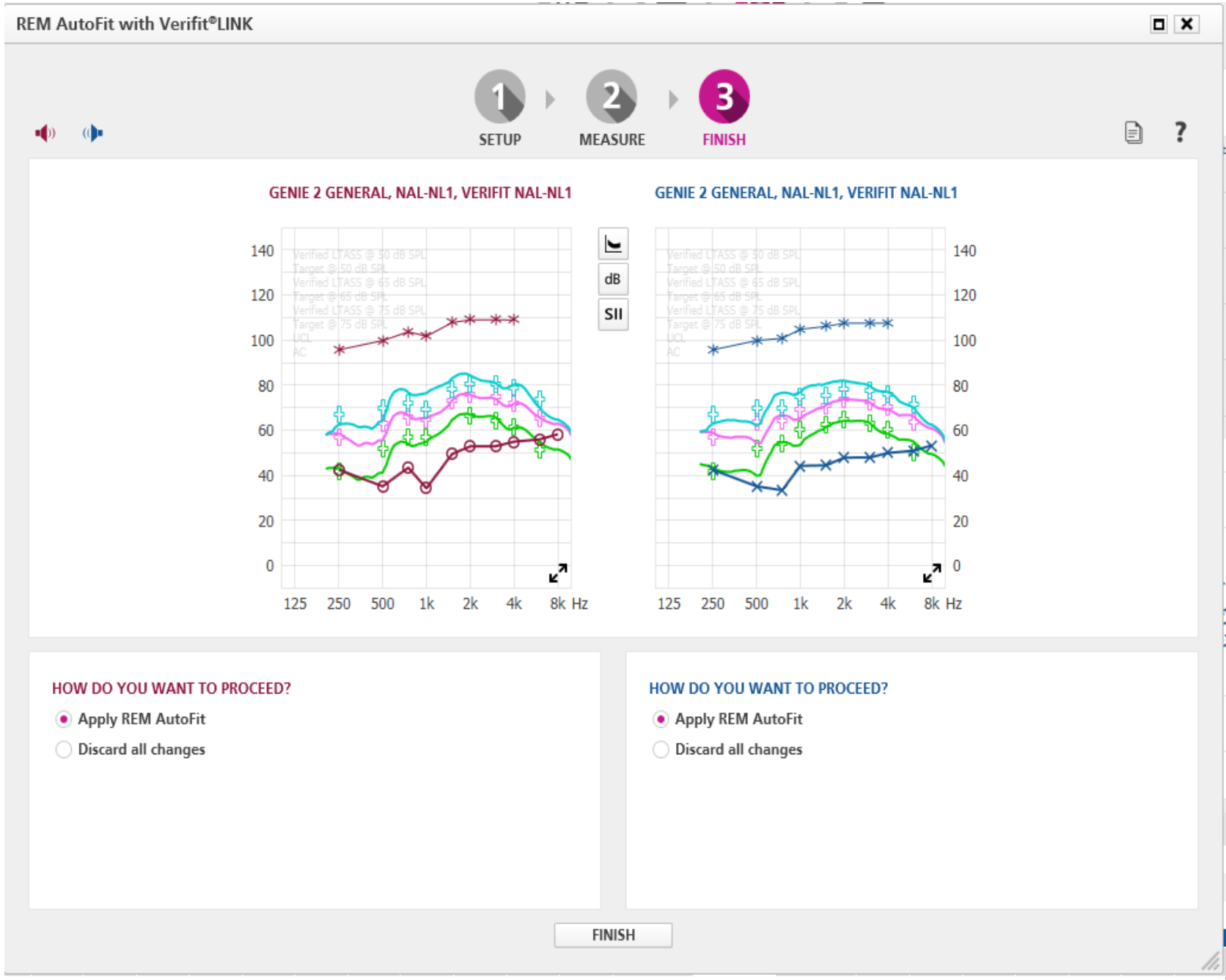


VerfitLINK Method Described

Performs 4 automatic monaural measurements

- Initial measurements right and left
- Gain-adjusted measurements right and left

VerifitLINK is a free software download for the VF2 and VF1 (serial numbers 2070 or higher



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Study Questions

1. How efficient are the technician-based methods versus the clinician method?
2. How accurate are the technician-based methods compared to the clinician method?
3. Are the technician-based methods a viable option for fitting hearing aids when a clinician method is impractical?

RESULTS

Efficiency

Significant overall effect of time

Pairwise comparisons indicated the time to complete the fitting was significantly different for each of the 4 methods (p<.001)

Technician-based fit methods were faster compared to the clinician fit method

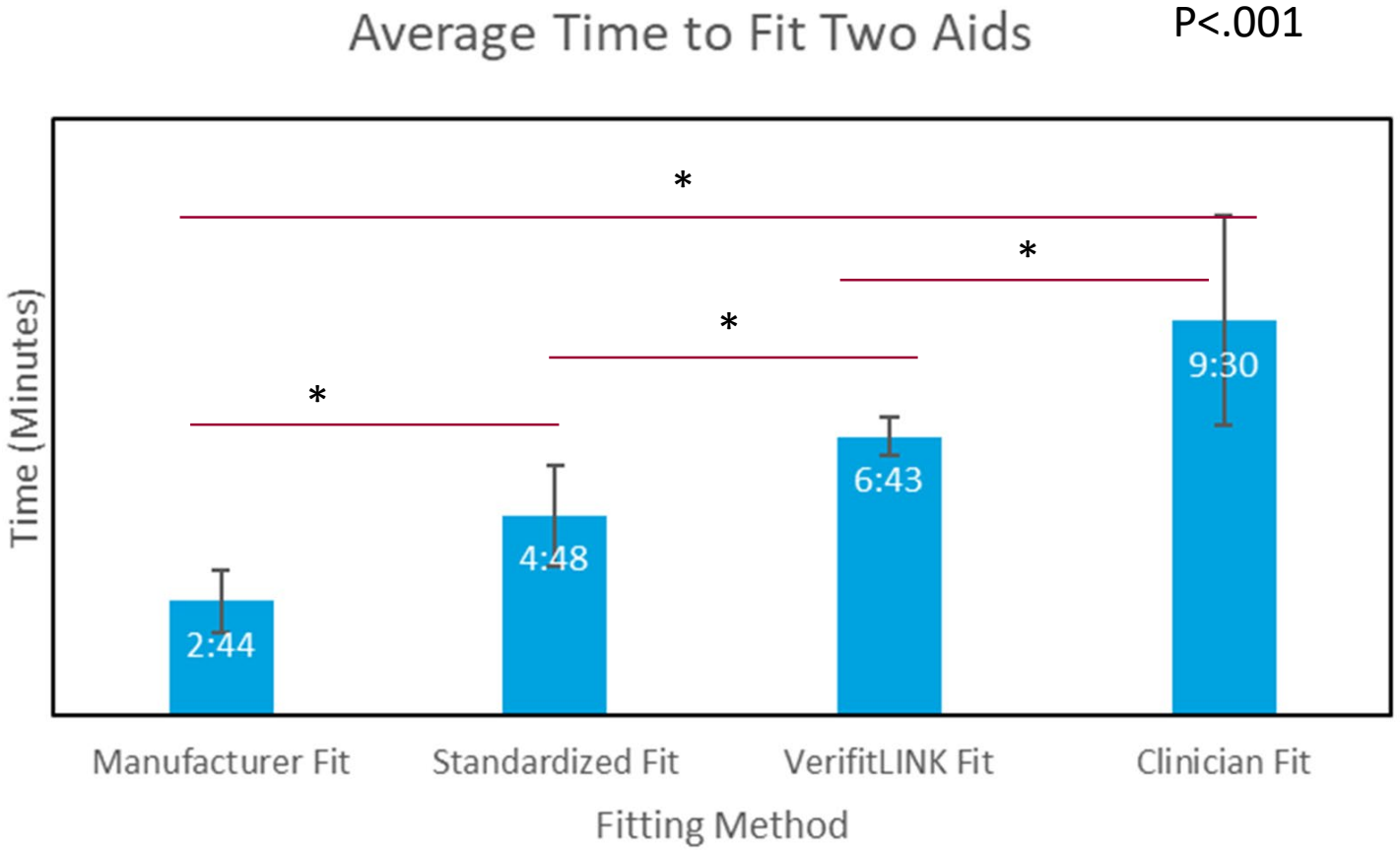
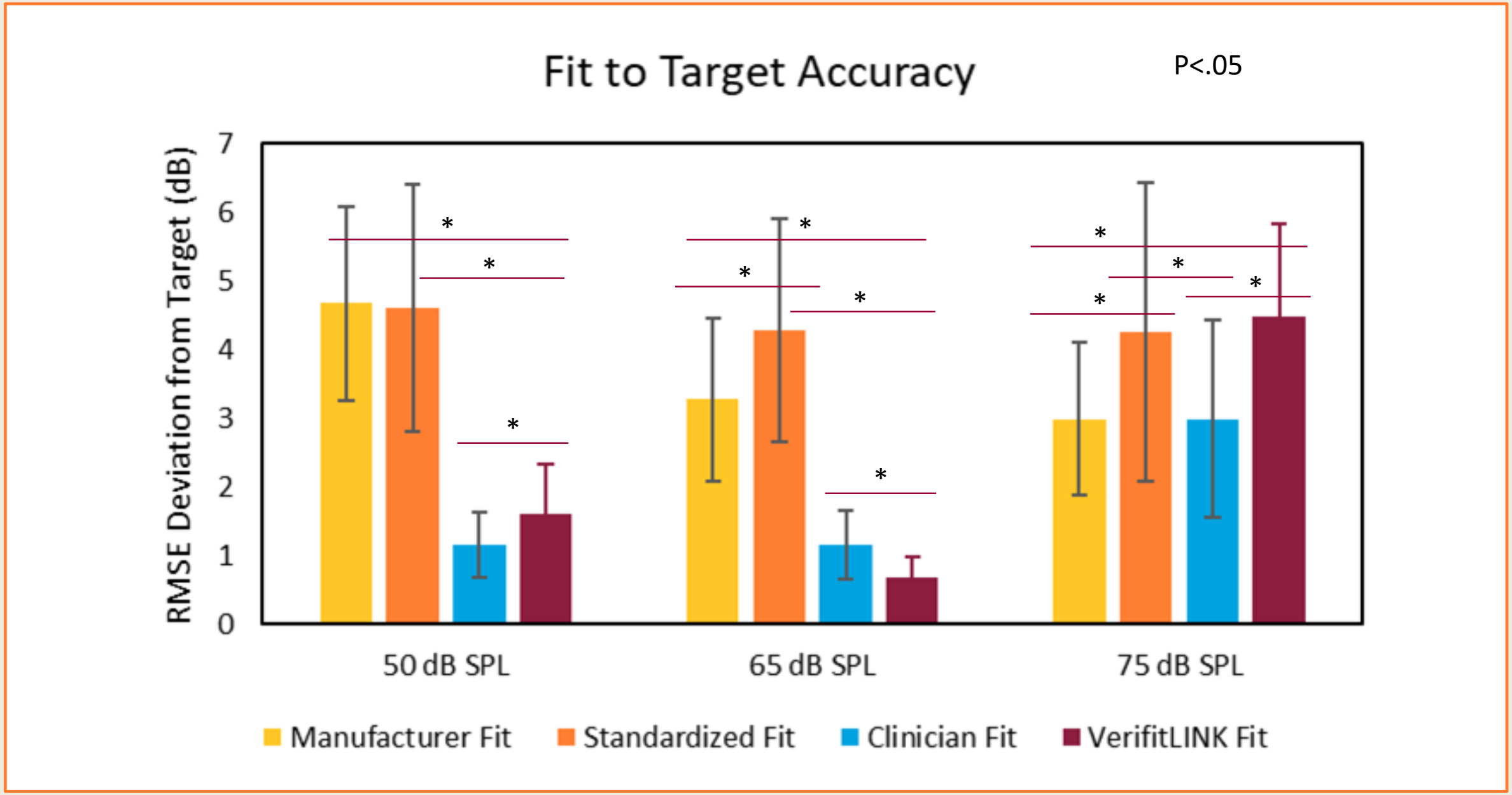
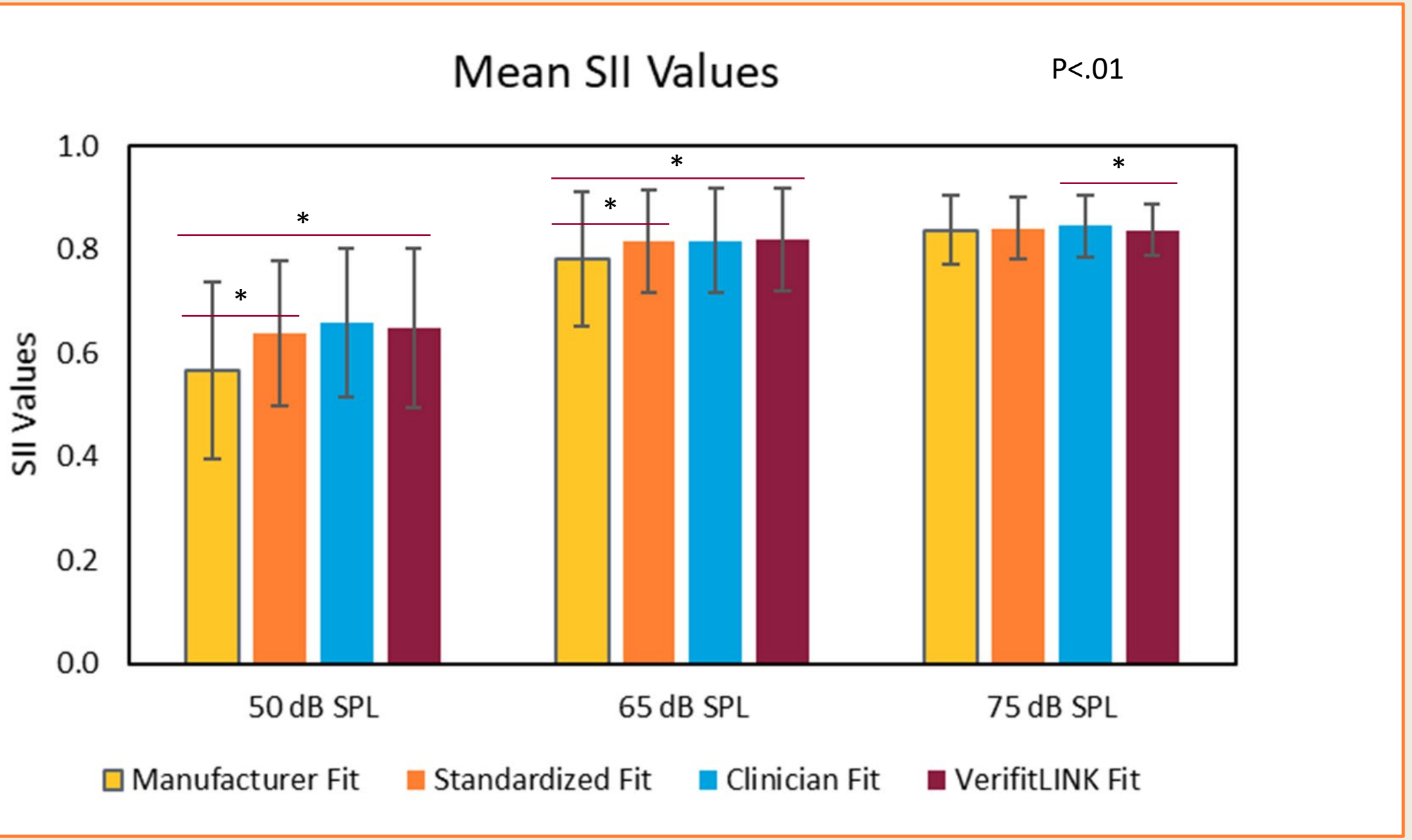
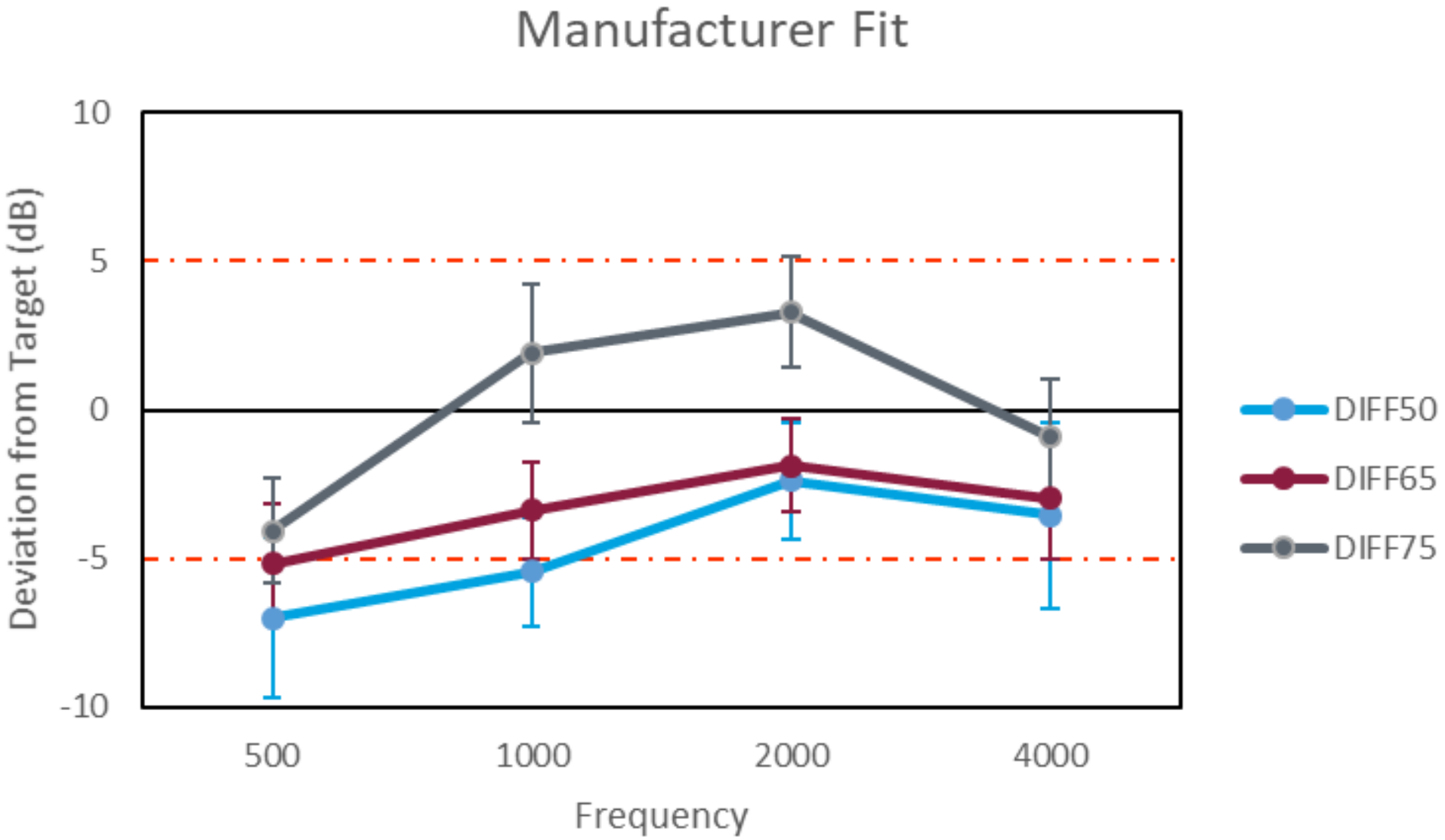
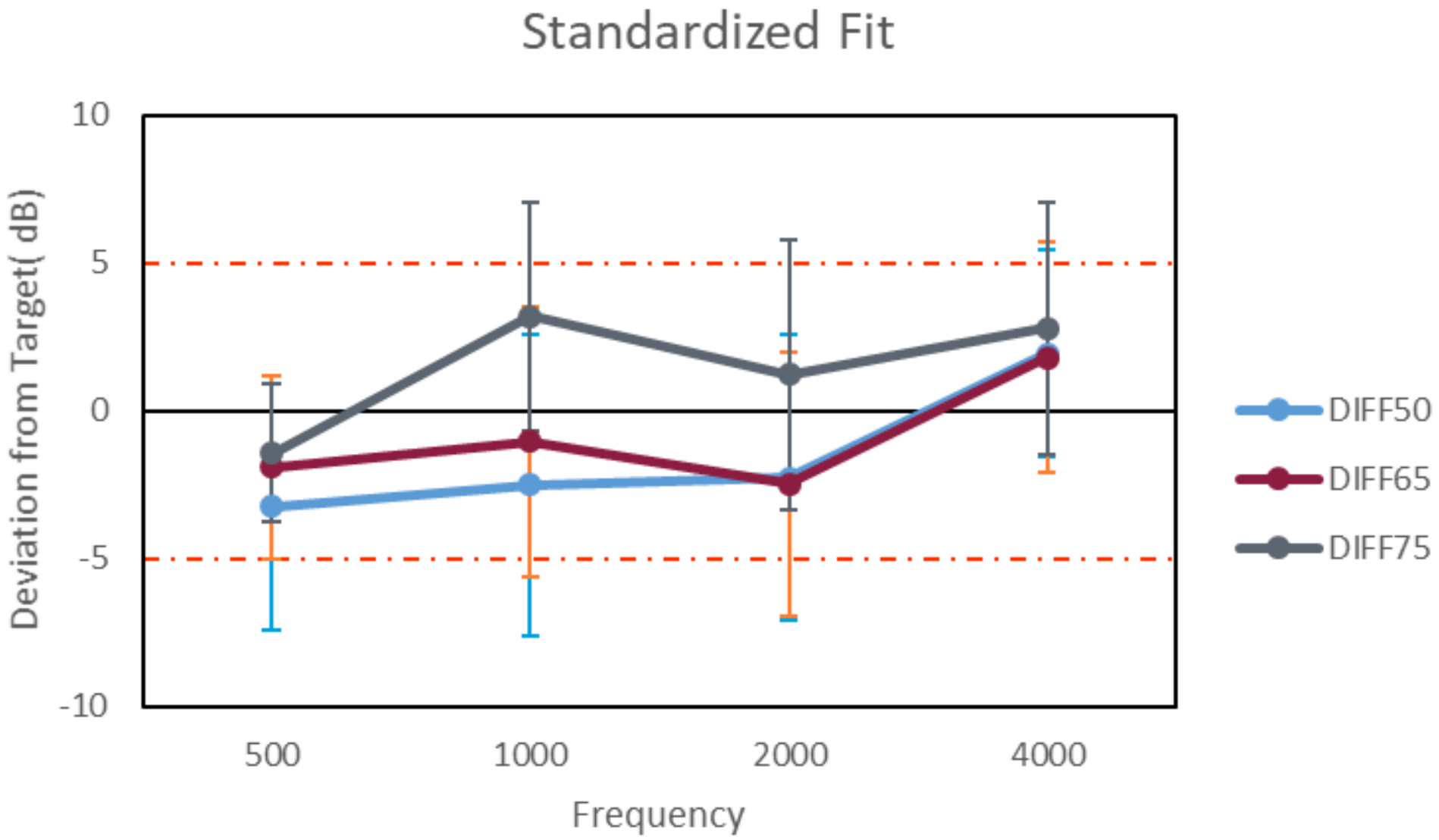


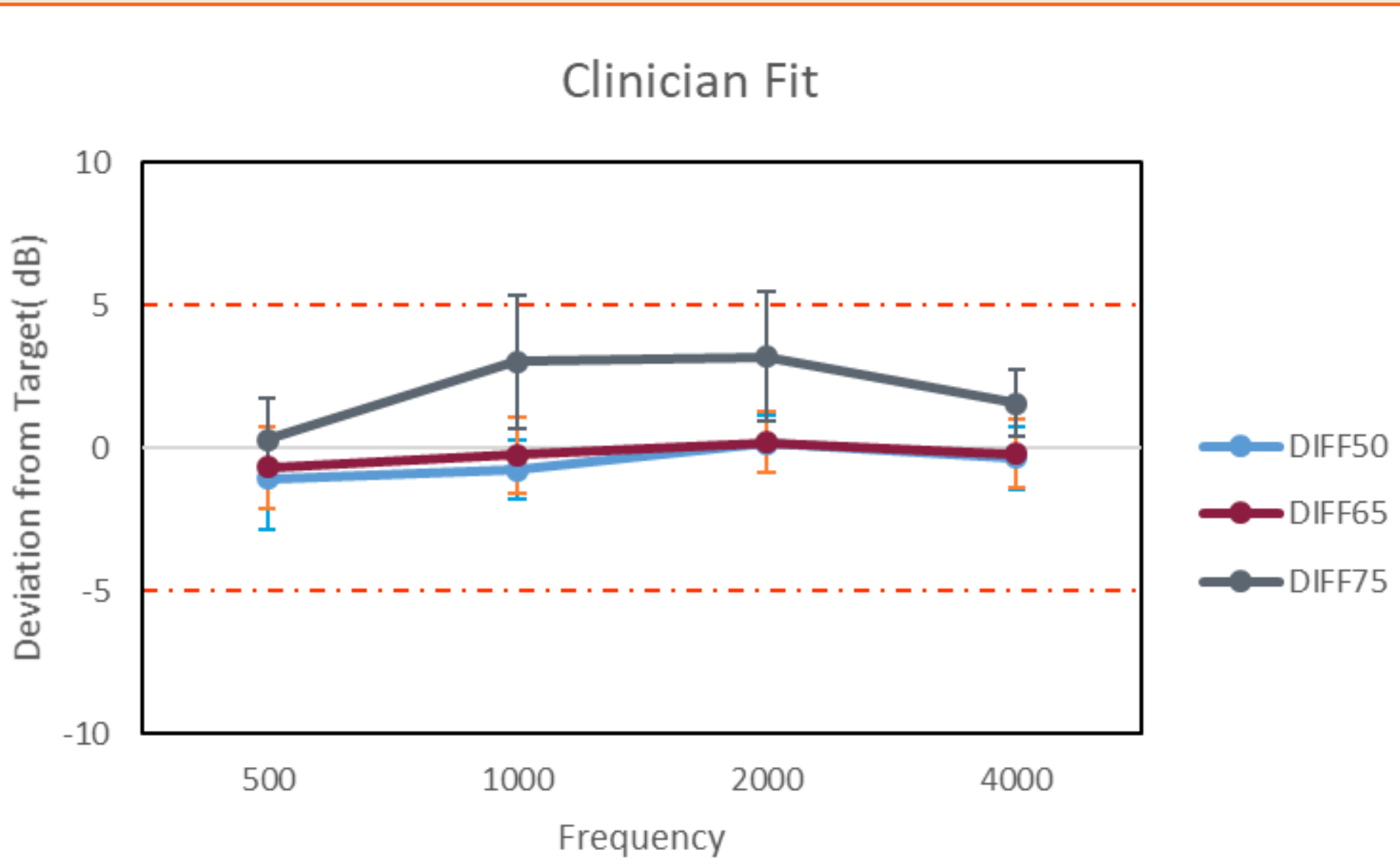
Figure: Average (+/- 1 SD?) fitting time for each method. Astrisks indicate significant differences between methods (p<.001).

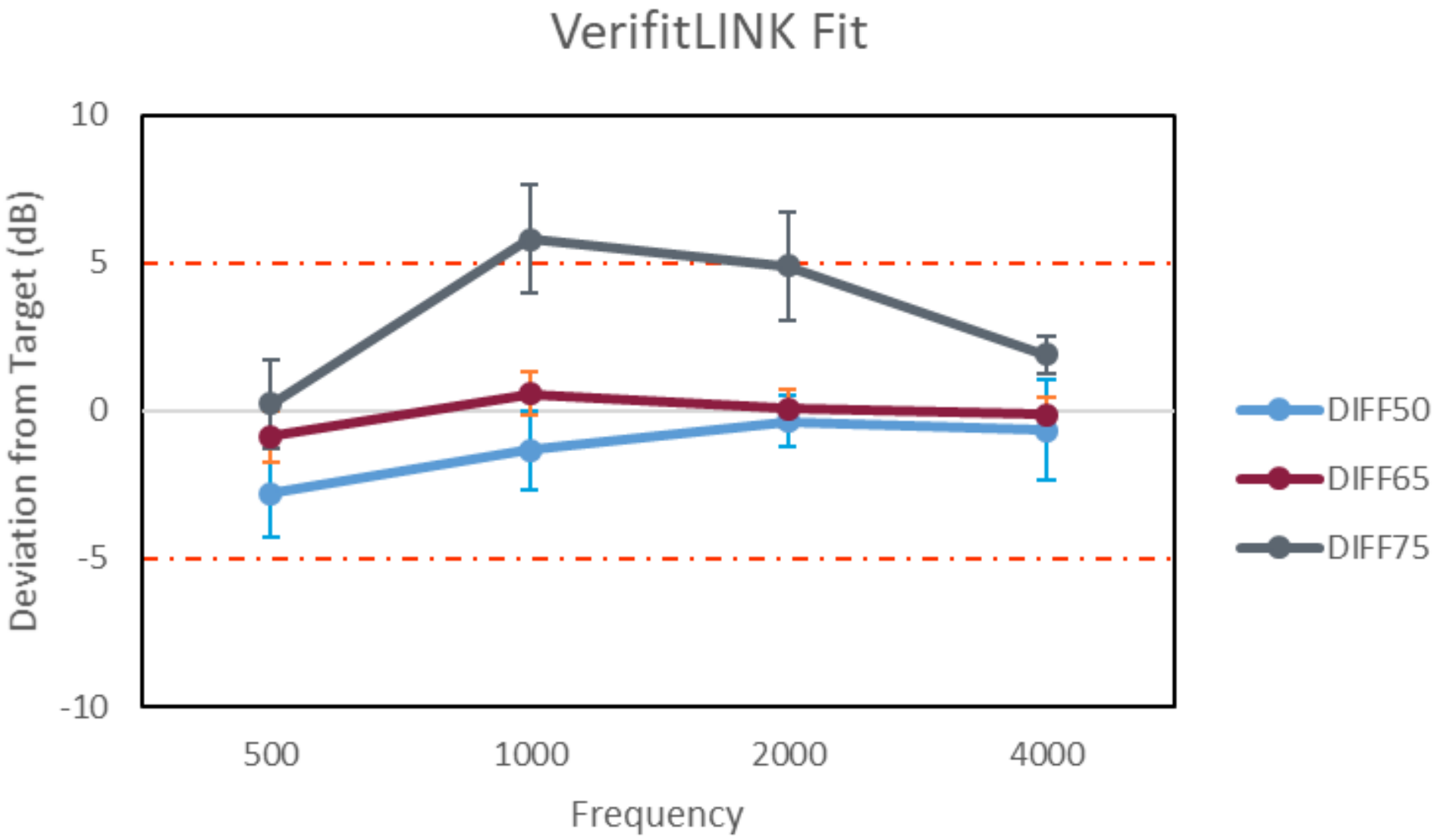

Fit to Target Accuracy
P<.05
RMSE Deviation from Target (dB)
0
1
2
3
4
5
6
7
*
*
*
*
*
*
*
*
*
50 dB SPL
65 dB SPL
75 dB SPL
Manufacturer Fit
Standardized Fit
Clinician Fit
VerifitLINK Fit


Mean SII Values
P<.01
1.0
0.8
0.6
0.4
0.2
0.0
SII Values
*
*
*
*
*
50 dB SPL
65 dB SPL
75 dB SPL
Manufacturer Fit
Standardized Fit
Clinician Fit
VerifitLINK Fit


Manufacturer Fit
Deviation from Target (dB)
10
5
0
-5
-10
500
1000
2000
4000
Frequency
DIFF50
DIFF65
DIFF75

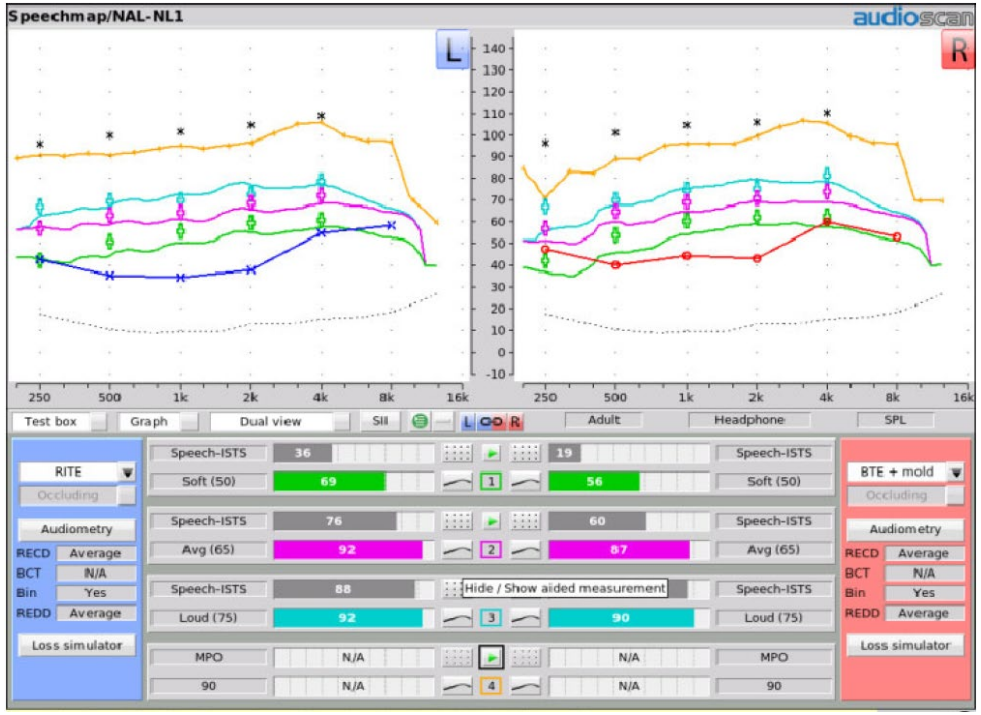

Standardized Fit
10
5
0
-5
-10
Deviation from Target(dB)
500
1000
2000
4000
Frequency
DIFF50
DIFF65
DIFF75


Clinician Fit
10
5
0
-5
-10
Deviation from Target(dB)
500
1000
2000
4000
Frequency
DIFF50
DIFF65
DIFF75

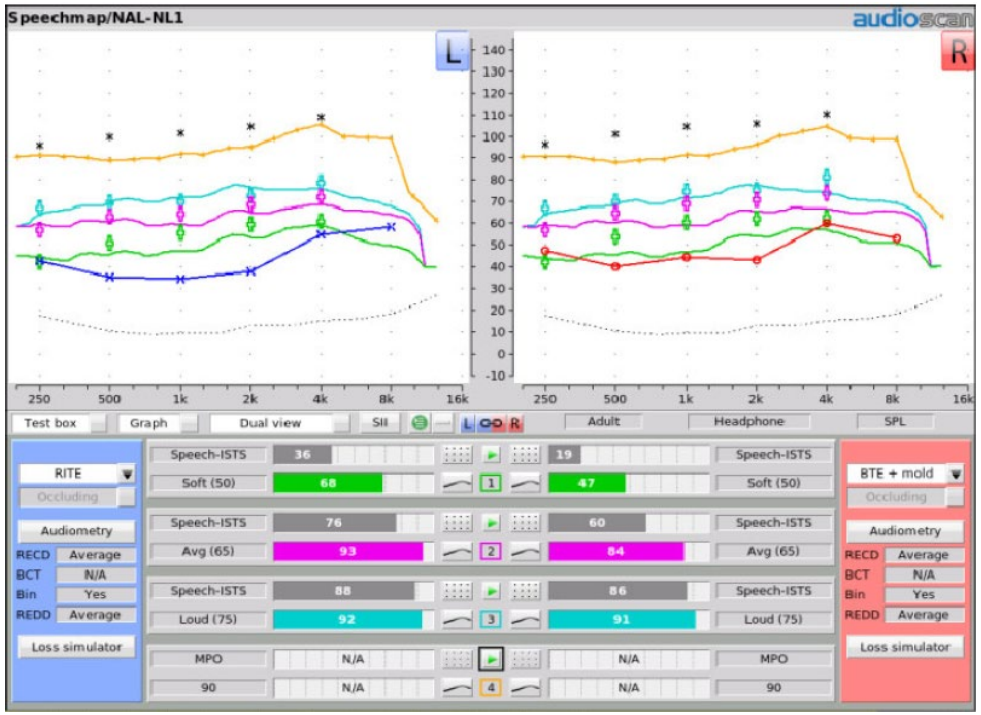

VerifitLINK Fit
10
5
0
-5
-10
Deviation from Target (dB)
500
1000
2000
4000
Frequency
DIFF50
DIFF65
DIFF75

Fitting Example

MANUFACTURER FIT

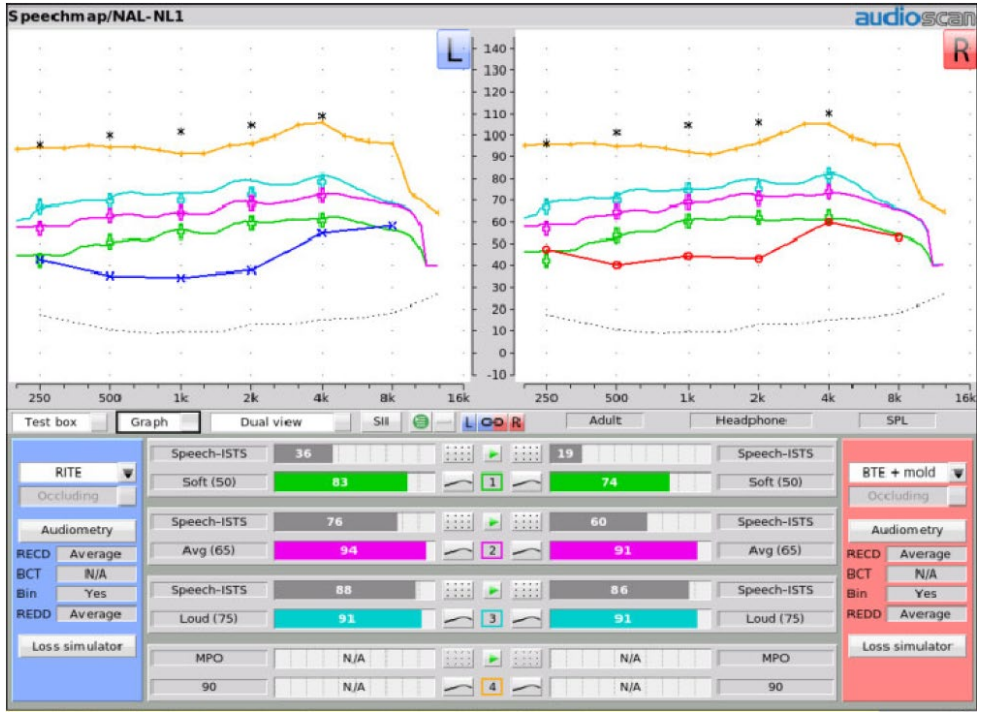


STANDARDIZED FIT

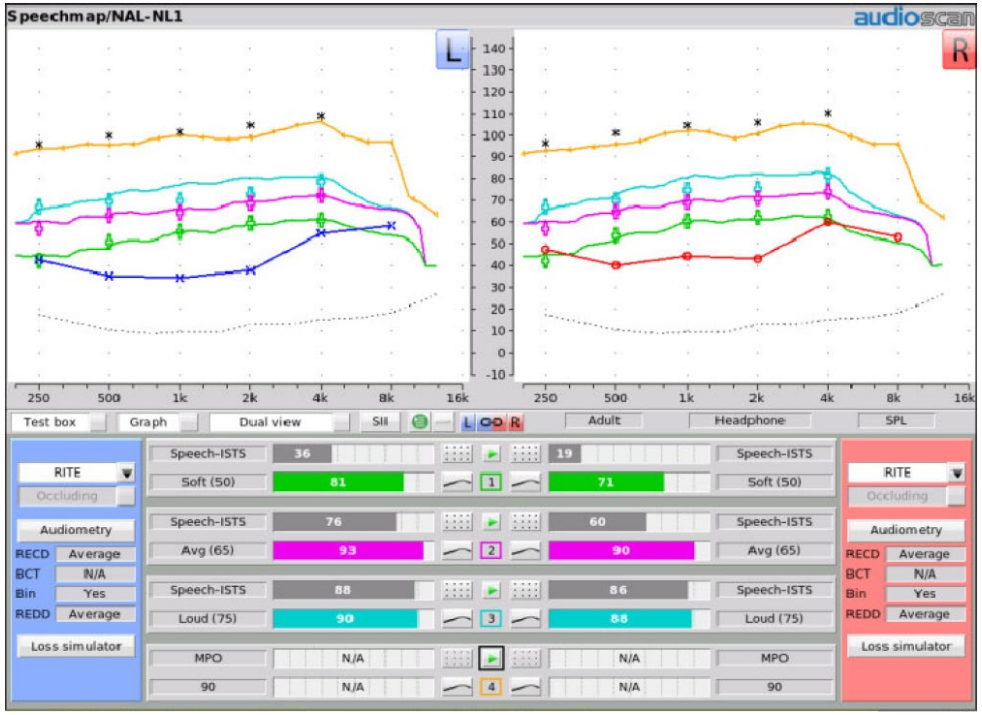


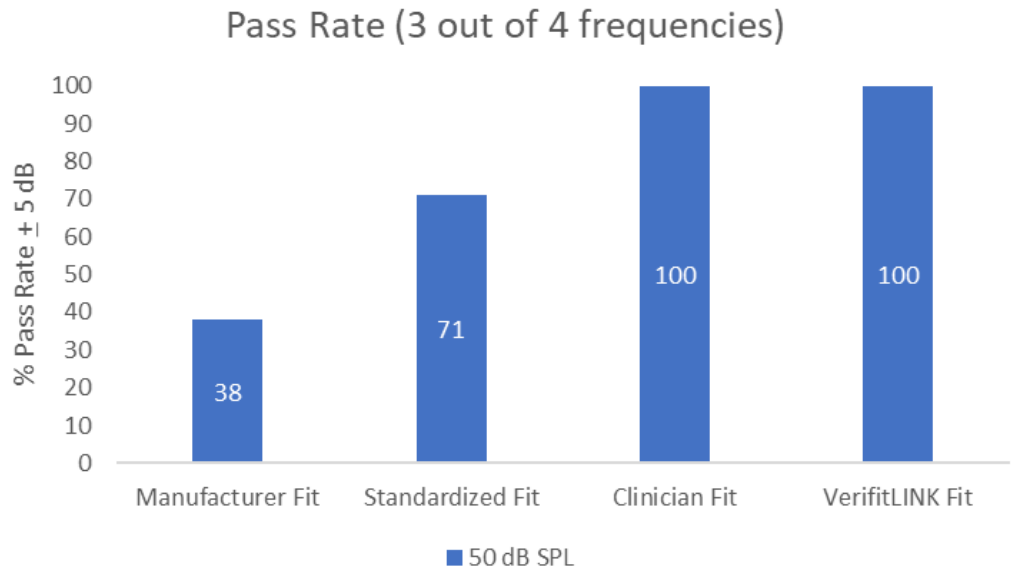
Fitting Example

CLINICIAN FIT

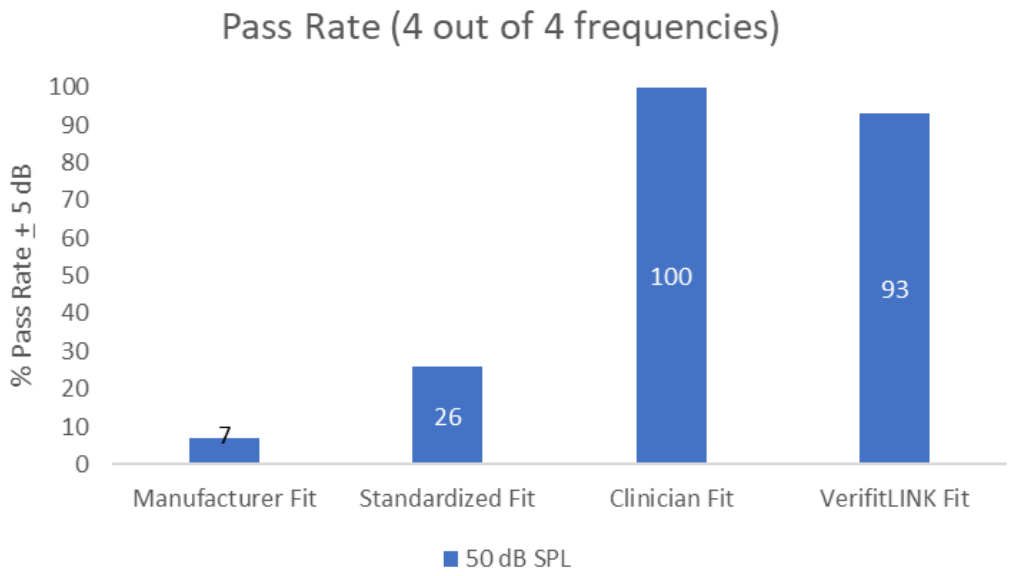


VERIFITLINK FIT



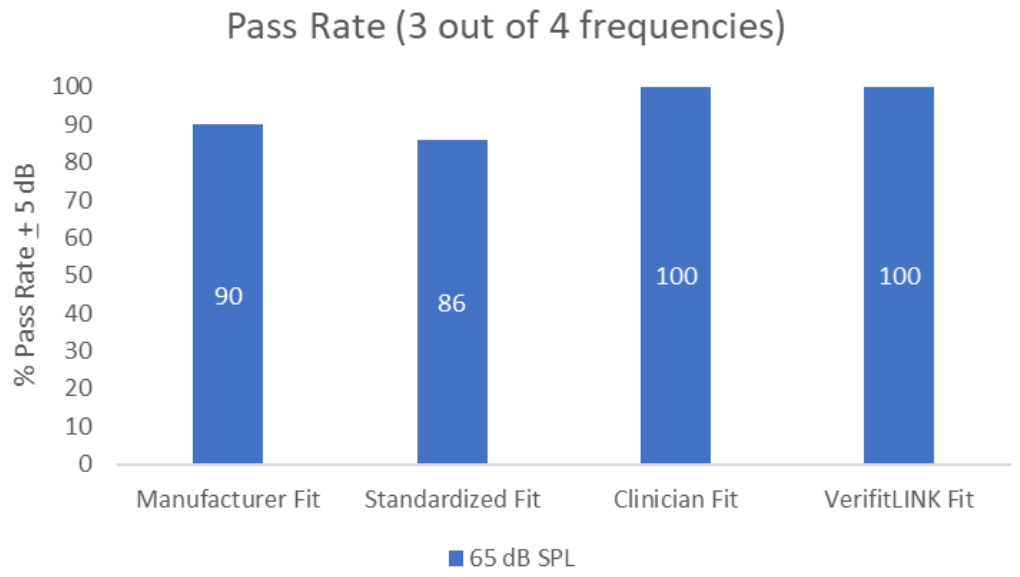


Pass rate for a 50 dB SPL input level if 3 out of the 4 frequencies from 500-4000 Hz were within ±5dB.

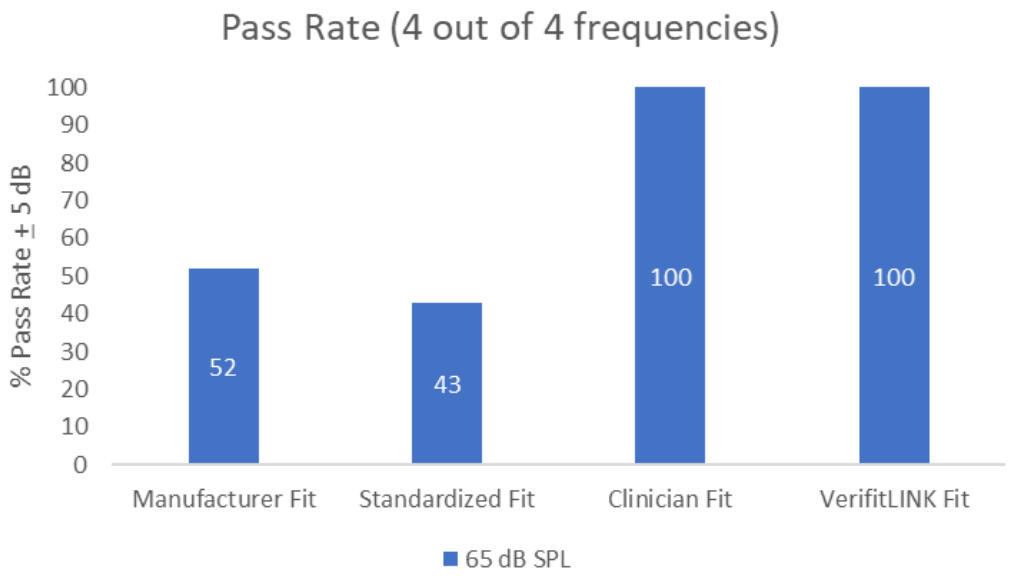


Pass rate for a 50 dB SPL input level if all frequencies from 500-4000 Hz were within ±5dB.

Pass Rate-50 dB SPL

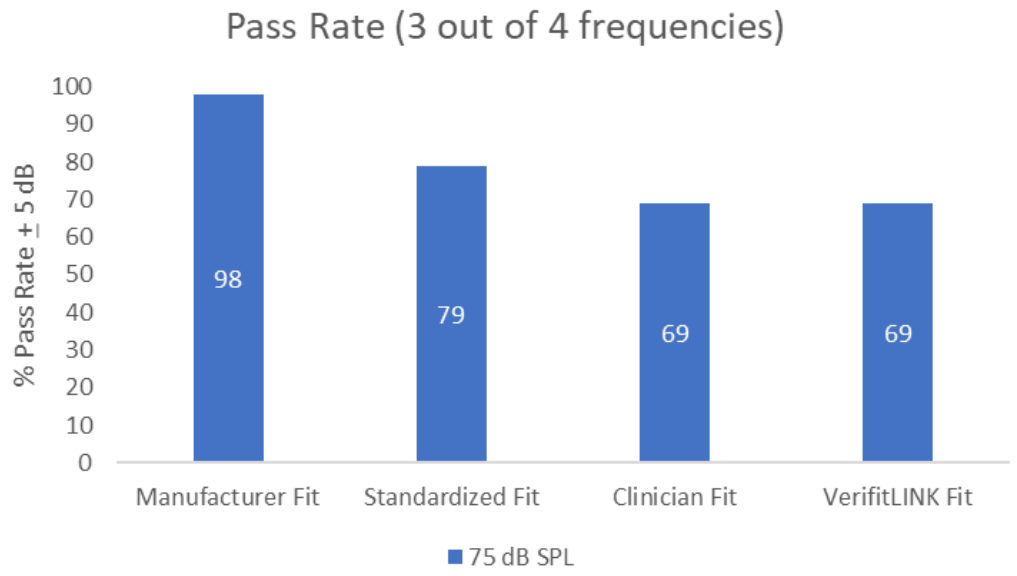


Pass rate for a 65 dB SPL input level if 3 out of the 4 frequencies from 500-4000 Hz were within ±5dB.

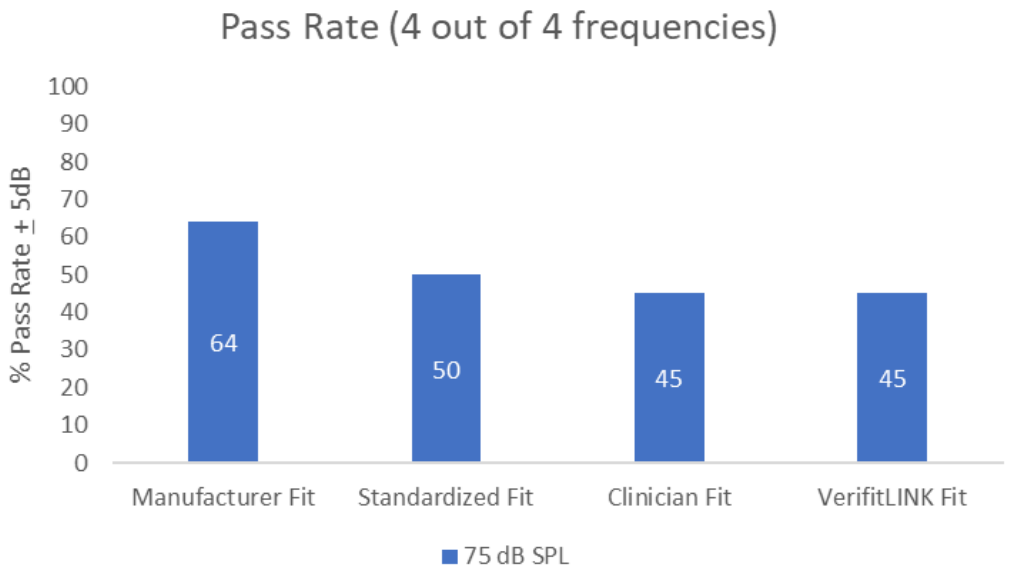


Pass rate for a 65 dB SPL input level if all frequencies from 500-4000 Hz were within ±5dB.

Pass Rate-65 dB SPL



Pass rate for a 75 dB SPL input level if 3 out of the 4 frequencies from 500-4000 Hz were within ±5dB.



Pass rate for a 75 dB SPL input level if all frequencies from 500-4000 Hz were within ±5dB.

Pass Rate-75 dB SPL

Study Question #1

How efficient are the technician-based methods versus the clinician method?

Technician-based methods were more efficient compared to the clinician method

<u>Time savings:</u>

Manufacturer Fit: 6 minutes, 46 seconds

Standardized Fit: 4 minutes, 42 seconds

VerifitLINK Fit: 2 minutes, 48 seconds

Study Question #2

How accurate are the technician-based fit methods compared to the clinician fit method?

The Manufacturer Fit and Standardized Fit methods were less precise compared to the Clinician Fit method

- Greater efficiency was at the expense of lost precision

An automated REM approach, using the VerifitLINK, achieved equivalent target matching performance compared to the Clinician Fit method

Study Question #3

Are the technician-based fit methods a viable option for fitting hearing aids when a clinician fit method is impractical?

The VerifitLINK Fit method is a good option to quickly and accurately automate the fitting process

Selecting a generic fitting formula in the manufacturer software does not guarantee targeted performance and is not recommended

The Standardized fit method, in this study, was only slightly more accurate compared to a Manufacturer 1st-Fit approach


thank you
danke
謝謝
ngiyabonga
teşekkür ederim
gracias
merci
obrigado
спасибо
Баярлалаа
рахмат
bedankt
dziękuję
mochchakkeram
go raibh maith agat
sukriya
kop khun krap
terima kasih
감사합니다
ありがとう
arigatô
dakujem
grazie
takk
tapadh leat
мерси
ευχαριστώ
dank je
mauruuru
hvala
sagolun
taiku
enkosi
sobodi
dėkuji
mèsi
faafetai lava
kiitos
dankie
dhanyavad
nanni
nandri
bayarlalaa
gràçie
köszönöm
vinaka
спасибі
blagodaram
mersi
kia ora
barka
welalin
tack
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misaotra
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хвала
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