

Stratifying Sensorineural Hearing Loss using Non-invasive Biomarkers: A Replication Study

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QR Code to Sam's Poster

Introduction

- Sensorineural hearing loss (SNHL) is a complex disorder, often the result of several etiologies accumulated across the lifespan, resulting in variable treatment outcomes [1,2,3].
- Current audiological testing cannot distinguish different inner ear pathophysiology's and clinical management focuses on audibility and patient reports rather than each patient's cochlear pathophysiology profile.
- Damage of cochlear sensory cells (OHCs and IHCs), afferent synapses, or degeneration of the stria, can affect listening outcomes for speech in divergent ways [1,2,4].
- Animal models of SNHL suggest that non-invasive biomarkers may allow for stratification of different cochlear pathologies in SNHL. [1,2,3,8,9]

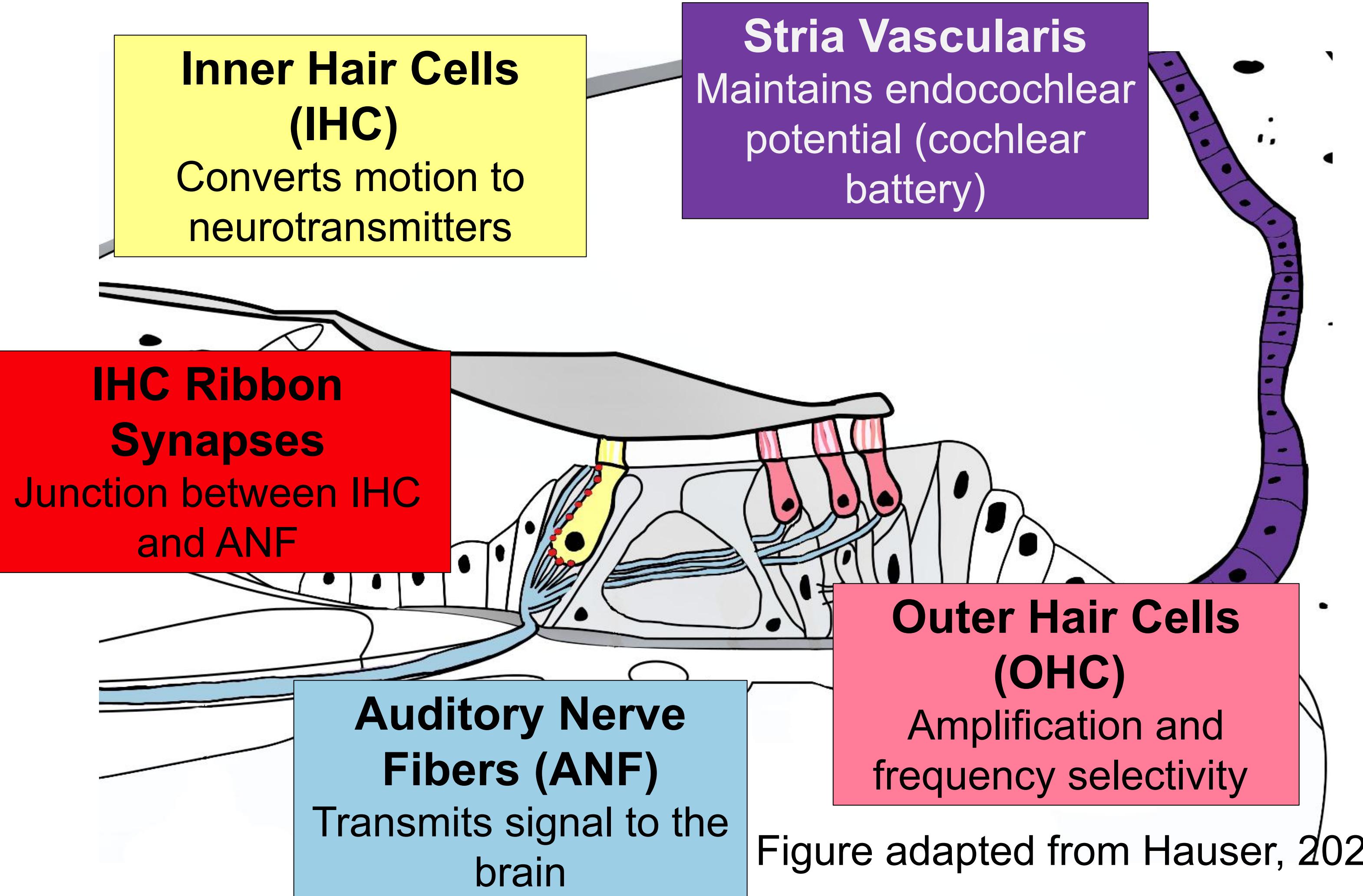


Figure adapted from Hauser, 2025

Can the addition of non-invasive biomarkers to clinical modeling better predict speech-in-noise scores?

Methods

Participants:

- 34 adults aged 18+
- Normal hearing group: no conductive components and clinically normal audiometric thresholds through 8kHz (N=13)
- Hearing loss group: Symmetric sensorineural hearing loss with no threshold exceeding 70 dB HL up to 8 kHz (N=21)

Clinic-style Measurements:

- Conventional pure tone air and bone audiology
 - AC: 250-16000 Hz
 - BC: 500, 1000, 2000, and 4000Hz
- Basic Demographic Information

Non-Invasive Biomarkers:

- Rectangular Amplitude Modulated Envelope Following Response (RAM EFR), 223 Hz modulation of 4000 Hz tone [5,6]
- Psychophysical Tuning Curve centered at 4000 Hz [7,8]

TTR placeholder

RAM EFR placeholder

Speech Measurement:

- Modified Rhyme Test (linear amplification for participants with hearing loss)

Results

MRT by Hearing Group

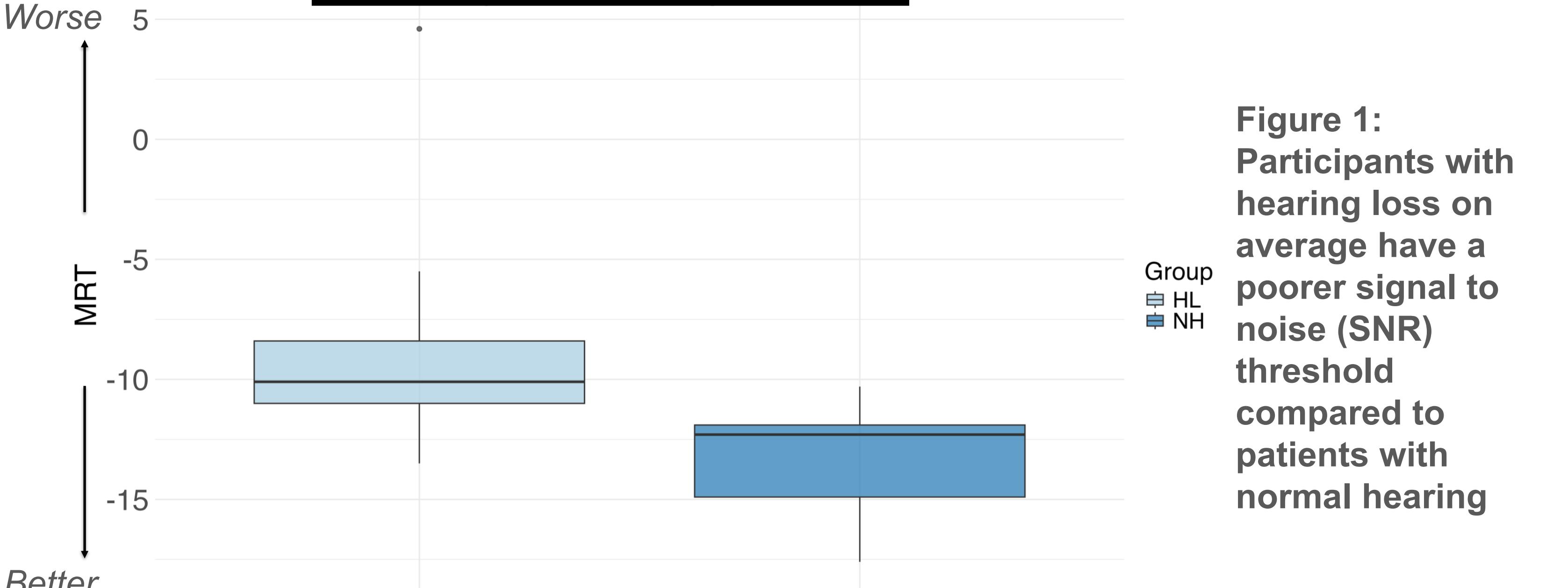


Figure 1:
Participants with hearing loss on average have a poorer signal to noise (SNR) threshold compared to patients with normal hearing

Model 1: Clinical Factors

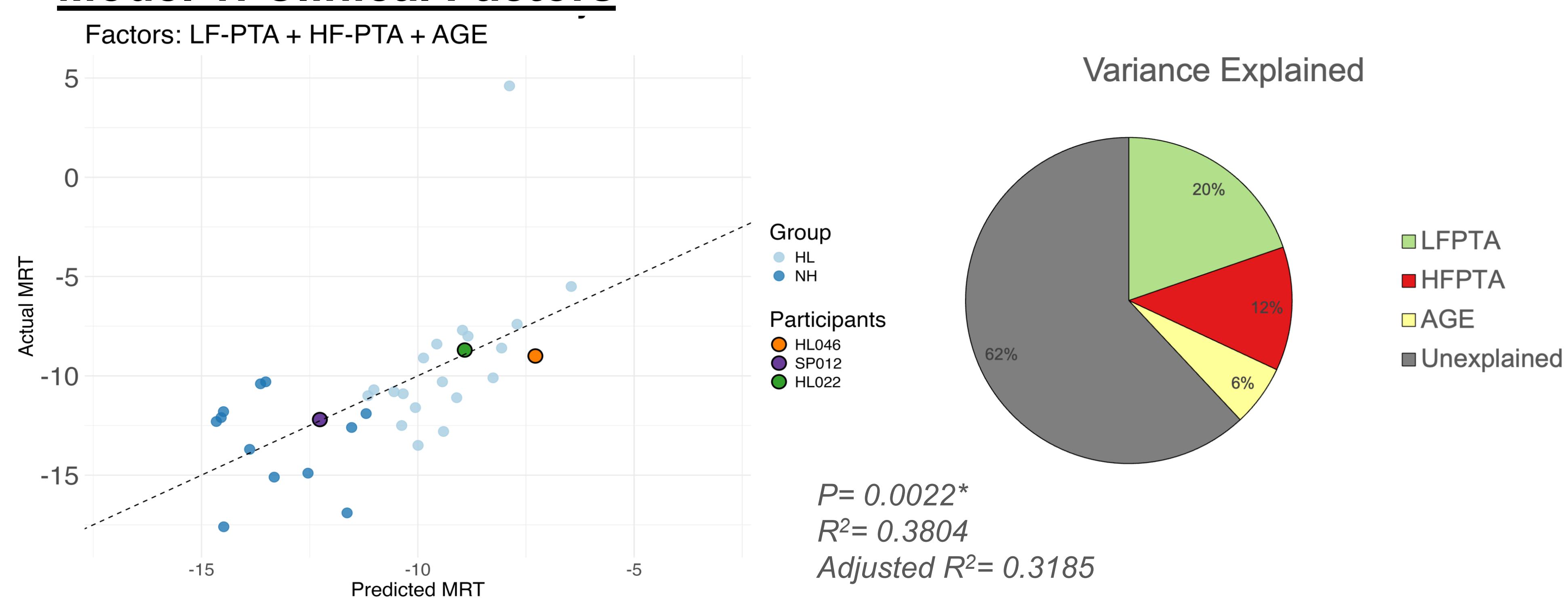


Figure 2: Traditional clinical factors significantly predict 38% of participants' MRT thresholds

Model 2: Biomarkers Only

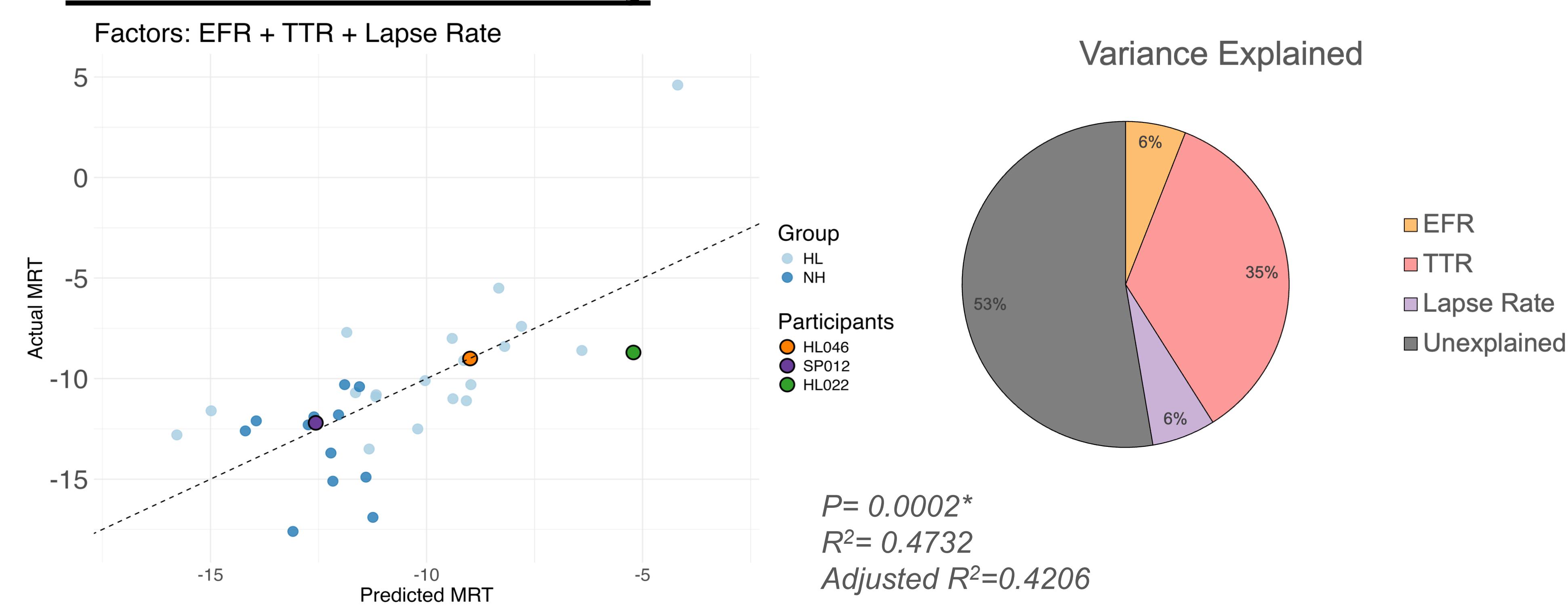


Figure 3: Biomarkers alone are better predictive of MRT thresholds compared to clinical-only methods

Model 3: Clinical and Biomarkers Combined

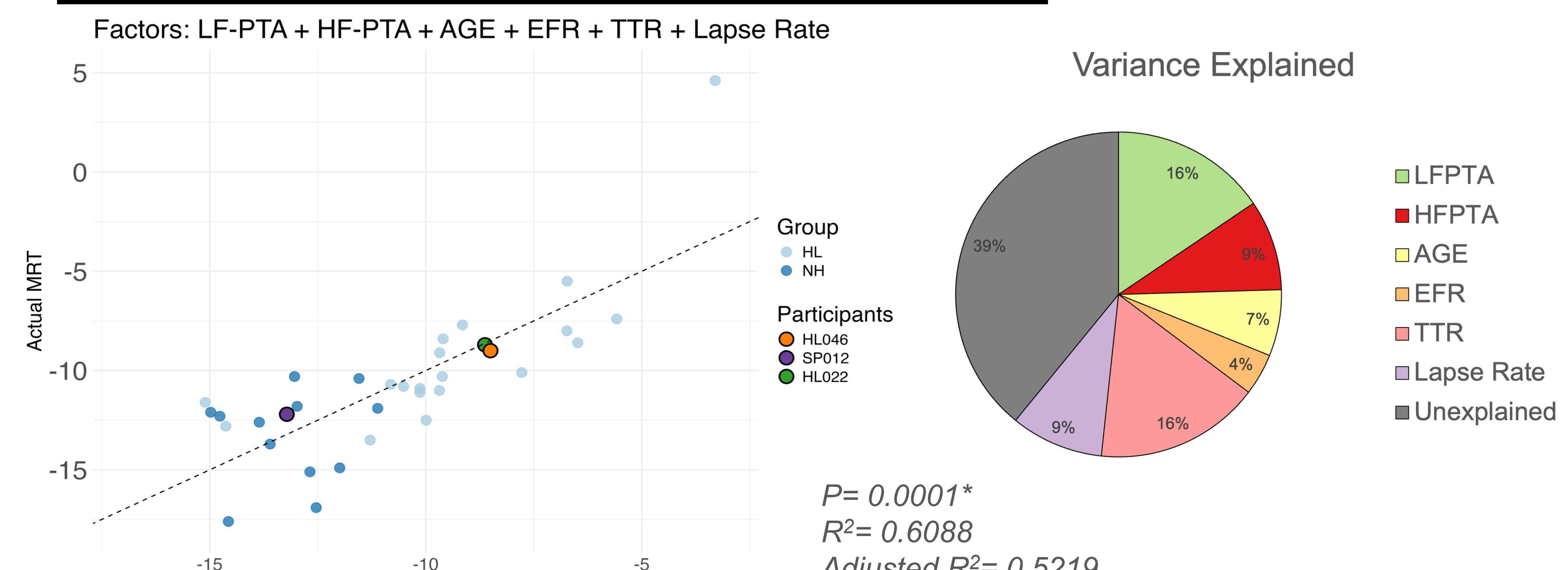


Figure 4: A combination model significantly predicts participants' MRT thresholds greater than chance

Results Continued

Participants Best Predicted by Each Model

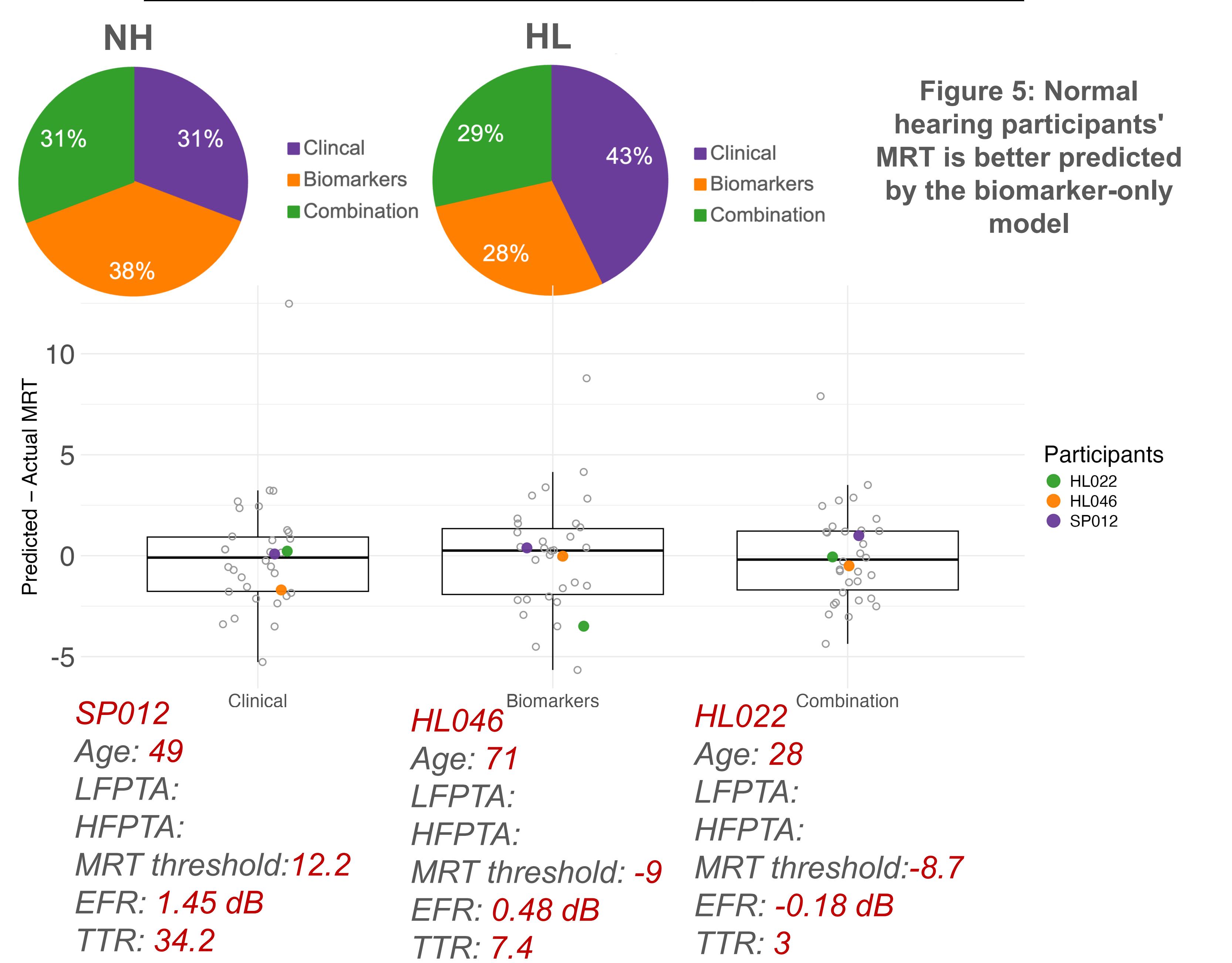
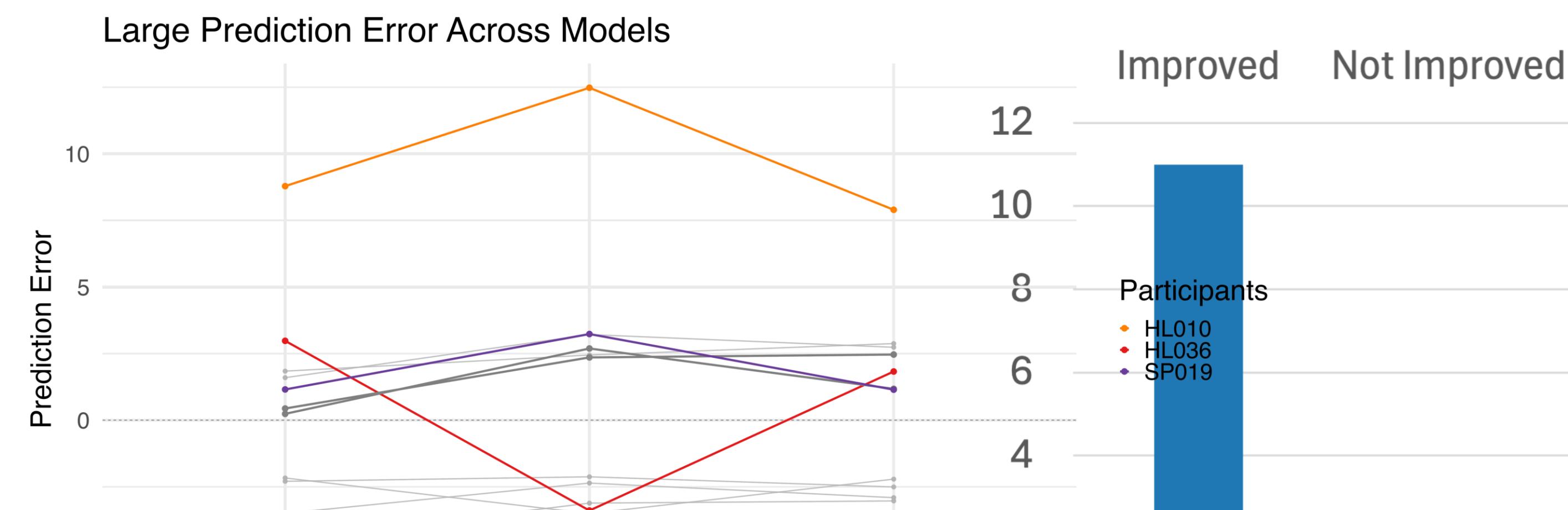


Figure 5: Normal hearing participants' MRT is better predicted by the biomarker-only model

Work in progress



Conclusions

- Both normal hearing and hearing loss participants benefit from different SPIN prediction models.
- Using a combination model improves both significance and accuracy of the predictive model.
- The addition of biomarkers to a model generally adds positive predictive value when there are large clinical model errors

Future Directions

- Continue with data collection.
- Add WBMEMR data to the models to better stratify cochlear synaptopathy.
- Addition of audiologic and otologic questionnaires into analysis to better assess the "clinical" model.
- Compare SPIN prediction models to pathophysiology clustering models.

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References: [1] Hauser et al., MoH, 2024. [2] Hauser, 2025. [3] Whitcomb, Clin Transl Gastroenterol, 2019. [4] Bharadwaj et al., Comm Biol, 2022. [5] Vasilkov et al., Hearing Research, 2021. [6] Garrett et al., eNeuro, 2025. [7] Bharadwaj et al., MoH, 2024. [8] Parida & Heinz, Hearing Research, 2022.