PREDICTING HEARING AID SUCCESS FROM CHARACTERISTICS OF THE PSYCHOMETRIC FUNCTION FOR SPEECH PERCEPTION IN NOISE

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INTRODUCTION

- The listener's psychometric function mediates any improvements in signal-to-noise ratio (SNR) that the HA may provide.
- Speech in noise (e.g., SNR for 50% correct; SNR-50) better predicts self-report outcomes than measures in quiet.[1,2]
- Some evidence suggests that listeners don't participate in environments where only 50% of speech is understood, and instead SNR-80 may more accurately represent the real world of HA users[3,4]
- Furthermore, the psychometric slope represents performance improvements as SNR becomes more or less favorable, and may better predict outcomes with HA.

RESEARCH QUESTIONS

1. Do outcomes differ between groups divided by threshold and/or slope (Figure 1)?
2. What metric(s) of the psychometric function (SNR50, SNR-80, and/or slope) best explain variance in self-reported HA outcomes?

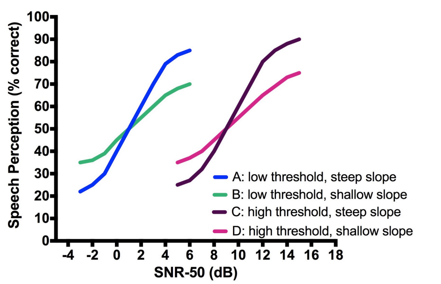


Figure 1. Hypothetical groups of subjects who vary in threshold and slope (see legend).

PARTICIPANTS

- 74 adult binaural HA users (mean age= 69.30; SD= 7.35)
- Native speakers of American English

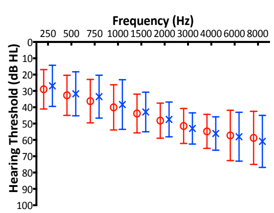


Figure 2. Mean and standard deviation of hearing thresholds levels across subjects for the left and right ears.

- Bilateral, symmetrical mild to moderately-severe SNHL
- 5 dB of high frequency averaged gain
- HAs worn at least least 7 hours/week
- Montreal Cognitive Assessment for screening adequate cognitive function (>21/30)[5]

METHODS

- The Hearing in Noise Test (HINT[6]) was used in an adaptive format to find speech reception thresholds in noise for 50 and 80% correct in unaided conditions with 4-talker babble (65 dBA).
- The adaptation algorithm used a 1-down, 1-up (SNR-50) or 3-down, 1-up procedure (SNR-80) with a 2dB step size after the first 5 sentences.
- For the slope estimate, a psychometric function was fit to the binary outcomes across all sentences.
- Self-report outcomes and the Speech Intelligibility Index (SII at 65 dB) were measured with the participants' own aids.
- Questionnaires included the Abbreviated Profile of Hearing Aid Benefit (APHAB), Satisfaction with Amplification in Daily Life (SADL), Speech, Spatial, and Qualities (SSQ), and International Outcomes Inventory for Hearing Aids (IOI-HA).

RESULTS: GROUPS

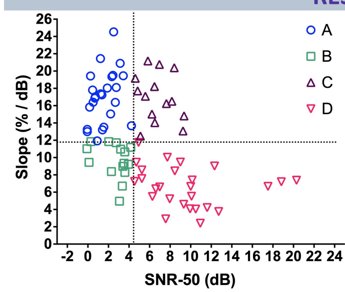


Figure 3. A high correlation was found between SNR-50 and SNR-80 (r=0.934; p<0.0001), but weaker correlations were found between slope and SNR-50 (r= -0.48; p<0.0001) and SNR-80 (r= -0.70; p<0.0001).

- Listeners were grouped into four groups, divided by their median value for SNR-50 and slope (n=21, 15, 14, 23 for Groups A, B, C, D, respectively).
- An ANCOVA (SII as a covariate) showed no significant differences between groups on the APHAB Aided or Benefit Global (Fig 4), SADL, SSQ, or most IOI-HA items.
- The only significant differences found were for HHIE Benefit (F(3,68)=3.012; p=0.036; Fig 5) and IOI-HA Quality of Life (F (3,70)=3.341; p=0.024).
- Post-hoc pairwise comparisons show the QOL effect driven by a significant difference between Groups B and C (mean difference: -1.08; p=.027; Fig. 6), but no significant effects on HHIE after correcting for multiple comparisons.

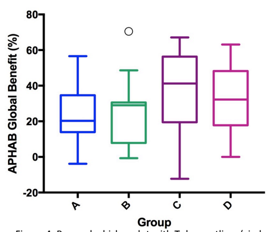


Figure 4. Box and whisker plot with Tukey outliers (circles) for APHAB Benefit scores across groups. After controlling for SII, differences between groups were not significant.

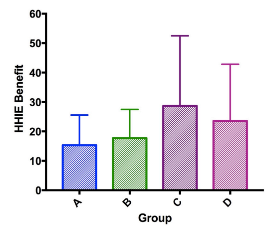


Figure 5. Mean and standard deviation of HHIE Benefit scores for each group. After correcting for multiple comparisons, no differences were significant.

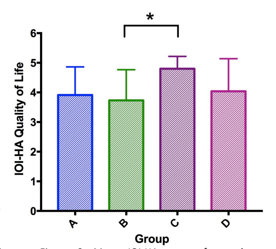


Figure 6. Mean IOI-HA scores for each group. Statistically only groups B and C were different from each other.

RESULTS: REGRESSION

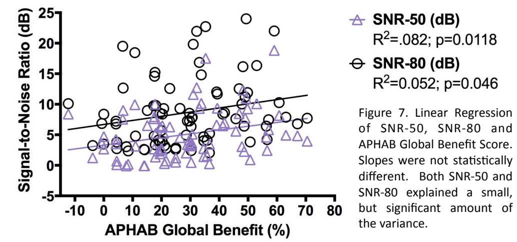
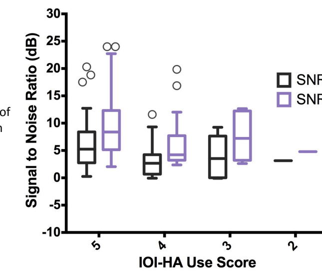


Figure 7. Linear Regression of SNR-50, SNR-80 and APHAB Global Benefit Score. Slopes were not statistically different. Both SNR-50 and SNR-80 explained a small, but significant amount of the variance.

Figure 8. Box and whisker plots with Tukey outliers (circles) for SNR-50 and SNR-80 on each outcome of the IOI-HA Use item. Both SNR-50 and SNR-80 explained a small, but significant amount of the variance.



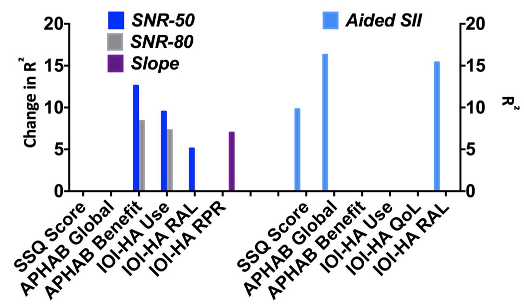


Figure 9. Hierarchical, stepwise regression was performed for each outcome of interest. Audibility (SII) was entered into the first block (right axis), followed by SNR-50, SNR-80, and slope in the second block (left axis). Age was not a significant predictor in any model. Only data for significant predictors are shown.

CONCLUSIONS

While more subjects are needed to reach adequate power, group data suggest that listeners with high thresholds and steep slopes (Group C) benefit the most from hearing aids. Our preliminary regression analysis shows SNR-50 was most predictive of self-report outcomes. However, for many outcomes none of the psychometric characteristics that we evaluated were predictive after controlling for audibility. Future work will also incorporate the effects of hearing aid processing on the relationships of interest.

ACKNOWLEDGMENTS & REFERENCES

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