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HEARING AIDS

Predicting aided speech-in-noise performance using the Audible Contrast Threshold test in Japanese hearing-aid users

Takanori Nishiyama[1,2,3], Chiemi Tanaka[4,5], Marianna Vatti[6], Sébastien Santurette[6], Johannes Zaar[7,8], Daisuke Suzuki[1,2,3,9], Tsubasa Kitama[1,2,3], Søren Laugesen[10], Gary Jones[11], Nobuyoshi Tsuzuki[2,3], Naoki Oishi[1,2,3], Makoto Hosoya[2,3], Hiroko Fujita[2], Takeshi Wakabayashi[2,3], Marie Shimanuki[2,3], Masafumi Ueno[2,3], Kaoru Ogawa[1,2,3], Seiichi Shinden[1,2,3,9]

[1]General Incorporated Association Shinden-Ogawa Audiology and Hearing Aid Laboratory, Tokyo, Japan; [2]OTO Clinic Tokyo, Tokyo, Japan; [3]Department of Otolaryngology-Head and Neck Surgery, Keio University School of Medicine, Tokyo, Japan; [4]Oticon Japan, Kawasaki, Japan; [5]Diatec Japan, Kawasaki, Japan; [6]Centre for Applied Audiology Research, Oticon A/S, Smørum, Denmark; [7]Eriksholm Research Centre, Snekkersten, [8]Hearing Systems Section, Department of Health Technology, Technical University of Denmark, Kongens Lyngby, Denmark; [9]Department of Otolaryngology-Head and Neck Surgery, Saiseikai Utsunomiya Hospital, Utsunomiya, Japan; [10]Interacoustics Research Unit, Kongens Lyngby, Denmark; [11]Demant A/S, Smørum, Denmark

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Aim

This clinical study investigated how audiometric thresholds, spectro-temporal modulation detection as measured by the Audible Contrast Threshold (ACT) test, and age, were related to aided speech-in-noise performance in Japanese HA users.

Materials and Methods

- 41 experienced Japanese HA users (15 males; 26 females); Mean age: 65.0 ± 11.9 years (range: 33 to 80 years)
- Visited OTO Clinic Tokyo between February 2022 and March 2024
- Mild to profound bilateral hearing loss (HL) received closed custom earmold fittings with Oticon More 1 miniRITE-R
- Underwent the Utsunomiya method (UM) for gain adjustment and HA accommodation (Shinden et al., 2021; Suzuki et al., 2023) Recruited with at least 3 months of HA usage; Accommodation period with the HA before testing
- Lab testing:
  - Audiometric and screening measures
  - ACT (average of two measurements, Fig. 1)
  - Aided speech-reception thresholds (SRTs) measured with the Japanese Hearing In Noise Test (HINT, Shiroma et al., 2008), using the same ecologically valid setup as in Zaar et al. (2023) (Fig. 2)
  - Four different help-in-noise settings (directionality and noise reduction, referred to as "NR" in the following) tested: Off, Mild, Medium, and Strong

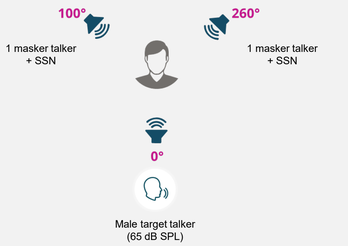

Figure 2. *Japanese HINT set-up. Target speech from the Japanese HINT and spatially-separated Japanese masker talkers and speech-shaped noise (SSN) 6 dB below the level of each masker talker.*

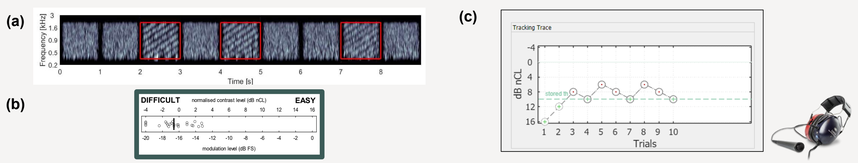

Figure 1. *ACT set-up. (a) Spectrogram of an ACT stimulus train. Stimuli are delivered in a train of "waves", where unmodulated reference waves are interspersed with modulated target waves. (b) normalized Contrast Level (nCL) scale, defined based on normative study with 25 young (18-25 years) normal hearing (<20 dB HL) subjects. (c) Hughson-Westlake threshold-seeking rule with 2-dB step size employed for threshold detection, using headphones. (d) Psychometric function used to estimate threshold. See also Zaar/Simonsen et al. (2024).*

Results: Relationship between ACT and aided speech intelligibility in noise

- Aided SRTs with NR off were highly correlated with ACT values (r = 0.63, p < 0.001) (Fig. 3).
- ACT was found to be the strongest predictor of SRTs with NR off (p < 0.001), explaining 39.1% of the variance. Audiometric thresholds (bilateral 4-frequency pure-tone-average) explained 19.2% of the variance (p < 0.01). Age was not a significant predictor (p = 0.80) (Fig. 4).
- Combining ACT, audiometric thresholds, and age could predict 43.6% of the variance in aided SRTs with NR Off (Fig. 4).
- The predicted SRTs were significantly correlated with the measured SRTs (r = 0.66, p < 0.001) (Fig. 5).

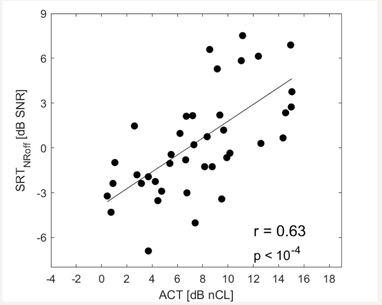

Figure 3. *Relationship between ACT values and measured aided SRTs with NR Off.*

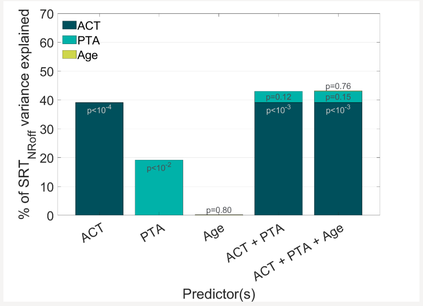

Figure 4. *% of the variance (R^2) in aided SRTs with NR Off explained by different variables.*

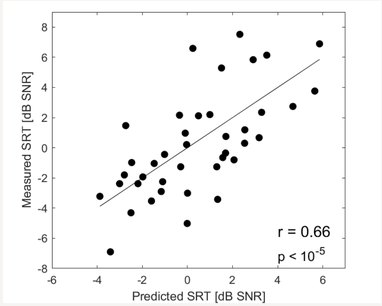

Figure 5. *Relationship between measured SRTs and SRTs predicted from ACT, audiogram, and age.*

Results: Predicted speech intelligibility benefit from different NR settings

- At a group level, increasing the NR setting led to lower SRTs (Fig. 6a).
- The lower the performance with NR off, the more the measured and predicted performance increased when changing NR mild to strong and NR medium to strong (Fig. 6b & 6c).

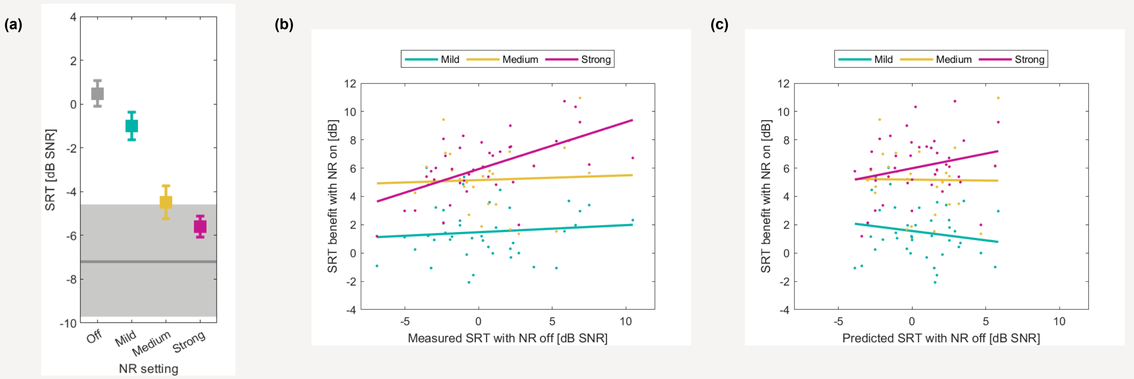

Figure 6. *(a) Measured SRTs (mean and standard error) with different NR activation levels in the HAs. (b) Scatter plot of the individual SRT benefit for the Mild, Medium, and Strong NR settings relative to the measured SRTs with NR off. (c) Scatter plot of the individual SRT benefit for the Mild, Medium, and Strong NR settings relative to the SRTs with NR off predicted from ACT, audiogram, and age.*

Conclusions and Outlook

- ACT is significantly correlated to how Japanese people with hearing loss understand speech in noise, when tested in an ecologically-valid setup.
- ACT increases the prediction of speech-in-noise ability substantially, compared to what can be achieved when using the audiogram alone.
- These results indicate that ACT may be a useful tool to adjust NR settings for individual Japanese patients.
- The same subjects are also enrolled in field testing over a 6-month period (see WCA ePosters Vatti et al., 2024a, and Vatti et al., 2024b), including daily field reports on A/B program comparisons, structured interviews after each 4-week field period, and testing of different noise reduction, brightness, & soft gain comparisons.
- This will complement the present lab data with a subjective assessment of the different tested NR settings in the same population in real-life settings. For a first analysis of comparable field data in a group of native German speakers, see Ihly et al. (2023).

Acknowledgments

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