Noise control algorithm reduces listening effort for adolescents who are bilateral hearing aid users

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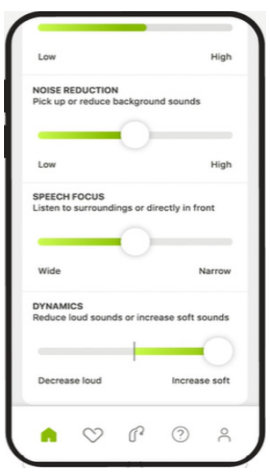
Rationale & Purpose

- Children with hearing loss are learning in classroom environments that routinely exceed recommended noise limits with poor signal-to-noise ratios (SNRs; American National Standards Institute, 2010).
- Hearing aid noise cleaning technology, such as directional microphones or single, microphone digital noise reduction, can mitigate challenges created by poor SNRs (Sarampalis et al. 2009; Gustafson et al. 2014).
- These features are not universally recommended for school-aged children; they require specific listening conditions to maximize audibility and have negative consequences if they are inappropriately activated.
- Building on the findings by Gazibegovic et al (2024) which showed children could make appropriate decisions when controlling the settings in their hearing aids with myPhonak Junior in challenging listening environments, this study focussed on whether youth would benefit from an advanced noise cleaning algorithm in a lab and during a field trial with the ability to adjust the noise cleaning settings via an app.
- The purpose of this project was three-fold:
  - To investigate whether advanced noise cleaning improves speech recognition scores or listening effort (measured subjectively and behaviorally) for adolescents in a noisy environment.
  - To evaluate if adolescents prefer advanced noise cleaning algorithm to be activated when in a noisy environment.
  - To evaluate if adolescents can reliably manipulate this setting in a remote-control smartphone app.

Materials & Methods



Dynamic Noise cancellation: Phonak's advanced noise cleaning algorithm (Controlled on the Speech Focus slider in Speech in Noise classification)

Participants:
- 18 adolescents (aged 10-17 years) with mild to severe bilateral symmetric sensorineural hearing loss; 3 participants were later excluded due to lack of hearing aid experience

Hearing aids:
- Premium level technology rechargeable receiver-in-the-canal devices with domes fit to DSL Pediatric Targets and a corresponding smartphone application

Procedures:
- A-B paired comparison testing to determine their preferred advanced noise cleaning setting (off, weak, strong) in a noisy laboratory (reverberant, 0 dB SNR, 68 dB noise)
- Evaluation of the ability to manipulate advanced noise cleaning settings in an app (same environment as A-B testing)
- Field trial to practice using the app at home for 1-week.
- Dual-task testing to evaluate word recognition performance and listening effort with and without advanced noise cleaning enabled in laboratory (reverberant, +2 dB SNR)
- Subjective ratings of listening effort following each test condition in dual-task testing.

Results & Discussion

- Activating advanced noise cleaning did not negatively impact sentence recognition performance in noise (Figure 1). SRT was equivalent for all DNC settings.

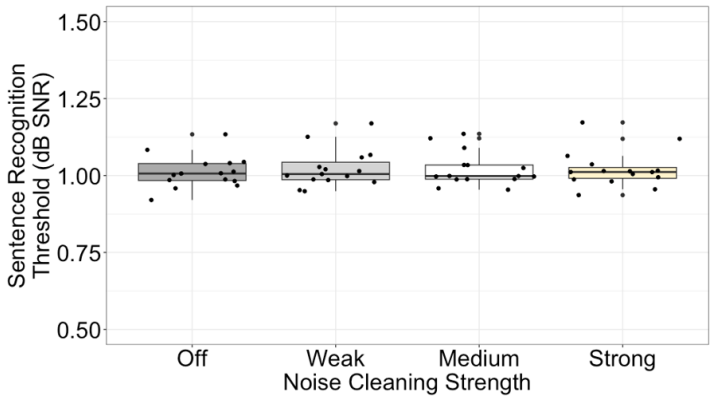


Figure 1. Sentence recognition thresholds (dB SNR) were not significantly different between noise cleaning setting, as analyzed using linear mixed-effects modelling ($p > .50$).

- Subjective listening effort was reduced when participants used the 'strong' advanced noise cleaning setting compared to all other noise cleaning settings, including their custom setting (Figure 2).

Results & Discussion (Continued)

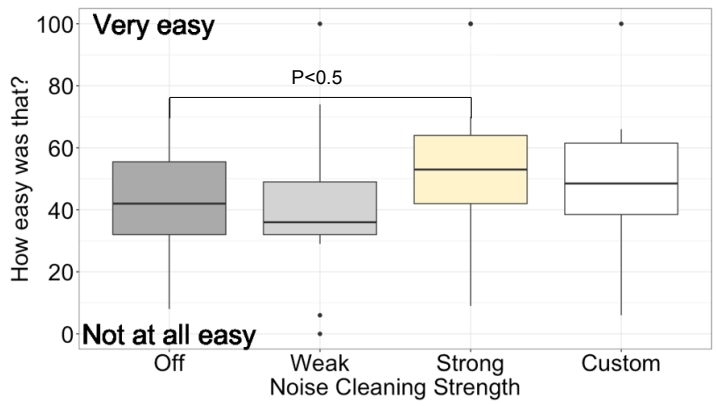


Figure 2. Subjective ratings of listening effort were significantly higher (better) with the strong noise cleaning setting than with the noise cleaning set to 'off,' 'weak,' or the participant's custom program. Scores were analyzed using a linear mixed effects model.

- Most participants (80%) preferred advanced noise cleaning algorithm to be active during paired comparisons testing.
- Preferences were stable between laboratory tasks and field trial; participants who preferred advanced noise cleaning 'off' during laboratory tasks also preferred 'off' during field trial, as indicated by slider position (see Fig 3).
- Most of the participants (67%) reported they would use the app at home at least occasionally in the future (several times a week).

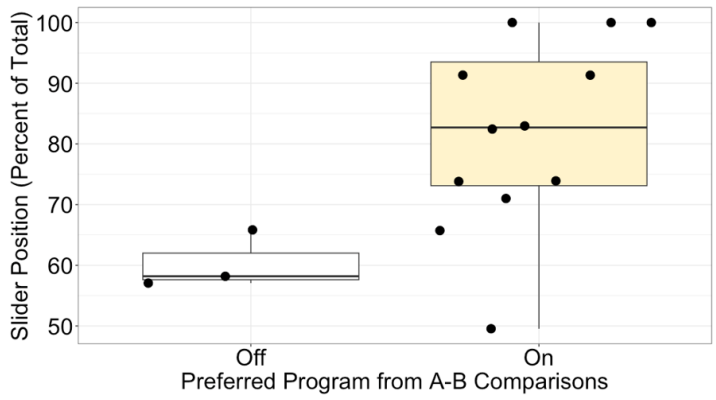


Figure 3: Slider setting was significantly lower ($p < .05$) for participants who preferred noise cleaning to be 'off' during paired-comparison testing compared to those who preferred it to be on (any strength). Slider position was analyzed using linear regression.

Conclusionscxc

- Most adolescents preferred to use advanced noise cleaning algorithm while listening in the laboratory and at home. Those who did not prefer advanced noise cleaning activated in the lab consistently disabled advanced noise cleaning in the smartphone app during field trials. These data, combined with the lack of negative effect for cleaning on speech recognition, suggests that activating the algorithm has limited negative consequences. In addition, for many participants, the advanced noise cleaning technology can be beneficial in terms of subjective listening effort. These findings support access to this advanced noise cleaning technology for adolescents, especially if they have access to a smartphone app to manually manipulate settings.

Selected references

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