Abstract

Digital noise reduction (DNR) algorithms aim to improve the output signal-to-noise ratio (SNR), speech recognition, and listener comfort in noise. This is especially important for children, who require a better SNR than adults to achieve similar levels of speech recognition. Because DNR has been found to provide no improvement or decrement in speech recognition, this study focused on the effects of DNR on listening effort. The purpose of this study was to examine how DNR algorithms providing different amounts of output SNR improve effect speech recognition and listening effort. Twenty-four normal hearing children (ages 6-12) were recruited and randomly assigned to one of three conditions: DNR-off, DNR-6, and DNR-12. Listeners were exposed to sentences with white noise added at three different input SNRs: -5 dB, 0 dB, and +5 dB. For both HA1 and HA2, phoneme recognition scores improved as input SNR improved for all listeners in both DNR-on and DNR-off conditions. The improvement in output SNR with the use of DNR had a significant effect on phoneme recognition scores.

Methods

Twenty-four children (7-12 years) with normal hearing (thresholds <15 dB HL for octave frequencies from 250-8000 Hz) served as subjects for this study. All children spoke English as their native language and passed the Barrie-Barkham Quick Screen of Phonology to ensure that speech production errors would not influence testing.

Results

For both HA1 and HA2, phoneme recognition scores improved as input SNR improved for all listeners in both DNR-on and DNR-off conditions. The improvement in output SNR with the use of DNR had a significant effect on phoneme recognition scores. Mean score gains were greater than zero for all input SNRs for both devices, indicating that DNR improves listening effort. In both devices, the DNR algorithm reduced listening effort and, although not significant, a greater reduction was seen with HA2.

Discussion

The DNR algorithm that improved the output SNR yielded better phoneme recognition than the DNR that did not improve output SNR.

Conclusion

The overall goal of the present study was to examine how improvements in the output SNR with the use of DNR impacts speech recognition and listening effort in children. To be more meaningful, future findings need subjective perception improvements with the use of a DNR algorithm that sufficiently improves the output SNR while maintaining signal quality. Results also suggest that DNR effectively reduces listening effort in children and that these improvements are not necessarily related to the output SNR improvements or speech spectrum provided by DNR. Further studies are needed to assess the effects of DNR improvement in output SNR provided by DNR for children with hearing loss, and to determine the amount of output SNR improvement required to show these improvements.

References