Field Study News

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Remote microphone listening devices for children and adults with unilateral hearing loss

Research carried out over the past three decades has revealed the potential effects of unilateral hearing loss on functional hearing abilities and psychosocial/psychoeducational outcomes in children. This study, conducted at the University of Melbourne, evaluated the speech perception benefits afforded by remote microphone technologies and investigated the real-world listening/communication advantages of an optimized system in both children and adults with varying degrees of unilateral hearing loss.

Introduction

Unilateral or single-sided hearing loss is common in children, affecting around 1-3% of school-aged students (Bess et al., 1998; Wake et al., 2016). In the past, clinicians and educators have adopted a failure-based model of intervention in affected children. That is, employing a "wait and see" approach until developmental delays become obvious or until the point of academic failure (Porter, Bess & Tharpe, 2017). Recent evidence has, however, revealed that a high proportion of children with unilateral hearing loss experience both auditory and general developmental problems. Auditory localization and speech perception in background noise deficits are a direct consequence (Bess et al., 1986) and these commonly lead to a range of social, emotional and behavioral difficulties (Bess et al., 1986; Lieu et al., 2012). Furthermore, educational progress may be impeded, and recent evidence suggests that while only around 2% of normally hearing students fail a grade at school, approximately 35% of children with unilateral hearing loss need to repeat at least one academic year (Porter, Bess & Tharpe, 2017). Clearly there is a need to support affected individuals and to improve the available auditory signal through the provision of listening devices, as part of a comprehensive intervention strategy.

This study had two main objectives:

1. Evaluate the benefit of Roger™ remote microphone technologies (Roger Touchscreen Mic coupled to a Roger Focus) for listeners with unilateral hearing loss.

Roger Touchscreen Mic

Roger Focus

2. Explore which ear/device configuration would produce the best perceptual outcome.

Methodology

Participants: Eight school-aged children (10.3 ± 5.1 years) and six adults (32.0 ± 8.2 years) with unilateral sensory hearing loss took part in the study. Sound detection thresholds in the better ear were within normal limits (≤15 dBHL) in all cases. The losses in the poorer ear ranged from mild to profound degree (4-frequency average: 72.3 ± 42.8 dBHL) and in all instances were thought to be of congenital origin.

Devices: None of the participants had been hearing aid users prior to the study. In 6 cases a Sky™ V 90 hearing aid and integrated Roger receiver was fit on the poorer ear and matched to NAL-NL2 prescriptive targets. The gain was adjusted if necessary to ensure participant comfort. Domes were used if the appropriate level of amplification could be reached, otherwise impressions were taken and molds fitted. For the remaining 8, the severity of the loss precluded fitting of the Sky hearing aid device in the impaired ear.

Speech perception in background noise

Open-set speech perception testing (CNC-words) was carried out with the following device configurations:

Configuration	Better ear	Poorer ear
1	unaided	unaided
2	Roger Focus	unaided
3	unaided	Sky V
4	unaided	Sky V + Roger
5	Roger Focus	Sky V + Roger

Testing was undertaken in the free field using a two-speaker set-up as per Rance et al. (2010). Recorded speech stimuli were presented via a speaker situated in front of the subject and background noise (4-talker babble) was presented from behind. The signal-to-noise ratio was 0 dB at the listener's head.

Real-World Device Trial (3 weeks)

After the fitting and speech perception session participants underwent a take-home device trial. Children wore the device configuration that afforded them the highest speech perception score. Adults wore their preferred configuration, which was usually the one that provided the highest speech score.

In most cases, device set-up for the trial was either Roger Focus worn on the better ear, or Roger Focus on the better ear and a hearing aid plus Roger on the poorer ear.

The device trial employed a balanced (ABBA) design alternating between no device and device conditions as per Rance et al. (2010). Each trial phase lasted 1 week at the end of which, the child participants (and their teachers) completed the Listening Inventory for Education – Revised (LIFE-R) questionnaire. Adult subjects completed the Speech, Spatial and Qualities of Hearing Scale (SSQ) questionnaire after each trial phase.

Results

Speech perception in noise

CNC phoneme scores varied across listening conditions (Figure 1). A two-way repeated measure ANOVA with "subject" as a random variable revealed significant differences between listening conditions ($F=26.37$, $P<0.001$) and a Tukey post-hoc comparison revealed the following results:

1. CNC score for all device configurations was significantly higher than for the "unaided" condition.
2. Roger Focus worn on the normally hearing ear/better ear afforded significantly better speech perception than the "hearing aid alone" condition.
3. Performance for the "hearing aid alone" and "hearing aid plus Roger" conditions were equivalent, but adding a Roger Focus to the better ear resulted in significant improvement in speech perception.

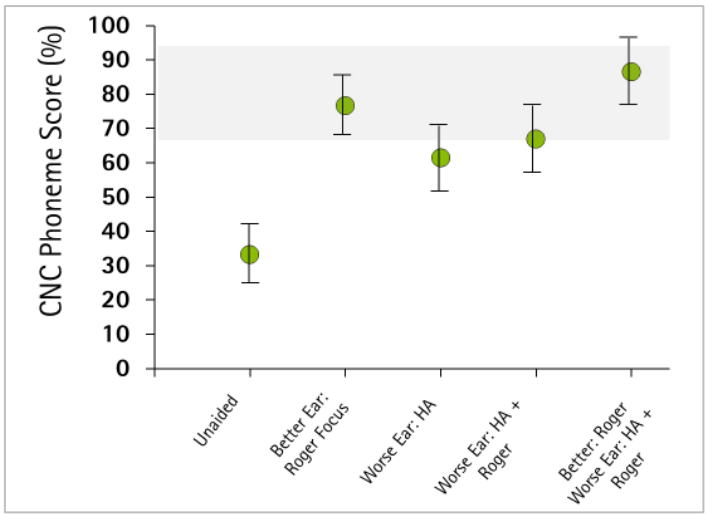

Figure 1. Free-field CNC scores for speech in background noise (0 dBSNR). Shown are mean scores (percentage phonemes correct) and 95% confidence intervals for each listening condition. The shaded area represents the 95% performance range (unaided) for children with normal hearing bilaterally.

Take-home device trial

Both students and teachers considered that classroom listening and comprehension were significantly improved when wearing the auditory device(s). LIFE-R questionnaire results are shown in Figure 2. A two-way repeated measure

ANOVA with "subject" as a random variable revealed significant differences between unaided and aided listening conditions (Student: F=5.84, P=0.011; Teacher: F=16.55, P=0.001).

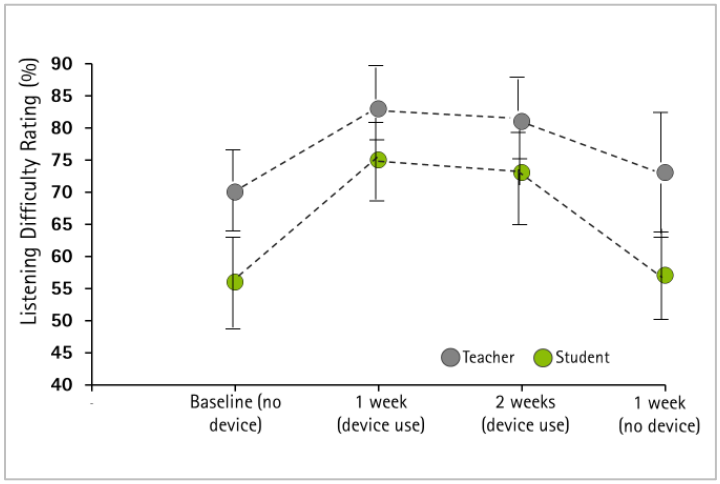

Figure 2. Student and teacher listening/comprehension difficulty ratings across unaided and aided period

Adult subjects reported a significant improvement in their real-world speech perception ability and comprehension (SSQ questionnaire) when device-aided (F=17.37, P<0.001) (Figure 3). There was no change in spatial listening or hearing quality.

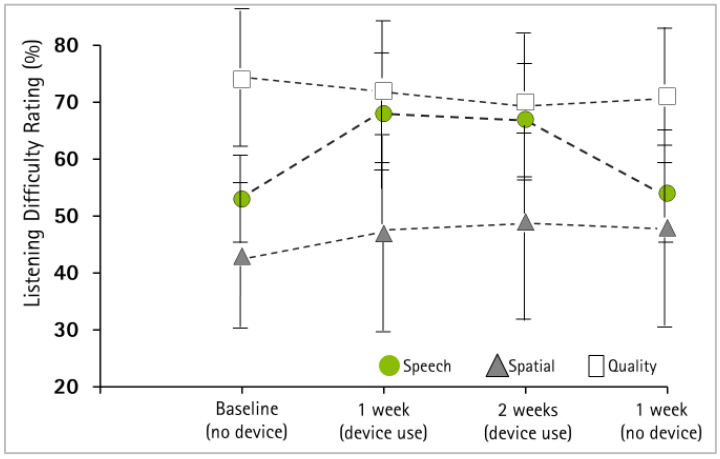

Figure 3. Unaided and aided speech comprehension, spatial listening and hearing quality ratings.

Conclusion

Remote microphone systems used in combination with hearing aids or alone can provide real-world benefits for children and adults with unilateral hearing loss. The major perceptual improvements in this study were achieved with the provision of a Roger Focus device fit to the normally hearing ear – either alone or in combination with a hearing aid with a Roger integrated receiver on the poorer side. Despite the fact that none of the participants were hearing device users prior to the study, six of the eight child participants elected to continue wearing the Roger Focus on the better ear at project completion.

References

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