Field Study News

June 2014

roger

Roger Focus for school children

Study confirms the performance, fit and benefit of a new wireless communication system designed for individuals with at least one normal hearing ear

The objective of this study was to assess the performance of a new digital ear-level communication system with children and to determine whether the system could be appropriately fitted on children in the school setting. The study was conducted with 15 children aged 6 to 16 years old. Results showed that all children could be fitted with the appropriate gain levels. SlimTubes with stock open domes are able to be used to couple devices to all of the children's ears comfortably and without insertion loss. Finally, speech in noise testing resulted in significant improvements in performance, indicating that the device would be beneficial in everyday classroom situations.

Introduction

It has been well established that children need more positive signal-to-noise ratios (SNR) than adults in order to achieve equal speech recognition scores (Crandall and Bess, 1987; Nabelek and Robinson, 1982). This is due to both an immature central auditory system and a less robust language system limiting their ability to "fill in the blanks." Since understanding happens at the brain rather than at the ear, many factors including attention, memory, language, and cognition contribute to our ability to process auditory information.

For some children, understanding is further diminished by one of a number of conditions which negatively impact these functions. Auditory processing disorder (APD), unilateral hearing loss, autism spectrum disorder, atresia and second language learning represent a few of these conditions. Research has shown that for these children, wireless communication systems are very beneficial (Hornickel, et al, 2012; Johnstone, et al, 2009; Rance et. al., 2013; Schafer et. al, 2012; Tharpe, Ricketts and Sladen, 2003). An ear-level solution is advised so that it can move with the child throughout the day and provide maximum access to the signal of interest without the degrading effects of poor acoustics, distance and competing noise.

The Roger Focus is a new digital, ear-level wireless communication system designed to deliver a signal of interest directly to the listener's ear, preserving a favorable SNR without any obstruction of natural hearing or other sounds in the environment. The Roger Focus system utilizes a state of the art digital wireless transmission that is designed to minimize size, interference and hassle while maximizing signal quality. It features broadband audio with minimal acoustic delay in a small ergonomic, behind-the-ear housing.

Methodology

15 children aged 6 to 16 years old participated in the evaluation of Roger Focus. 10 of these children had unilateral hearing loss, 3 had fluctuating conductive hearing loss, 1 presented with auditory processing difficulties and 1 had minimal hearing loss. All children were previous users of ear-level communication devices. Roger Focus was fitted on the better ear of each subject.

Roger Focus devices were initially fitted to the children's ears with SlimTubes and standard open domes. SlimTubes of size 0-2 were selected accordingly and coupled with a small or medium open dome. The American Academy of Audiology (AAA) procedure, as described by Schafer (2013), was used to ensure that the devices were acoustically appropriate for each child's individual hearing thresholds. DSL v5 pediatric targets were generated for each child's individual hearing thresholds in the better ear. Real ear measures were used to set the Roger Focus receivers. With the EasyGain feature available in the Roger inspiro, gain was adjusted in order to generate the best approximation to DSL targets.

PHONAK
life is on

The FM offset protocol was then used to ensure that the fittings were within the specified average +/- 3 dB tolerances published by AAA in 2008.

Further testing was completed in the soundbooth. Patients were placed in the soundfield with speakers at +/- 45 degrees azimuth. The Roger inspiro microphone was hung 6 inches (15cm) below the center cone of the speaker on the poorer hearing side. The signal was delivered to this side. The noise was presented on each child's better hearing side. First, a 7-point loudness scaling procedure was used to determine if the target levels were comfortable for the child. If not rated as "comfortable" the EasyGain feature was used to adjust the receiver and the test was repeated until the child gave a rating of comfortable. A +5 SNR was used to assess comfort with a 60 dB HL signal and 55 dB HL of background babble.

Bamford-Kowal-Bench (BKB) sentences were used to assess speech understanding in noise at a -5 SNR. For this testing a 60 dB HL presentation level was used in the presence of 65 dB HL background babble.

Following testing, children used the Roger Focus receivers in their daily classroom routines for the next 3 weeks. Following the trial, a questionnaire was administered to each child in his/her classroom to obtain subjective feedback on signal quality, comfort and the design of the device.

Results and discussion

All devices could be fitted within the +/- 3 dB tolerance as specified by the FM offset protocol. Real ear measures confirmed that the devices did not exceed MPO targets at any frequency. Real ear unaided responses were measured and compared to real ear occluded responses with the Roger Focus turned off to ensure that there was no insertion loss. Since Roger Focus was fitted to a single normal hearing ear in most cases, it was imperative that use of the Roger Focus did not degrade environmental hearing. With the SlimTube and open dome configuration, no measureable insertion loss was detected for any of the fittings.

Loudness scaling could be performed on 14 out of the 15 test subjects. One of the youngest children did not demonstrate competency with the task and so the device was left at best match to target settings. Of the remaining 14, 11 rated the target settings as comfortable in a +5 SNR. The gain was elevated on 3 fittings for children who rated the sentences as "too soft". A rating within the comfortable range was achieved for all children.

The ability of the Roger Focus to route the signal-of-importance to the better ear and overcome poor acoustic conditions and background competition led to significant improvement in speech understanding in noise. Individual scores can be seen in Figure 1, with some children receiving more than 90% improvement with Roger Focus compared to listening to speech in noise without a wireless system. Average improvement in sentence recognition scores with Roger Focus was 53% across all subjects. Using a repeated measures t-test, scores on the BKB-SIN Test significantly increased between no communication system (M=45.65) and Roger Focus (M=92.59); $t(16) = -5.566$, $p < .05$. The Cohen's D coefficient of 1.35 indicated a large magnitude of effect.

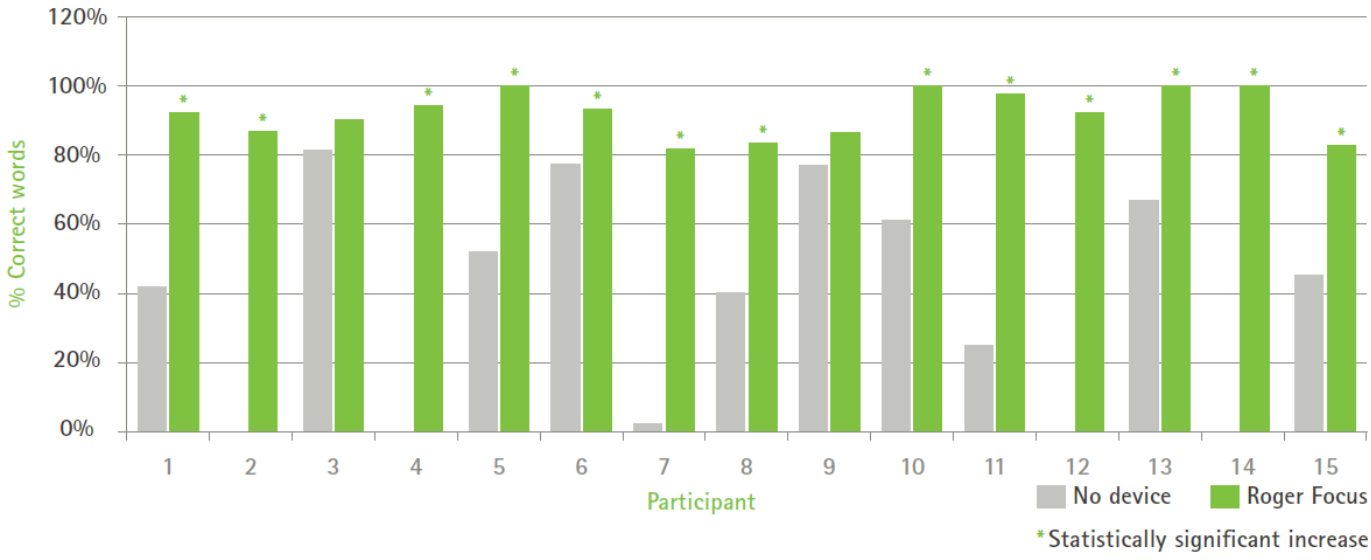

Figure 1
Speech performance in noise for each of the 15 subjects without a wireless communication device compared to with Roger Focus. The green bars with stars indicate the critical difference for statistical significance between conditions was met.

All children in this study, including the youngest first grader, could be fitted with a SlimTube and a standard dome (Picture 1). This included a total of 7 subjects between 6 and 8 years of age. At the time of the initial fitting, 12 out of 15 children chose to continue to use the SlimTube and open dome over the custom earmolds that were used for their previous FM systems. The remaining 3 children wished to go back to the custom earmold solution that had previously used. The SlimTube was replaced with a pediatric earhook and the dome was replaced with an earmold and standard tubing. 12 children (86%) chose to wear the Roger Focus over their previous FM unit. The remaining 3 children had no preference between Roger Focus and their previous FM unit. The primary reported reasons for preferring the Roger Focus system were wearing comfort, access to volume control, sound quality and retention.

Picture 1
The youngest child, age six, wearing a size 0 SlimTube and small open dome. She did not experience any problems with insertion loss, discomfort or retention.

Conclusions

This study showed that the Roger Focus provided significant benefit from children with at least one normal or near-normal hearing ear. The Roger Focus device provided gain levels that met the FM offset tolerances specified by the AAA HAT guidelines (2008). All children were able to be fitted with listening levels that they deemed comfortable in a formal loudness scaling procedure and also after a three week real-life listening trial. Additionally, most children down to age six could be comfortably fitted with the standard SlimTube lengths and no child had any issues with retention over the course of the study. It was also confirmed that Roger Focus can be fitted without any insertion loss, ensuring that audibility is not impaired in what could potentially be a child's only hearing ear. Finally, compared to ear-level FM devices previously used by this sample, a majority of children preferred the Roger Focus for the sound quality, comfort, aesthetics and the available volume control.

Acknowledgments

The author would like to gratefully acknowledge the collaboration and contributions of the audiologists at the Special Educational District of Lake County (SEDOL).

References

AAA Clinical Practice Guidelines: Remote Microphone Hearing Assistance Technologies for Children and Youth Birth-21, (2008). Available: http://www.audiology.org/resources/documentlibrary/Pages/HearingAssistanceTechnologies.aspx

Crandell, C., Bess, F. (1987). Developmental changes in speech recognition in noise and reverberation. ASHA, 29, 170.

Hornickel, J., Zecker, S.G., Bradlow, A.R., and Kraus, N. (2012). Assistive listening devices drive neuroplasticity in children with dyslexia. Proceedings of the National Academy of Sciences vol 109 (41). pp 16731-36.

Johnstone, K.N., John A.B., Hall J.W., Crandell C.C. (2009). Multiple benefits of personal FM system use by children with auditory processing disorder (APD). International Journal of Audiology vol 48 (6). pp 371-83.

Nabelek, A., Robinson, P. (1982). Monaural and binaural speech perception in reverberation for listeners of various ages. Journal of the Acoustical Society of America vol 71. 1242-48.

Rance G., Saunders K., Carew P., Johansson M., Tan J. (2013). The Use of Listening Devices to Ameliorate Auditory Deficit in Children with Autism, The Journal of Pediatrics vol 164 (2). pp 352-57.

Schafer, E.C., Bryant, D., Sanders, K., Baldus, N., Algier, K., Lewis, A., Traber, J., Layden, P., Amin, A. (in press). Fitting and verification of frequency modulation (FM) systems on children with normal hearing. Journal of the American Academy of Audiology.

Schafer, E.C., Mathews, L., Mehta, S., Hill, M., Munoz, A., Bishop, R., & Maloney, M. (2012). Personal FM systems for children with autism spectrum disorders (ASD) and/or attention-deficit hyperactivity disorder (ADHD): An initial investigation. Journal of Communication Disorders vol 46 (1). pp 30-52.

Tharpe, A.M., Ricketts, T., & Sladen, D. (2003). FM Systems for Children with Minimal to Mild Hearing Loss. ACCESS: Achieving Clear Communication Employing Sound Solutions. pp 191-97.