Phonak
Field Study News

Increasing access to child-directed speech with remote microphone use in the home

A remote microphone system (RMS) enhances speech perception by improving the signal-to-noise ratio (SNR), thus overcoming the impact of noise and distance. Benitez-Barrera, Angley and Tharpe (2018) showed that RMS use in the home provides children with hearing loss access to a larger quantity of caregiver talk from a distance. The purpose of this study was to extend their findings and determine how much of that extra caregiver talk was child-directed.

Lisa Bacic; August 2019

Introduction

Remote microphone systems are one type of technology known to improve access to speech, especially when distance and noise are factors. By wirelessly delivering speech from the transmitter to the receiver worn by the child, the effects of distance, background noise, and reverberation are significantly reduced. This in effect greatly improves the signal-to-noise ratio (SNR) delivered to the child's ear, making it easier to attend to and process speech. They are widely used for school-aged children with hearing loss because classrooms are noisy listening environments and children need access to high-quality clear speech to learn (Flexer, 2002).

However, access to high-quality, clear speech is not only critical in the classroom. It is imperative for optimum language development in young children with normal hearing (Hoff & Nagles, 2002) and those with hearing loss (e.g., Stelmachowicz, Pittman, Hoover, Lewis, & Moeller, 2004). Young children benefit from both high-quality speech and from having access to more words from caregivers in their preschool years (Hart & Risley, 1995).

Recently, Benitez-Barrera, Angley and Tharpe (2018) questioned whether children could benefit from the enhanced speech perception an RMS offers before they reach school age, particularly in the home setting.

For their study, they examined the use of RMS in homes of children with hearing loss to determine the impact of its use on the amount of talk by caregivers, and the amount of caregiver talk to which the children had access. They found that, on average, RMS use in the home provided children

with access to approximately 5,300 more key caregiver words during an eight-hour day; and caregivers spoke more from a distance while using the RMS than when not (Benitez-Barrera & al., 2018).

These findings were compelling and the authors wanted to extend their research to investigate whether RMS use impacted not just the amount of caregiver talk but also the *quality* of the extra caregiver talk.

According to the authors, factors that contribute to the quality of language include whether caregiver talk is child-directed (Weisleder & Fernald, 2013; Dilley et al., 2018); whether the conversation topics are relevant to the child's attention (Tomasello & Farrar, 1986); and whether caregivers are responsive to their children during communication exchanges (Nittrouer, 2010).

The purpose of this study was to extend the previous findings by examining the quality of the talk produced by caregivers from the recordings obtained by Benitez-Barrera and colleagues (2018). Quality talk was defined as child-directed speech.

The current study aimed to determine: 1) whether an RMS could provide a child with more access to child-directed speech in the home than when one was not used; 2) whether caregivers produced a greater proportion of child-directed speech when using an RMS than when not used; and 3) whether caregivers produced a greater proportion of child-directed speech in their overall talk from a distance when using an RMS, than when not used.

Methodology

The data from nine families of preschool-aged children with bilateral permanent hearing loss, ranging from moderate to profound in degree, were included in this study (age = 2:6 to 6:4, years: months).

All children were full-time hearing technology users. One adult caregiver was identified as the key caregiver and the child with hearing loss was the key child.

Each participating family was provided with a Phonak Roger™ RMS for use during the study. All devices were set with the child's own hearing aid or cochlear implant microphones activated; thus, the environmental microphones were active when the RMS microphone was active. The Roger settings were set to default values, which provides the RMS signal with a 10 dB advantage relative to the incoming signal.

Key caregiver talk was measured using Language Environmental Analysis (LENA™) technology (Xu, Yapanel, & Gray, 2009). LENA allows for automated measurement and analysis of large quantities of data (i.e., daylong audio-recordings) relevant to a child's language environment as collected in natural settings (Oller et al., 2010).

Families were provided with LENA recorders, which can record up to 16 hours of data that can subsequently be downloaded and automatically analyzed by LENA software. Based on acoustic parameters of the language environment, the LENA software yields an estimate of the amount of talk produced in close proximity (i.e., within approximately 6 to 8 feet) to the recorders. Estimated female (i.e., Female Adult Near; FAN) and male (i.e., Male Adult Near; MAN) word counts were used to quantify key caregiver talk. In previous studies, the child of interest (i.e., key child) wore a LENA recorder to obtain an estimate of the caregiver talk that is produced close to the child (e.g., Aragon & Yoshinaga-Itano, 2012).

In this study, the key child, as well as the key caregiver, wore LENA recorders while participating. Caregivers were instructed to activate both recorders simultaneously (the key child's and the key caregiver's) as soon as possible after their child awoke in the morning and to allow the recorders to run throughout each day up to the maximum recording time (i.e., 16 hours). Families were provided with four fully-charged recorders for each weekend in which they participated in the study (one for the key child and one for the key caregiver for each day of the weekend). Recorders were clearly marked as 'child' or 'caregiver' with pictures to avoid confusion.

Families were recorded in their homes for two consecutive weekends – one weekend while using the RMS (the key child wore the RMS receiver, and the key caregiver wore the RMS transmitter) and one weekend without the RMS. In an attempt to reduce potential novelty effects, families were instructed to use the RMS at home for the three nights immediately prior to the RMS weekend (Wednesday, Thursday, Friday).

Results

Key Aim 1: *To determine if an RMS provides a child with more access to child-directed speech in the home than when an RMS is not used.*

Only data from the no RMS weekend was used to analyze this aim, as this condition represented a typical weekend with no effects of new technology present in the home.

On average across families, 57% of the total caregiver talk was child-directed. Of all child-directed caregiver talk, 45% was produced near the child, and 12% was produced from a relatively far distance (greater than 6 to 10 feet away from the child). A significantly greater amount of CDS produced by the key caregiver could be accessible to children with hearing loss by using the RMS in the home (see Figure 1).

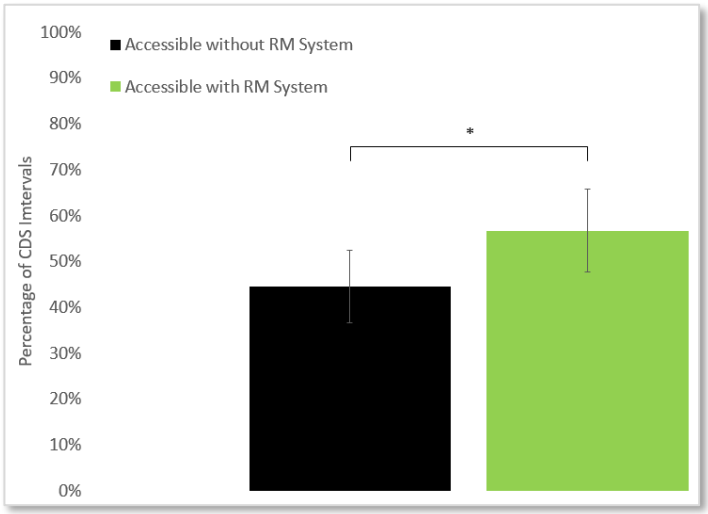

Figure 1: Percentage of CDS accessible to the child for both no-RMS and RMS conditions. * = significant difference

Key Aim 2: *To determine whether caregivers produced a greater proportion of child-directed speech when using an RMS than when an RMS was not used.*

The percentage of far child-directed speech produced by the key caregiver in both study conditions (RMS and No RMS) was calculated. There was no difference between the mean percentage of CDS produced by caregivers in the No RMS and RMS weekends (57% and 55% respectively.

Key Aim 3: *To determine whether caregivers produced a greater proportion of child-directed speech in their overall talk from a distance when using an RMS than when an RMS was not used.*

The percentage of far child-directed speech produced by the key caregiver in both study conditions (RMS and No RMS) was calculated. There was no significant difference between the percentage of child-directed speech produced by caregivers in the far distance category for the No RMS and the RMS weekend (12% and 18%, respectively).

Discussion

Benitez-Barrera and colleagues (2018) demonstrated that children with hearing loss had access to *more* caregiver talk coming from a distance when using an RMS in the home than when not. This study used the recordings from that same study to examine the *quality* of the talk produced by caregivers. Quality talk was defined as child-directed speech.

Recordings from nine families of children with hearing loss revealed that use of an RMS system in the home did not impact the manner in which caregivers interacted with or talked to their child (i.e., did not significantly impact caregivers' generalized tendency to speak directly to their children). However, the RMS system did make it *more likely* that the child had clear access to the linguistic input that their caregivers provided during interactions, especially when at a distance.

On average, 57% of the talk that caregivers produced during a typical weekend at home was child-directed and 12% of this child-directed talk was produced from greater than 6 to 10 feet away from the child. This 12% of child-directed speech produced at a relatively far distance from the child reflects high-quality caregiver talk that would likely only be heard by the child if using an RMS. Giving children with hearing loss access to 12% more child-directed speech with an RMS is considered a substantial increase in the amount of quality language made available.

Conclusion

This study showed that caregivers produced the same amount of child-directed speech when using and when not using the RMS. However, it was concluded that children with hearing loss could potentially access 12% *more* child-directed speech if caregivers use an RMS because of their distance from their children when talking to them.

These findings support the use of an RMS, like Phonak Roger, in homes of children with hearing loss to increase a child's access to child-relevant caregiver talk which is important for the development of language and communication skills in children.

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Investigators

Anne Marie Tharpe,
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Dr. Anne Marie Tharpe is an audiologist and Chair, Department of Hearing and Speech Sciences, Vanderbilt University School of Medicine in Nashville Tennessee. Her research interests are in the area of pediatric hearing loss. Specifically, she has explored the developmental impacts of minimal and mild hearing loss on children, children with hearing loss and additional disabilities, and more recently, the sleep patterns in those with hearing loss. Dr. Tharpe has published extensively in national and international professional journals, has published numerous books and book chapters, and has presented to over 250 audiences around the world on pediatric audiology issues.

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Carlos Benitez-Barrera is a Ph.D. student in the Auditory Development Laboratory led by Dr. Anne Marie Tharpe in the Department of Hearing and Speech Sciences, Vanderbilt University. His research interests include the intersection of auditory electrophysiological and behavioral outcomes, and technological interventions with young children who have hearing loss. Mr. Benitez-Barrera was awarded the Singh Memorial International Scholarship from the ASHA Foundation (2015) and the Fonds Jean Falk-Variant Award from University of Lausanne (Switzerland, 2017).

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Dr. Angley is an audiologist and Associate Director, Adult Hearing Aids in the Department of Hearing and Speech Sciences, Vanderbilt University Medical Center. Her clinical interests include adult diagnostic and rehabilitative services. Her research interest include telehealth, and technological interventions with patient of all ages with hearing loss. Dr. Angley has presented her work at state and national meetings.

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Emily Thompson is currently a first-year Doctor of Philosophy (Ph.D.) student in Vanderbilt University's Department of Hearing and Speech Sciences. She recently earned her Doctor of Audiology (Au.D.) degree from Vanderbilt School of Medicine in May 2019 after pursuing a pediatric specialty concentration in management of early childhood hearing loss. In addition to serving as a LEND Program trainee, she recently completed an NIH-funded T35 Research Traineeship with Vanderbilt faculty mentor Dr. Anne Marie Tharpe. Ms. Thompson's primary research interests encompass pediatric amplification and aural rehabilitation, with a clinical focus on exploring the communication/psychosocial impacts of childhood hearing loss.

Tiffany Woynaroski,
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Tiffany G. Woynaroski PhD, CCC-SLP is an Assistant Professor in the Department of Hearing and Speech Sciences at Vanderbilt University Medical Center. Her research aims to identify brain and behavioral factors that explain heterogeneity in language, social, and communication ability, predict differential growth and response to intervention, and/or elucidate the mechanisms by which treatments impact language, social, and/or communication outcomes.

Lisa Bacic
Reporter

Lisa Bacic is a speech-language pathologist and presently fills two roles at Phonak HQ, Editorial Manager and Pediatric Rehabilitation Manager. Lisa worked as a clinical speech-language pathologist in Canada for over 15 years before moving to Switzerland and joining Phonak HQ in 2016. She is presently an employee representative for the Hear the World Foundation.