

WIRELESS REMOTE MICROPHONES THAT TEENS WANT TO USE

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Abstract

Children require clear speech at good signal-to-noise ratios for optimum listening and learning, and this is true both inside and outside the classroom. The use of remote microphone technology can be of great benefit, and has traditionally taken the form of FM systems. Today, digital wireless technology provides new opportunities for better listening in a multitude of situations, and expands the functionality to include connectivity to other sound sources. In addition, direct connectivity to consumer smart devices is especially relevant for older children, as this type of technology is commonly used among tweens and teens. This paper outlines some of the barriers to use of remote microphone technology among older children, and discusses how ReSound digital wireless technology, and particularly the ReSound Multi Mic and Micro Mic, can help overcome them.

Children require clear speech at levels far exceeding the environmental noise and reverberation for optimum listening and learning. However, many of the real-world environments in which children spend a good deal of their time are not ideal in this respect¹. The combined effects of reverberation, attenuation of the important signal due to distance, and interfering noise can make listening and learning a struggle for any child. For the hearing impaired child, coping in such environments without assistive technologies is especially challenging²⁻⁵.

Use of wireless remote microphones can help compensate for poor listening environments⁶⁻¹¹. The specific technology used in such microphones has traditionally been based on analog FM transmission. However, remote microphones using digital wireless transmission have also become available. The potential benefits of FM-based and digital wireless remote microphones appear to be comparable¹². Remote microphone technology of some type is often recommended for hearing impaired children. In fact, pediatric amplification guidelines consider all children wearing hearing aids to be candidates for remote microphone technology^{13,14}. There is no shortage of literature documenting benefit in terms of improvement in language acquisition, and speech understanding, and the implications for academic performance^{15,16}. These benefits are indisputable. Nevertheless, it is also a common observation that hearing impaired children in their tweens and teens

may resist using their remote microphone systems. In fact, they may stop using them altogether. This presents quite a dilemma for their parents, teachers, and audiologists. On the one hand, the use of this assistive technology can provide the best possible conditions for learning. On the other hand, children's reasons for disuse of the assistive technology are valid for them and should be taken seriously.

BARRIERS TO USE OF REMOTE MICROPHONE TECHNOLOGY

Why would children stop using something that can help them to such a great extent? One survey that investigated reasons for resisting FM usage included responses from parents, teachers, audiologists, support personnel and students aged 8 to 18 years¹⁷. Each group indicated reasons why children would resist or fail to use FM systems. The reasons were subsequently organized into six categories, which are broadly defined here:

- Social. Resistance due to peer pressure, or feeling/looking different than others, having to ask the teacher to wear the microphone.
- Mechanical. The equipment did not work reliably.
- Support. Inadequate training of students and teachers in using the equipment.
- Comfort. A system characteristic that made it uncomfortable to use, such as requiring a different earpiece, or making the student's hearing aids bulky.

- Benefit. The equipment did not help sufficiently or it was possible to compensate in other ways without using the equipment.
- Convenience. It was bothersome to use the equipment, for example, having to carry the equipment around.

There was agreement across the groups surveyed that “Social” reasons were the most prominent for resisting use of FM technology. In fact, teachers did not tend to give reasons falling in other categories than “Social” and “Mechanical”. The responses of students, parents and audiologists were distributed similarly across categories, except that the students often gave “Benefit” related reasons, which parents and teachers did not. This suggests that the students may question the value of using remote microphone technology, while their parents, audiologists and teachers do not. Figure 1 shows the distribution of reasons for not using FM across the six categories for the student participants.

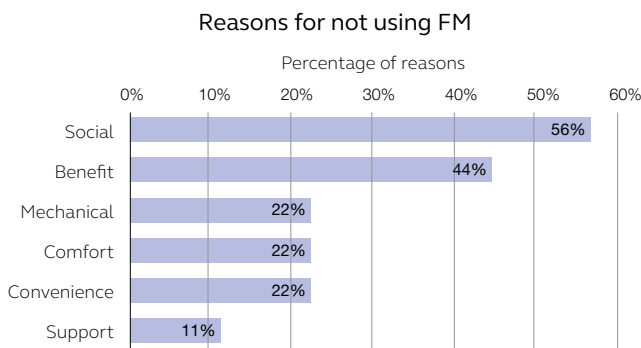


Figure 1. Students’ reasons for resisting use of FM remote microphone technology. Data from Franks¹⁷.

Even children who do see the value of remote microphone technology may not be benefitting as much as they could. Another report on use of and attitudes towards FM in a group of youths aged 11 to 20 years found that while most of them used FM regularly in the classroom, very few used it in any other situations, such as playing sports or being at home¹⁸. This was in spite of the participants being able to identify potential benefits of doing so. Reasons given for not using the systems outside of the class were lack of perceived ownership, wind noise outdoors, safety issues if the system involved wearing a device with a lanyard, fear of damaging or losing the equipment, and perceived lack of need outside of school.

NEW OPPORTUNITIES

The development of digital wireless technology has enabled new opportunities to address the objections tweens and teens may have to using remote microphone technology. The ReSound portfolio includes many hearing aids with 2.4 GHz digital wireless technology. With very few exceptions, all of these hearing aids can receive transmitted sound from ReSound wireless remote microphones in addition to other wireless accessories. Connectivity options with this technology are wide and fairly straightforward¹⁹, and extend to direct communication with consumer smart devices including iPhone and iPad, as well as many Android smartphones. This latter fact is especially attractive to this age group, as use of consumer smart devices is already commonplace among tweens and teens. ReSound 2.4 GHz wireless technology enables techniques for avoidance of interference and privacy of communications known from other digital wireless technologies like Bluetooth. Finally, specific to remote microphones, the cost of this type of technology is modest in comparison to an FM system. This makes the solutions from ReSound affordable for many families of hearing impaired students and accessible for use inside or outside of the classroom.

Pictured in Figure 2, the remote microphones include the ReSound Multi Mic and Micro Mic²⁰. The Multi Mic and Micro Mic are small remote microphones that can be clipped on to the clothing of a talker, and transmit the sound of the talker’s voice to ReSound wireless hearing aids. While both microphones have a directional microphone to best pick up the voice of the talker when worn, the Multi Mic also has a “table microphone mode” that optimizes the sound collection characteristics for picking up the voices of several talkers. In addition, the Multi Mic has other input modes, including telecoil, line-in, and Direct Audio Input (DAI) via a 3-pin Europlug connection. As a result, the Multi Mic can interface with nearly any type of assistive listening system a student is likely to encounter.

The ReSound 2.4 GHz wireless technology is uniquely suited for use by tweens and teens because it provides

wireless communication directly from a transmitter to “normal” hearing aids. By “normal”, it is meant that no boots, special attachments/modules, or ancillary devices are needed to receive the signal. This is in contrast to an FM receiver that attaches to the hearing aid, which also increases the chance of device failure due to faulty connections. With the built-in 2.4 GHz technology, there is no extra cost of additional devices to receive the signal, and apart from the hearing aids there is nothing that can be lost or damaged. Tweens and teens are also candidates for a wider variety of hearing aid styles than younger children, and will have more say on the style that is fit. Therefore, it is also significant that the 2.4 GHz wireless technology is available in various hearing aid styles including custom devices, BTEs, and RIEs. Finally, the fact that ReSound wireless hearing aids connect directly to consumer smart devices such as the iPhone and many Android phones provides unique ways of receiving sound and interacting with the hearing aids in a way that does not call attention to itself. The teen peers of teen hearing aid wearers are also using these same smart devices in their daily lives. These advantages may mitigate the “Social” reasons students might have for resisting the use of remote microphone technology.



Figure 2. The ReSound Micro Mic and Multi Mic stream sound directly to ReSound wireless hearing aids.

The ReSound solution can also address other objections to using remote microphone technology. One

obvious objection is “Comfort”. Because receiving the signal from the microphone involves nothing other than activating streaming via an on-board control on the hearing aids, remote control, or smart device app, there is no additional burden to the teen, and no physical change to what they are accustomed to wearing on their ears. Perceived lack of “Convenience” may also be lessened with the ReSound technology. The teen will still need to remember to bring the remote microphone, but will not require any other equipment, and there is nothing to set up with this solution. Finally, “Mechanical” issues may be less significant, as there are fewer components than in a typical FM system. This means less to manage and less that can go wrong. Support would continue to be important, but the focus of the support could be more on using the system to optimize benefit, with less time needed for educating on how to use it or troubleshooting technical issues.

BRINGING REMOTE MICROPHONE USE OUTSIDE THE CLASSROOM

Literature on the use of remote microphone technology with children has largely focused on classroom and learning situations, and to a much lesser extent on use by pre-schoolers. As mentioned earlier, older children – even those who are regular users of this technology in the classroom – seldom use it in other situations than in the classroom. Yet anyone with hearing impairment is likely to encounter many situations where they may struggle to hear well. This is no less true for young people. The potential of remote microphone technology to overcome the effects of distance, reverberation and background noise are just as meaningful outside the classroom as inside. In addition, remote microphones such as the ReSound Multi Mic offer extra functionality and connectivity that increases the usefulness of these devices even further. Because of the advantages discussed in overcoming the objections of tweens and teens to use of remote microphone technology, the ReSound solution is also uniquely positioned to promote use of remote microphones in many situations outside of school.

A barrier to encouraging broad use of remote microphones, as well as wireless connectivity capability in general, may simply be lack of awareness that the possibility exists. Young people are generally considered to be tech-savvy, and knowledgeable about what is happening in the technology sphere, but is this true where hearing aids and wireless connectivity are concerned?

TEENS' AWARENESS OF WIRELESS TECHNOLOGY

Athalye and colleagues²¹ explored the views of teens on wireless technology. All were regular users of hearing aids or cochlear implants. Citing the known lower acceptance of hearing aids in this age group, the investigators questioned the extent of teens' awareness of wireless technology and wondered whether its availability might make hearing aids more acceptable.

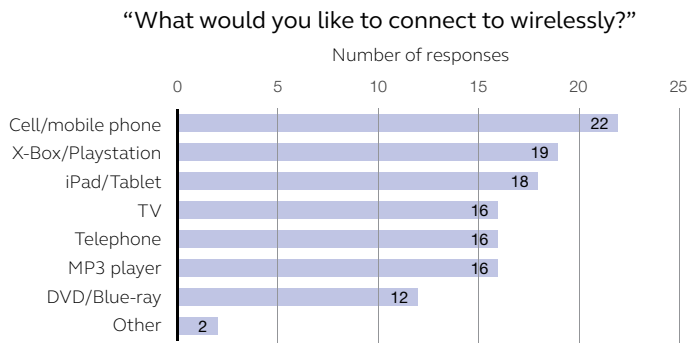


Figure 3. Responses to the question “What would you like to connect to wirelessly?” Multiple answers were possible.

Forty-five participants aged 10 to 25 years responded to a survey with both closed and open-ended questions probing their awareness of wireless technology as well as their views on how it is or could be used. The most commonly used wireless assistive device was reported to be an FM system. Surprisingly, however, more than half responded that they were not aware of wireless technology or not sure about it: “A wireless hearing aid or cochlear implant or bone anchored hearing aid is one that can connect to TV, mobile, MP3 player, iPad etc directly without any wires using Bluetooth or similar technology. Did you know about this?” The investigators interpret this finding to indicate that the participants simply did not know what wireless technology was. There was also a tendency to discriminate

between ability to connect to an FM system, and “wireless”, even though FM systems are in fact also a wireless technology.

Despite this lack of awareness, 96% of the participants agreed that wireless connectivity as defined in the question above would be helpful, and mostly agreed on what they would like to connect their hearing devices to. As shown in Figure 3, mobile phones were most commonly indicated, followed by video gaming systems and tablets. Telephones, TV and digital music players were also mentioned frequently.

As mentioned, FM systems were the most frequently used wireless assistive device used by these participants. The open-ended responses of 11 young people in this category were evenly divided between those who found it useful and those who found it not of benefit – or irritating. In the open-ended questions, the participants described their likes and dislikes with this type of system. Examples include:

“I use [FM] because it’s easier for me to help with, what teacher is talking. I like it, it helps me to hear the works, maybe fully understand what they are saying, what to do.”

“It is really helpful and I can hear a lot more at school, however it breaks a lot and at the moment the screen doesn’t come up.”

Some participants had both FM capability and digital wireless connectivity in their hearing aids/implants, and articulated a preference for the digital wireless functionality:

“The [FM] is annoying but the mini microphone is good, it’s less obvious, it blends in.”

“I use my microphone a lot.”

“The Phone Clip is really good because you don’t have to mess around with any headphones or wires and it sounds so much clearer, the music or film I am watching sounds clearer.”

Statements like these illustrate what young people value in wireless systems, including physical appearance, sound quality and ease of use. These comments are consistent with a study where students chose one of four FM systems⁷. Based on their reasons for the choice, the authors believed that the students were most influenced by the system’s appearance, sound quality, and user friendliness.

The survey results show that young people understand some of the benefits of wireless connectivity and that it means greater flexibility for them. Although there is a clear interest in wireless technology in this age group, little knowledge or awareness of its use was demonstrated. The authors highlighted a need for increased awareness, education and information about wireless technology, using communication methods used by today’s teenagers and young people.

EVIDENCE OF BENEFIT IN THE LAB AND THE REAL WORLD

It has been demonstrated that laboratory benefit of digital wireless remote microphones is equivalent to that provided by FM systems¹². But what about more realistic situations? And how would teens and their families perceive and accept such a device? One novel study sought to explore these questions for teens with mild to severe sensorineural hearing loss²². Speech recognition in noise measures in structured speech recognition tasks and subjective evaluation during typical teen activities in a camp setting were the outcome measures.

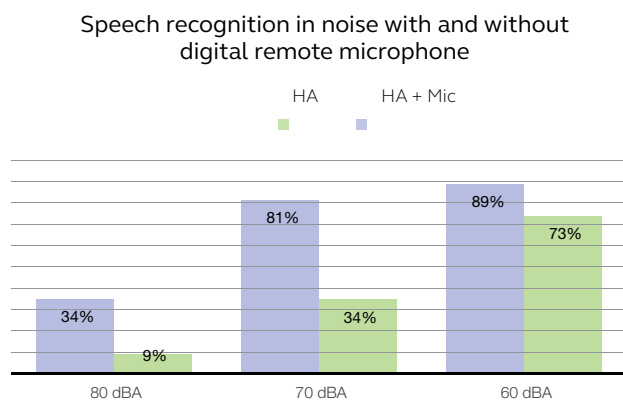


Figure 4. Speech recognition in 3 background noise levels with and without using a digital remote microphone with the hearing aids.

Nine teens aged 12 to 18 who wore hearing aids and were experienced using FM technology participated with their parents. For the study, they were fit with ReSound Up* hearing aids, and outfitted with ReSound Mini Mics. The Mini Mic is a forerunner to the ReSound Multi Mic and Micro Mic, sharing the same 2.4 GHz technology but with fewer auxiliary features and no directional microphone. Their speech recognition in varying background noise levels was tested in the lab, using the hearing aids alone and using the hearing aids in combination with the Mini Mic. When the Mini Mic was used, it was suspended in front of the speaker from which speech was presented, and streamed the sound to the hearing aids worn by the teen. As shown in Figure 4, performance was in all cases worse with increasing noise level. However, the addition of the Mini Mic augmented performance in all cases, including the high noise condition.

For the real-world subjective evaluation, participants were asked to wear the hearing aids and to use the remote microphones all weekend during all the camp activities. When possible, the microphone was placed on the person giving instructions or on the parent/sibling during mealtime. The camp activities included low-ropes course, archery, rock-wall climbing, fishing, a cookout, and hiking. There were also six “Olympic Games” that were designed to emphasize the benefit of the remote microphone. The games typically included a task to complete without the microphone and then with the microphone. The participants and their parents were asked to provide feedback about the Mini Mic following the activities.

In general, the positive comments outweighed the negative comments. One teen commented “it was better than my other FM system” and another said “without the microphone I had to really focus on the speaker to understand them.” Parents had comments like “I can speak softer with the microphone and he hears” and “no repetition, clear directions, clear understanding with microphone.” An overall camp evaluation was conducted prior to departure. The use of the Mini Mic during the Olympic activities was rated as “helpful”

* ReSound UP is a pediatric hearing aid available in some markets. It is equivalent to the ReSound Verso, which is available worldwide.



or “very helpful.” When asked to identify the aspects of camp that were most useful, the comments were primarily about the microphone and included “using the microphone in camp activities like rock climbing,” “working with the microphones,” and “playing the game with the mic.” These subjective reports also provide significant support for the use of the Mini Mic in a variety of situations where use of remote microphone technology is not common. This study further suggested that, given the simplicity of operation and the audio input connection, the Mini Mic may be particularly attractive to the teen who wants to listen to music, talk on the phone, or play video games with audio input to both ears.

SUMMARY

Hearing aid wearers can benefit from using remote microphone technology together with their hearing aids in difficult listening conditions. The potential benefit is particularly meaningful for children. Schoolchildren are the most frequent users of remote microphone technology in the form of FM systems. However, compliance in usage tends to decrease as students approach their teens, and usage is primarily confined to academic settings. Children have a variety of reasons for resisting use of FM systems as they grow older, many of which can be solved or mitigated by the use of digital remote microphones such as the ReSound Multi Mic and Micro Mic together with ReSound wireless hearing instruments. There may be a great lack of awareness in this population about the attractive solutions that exist in this realm.

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