

Extend your clients' hearing with the ReSound Multi Mic and Micro Mic

Neil Wright, AuD

ABSTRACT

Amplification is well-proven to be beneficial for improving both communication and quality of life. Although advances in noise reduction technology have resulted in modest increases in satisfaction with hearing aids in noisy environments, hearing aid users may still struggle in such situations. Poor signal-to-noise ratio is not the only issue. Every-day, real-world communication often involves situations where visual cues are limited or non-existent. This white paper discusses how the ReSound Multi Mic and Micro Mic use the ReSound proprietary 2.4 GHz wireless connectivity to increase the utility of ReSound wireless hearing aids in many everyday situations. These versatile accessories provide added benefit in many daily environments, and are especially beneficial in the numerous non-face-to-face communication situations met by all hearing aid users.

HEARING AIDS MAKE LIFE BETTER

Hearing aid satisfaction is at an all-time high. Over the past 15 years, overall client satisfaction with hearing aids, regardless of the current age of the hearing aid, has increased from 55% in 2000¹ to 81% in 2014². When considering only satisfaction with technology acquired within 4 years of the survey date, satisfaction increases from 59% in 2000 to 85% in 2014. And those with hearing aids less than a year old report a 91% overall² satisfaction rating now compared to just 63% in 2000¹. This increase in satisfaction could be attributed to the performance of hearing aids in one-on-one conversations or small groups where the highest rates of satisfaction are reported. When looking at the most recent survey data, 88% of individuals who wear hearing aids that are less than 5 years old report satisfaction with the instruments' performance in quiet, one-on-one situations².

As hearing aid satisfaction has increased, so has hearing aid usage. The most recent data from the MarkeTrak IX survey reports that hearing aid users are wearing their devices more consistently, with survey data showing a 9% drop in reported "Hearing aids in the drawer" since 2008²; down to just 3% of hearing aid users reporting they never wear their hearing aids. Beyond audiological benefits such as environmental sound awareness, increased ease of communication³, and decreased listening effort⁴, research has also shown that hearing impaired persons who pursue amplification report increased quality of life⁵, highlighted by hearing aid users being more likely to engage in social activities. Conversely, hearing-impaired clients who do not pursue amplification have been shown to report a lower quality of life, due to increased social isolation and increased communication difficulty⁶. In addition, recent studies have shown an association between hearing loss and cognitive decline⁷.

RESOUND MICRO MIC



Actual size

RESOUND MULTI MIC



NOISE IS STILL AN ISSUE

There is no doubt that amplification is hugely beneficial for those with hearing impairment. Nevertheless, there are still situations where hearing aid users struggle. Noisy environments have consistently dogged hearing aid users. Compared to 2008 survey results, hearing aid users in 2014 reported only a modest 6% increase in satisfaction in noisy environments. There is widespread availability of hearing aids with features intended to solve listening in noise issues. Why then is it the case that hearing aid users still struggle? It is not due to lack of research; poor signal-to-noise ratio

ReSound



rediscover hearing

environments, such as restaurants, have traditionally been a focus of research. And it is not due to ineffective advances in technology; directional microphone technology in particular has been proven to improve signal-to-noise ratio in noisy situations⁸. Consider, however, that in many everyday, real-world environments, poor signal-to-noise ratio is not the only issue. Much daily communication takes place in situations where visual cues are limited or non-existent, from driving in a car to going to places of worship to large groups in a crowded restaurant.

Under normal circumstances, spatial noise reduction technology within hearing aids utilizes directional microphones to emphasize speech sounds that are located in front of the wearer. While this is proven to be quite effective in decreasing the noise level and thereby increasing the signal-to-noise ratio, there are times when the person that is in front of the hearing aid wearer is not the person of interest. This is exemplified in the car scenario, where the person of interest may be to the left, right, or even behind the hearing aid wearer. Other speech enhancement and noise reduction technology can cut out sound around by attempting to focus on the loudest speech source around the wearer. Many of us have friends who talk louder (or softer) than others and the loudest person is not always the wearer's focus. This is not the fault of the hearing aid; this is how they have been designed, and in many noisy situations these technologies can prove incredibly beneficial. However, there are certain situations, such as the car mentioned above, where this is not the case. In scenarios such as these, the hearing-impaired client needs added control to focus on a speaker or speakers of interest.

BUT NOISE DOESN'T EXPLAIN EVERYTHING

Noise is not the sole issue hindering hearing aid wearers in these non-face-to-face listening environments. Reverberation is another speech distortion which can lead to decreased speech understanding. Places of worship, such as churches or synagogues, are prime examples. Excellent for long musical chords, the acoustics are less forgiving to speech signals, which rely heavily on softer, faster auditory cues that are critical for understanding. In this scenario, the speaker of interest can also be several meters away, and may not be providing adequate visual cues when presiding over a service. In reverberant situations, clients will benefit from increased direct auditory signal and a reduction in the reverberant tail, which can blend speech cues ultimately hindering speech clarity.

Both noisy and reverberant environments provide unique challenges to a hearing aid user. Sometimes the challenges of noisy and reverberant environments can be augmented by visual speech cues like speechreading. For both normal-hearing and hearing-impaired persons speechreading and visual cues have been shown to aid in speech understanding even in noisy environments.

THE IMPORTANCE OF VISUAL CUES

Understanding conversations in real-world noisy environments can be difficult if you are relying solely on auditory cues regardless of whether or not you have hearing impairment.

Visual cues have long been proven to provide additional benefit. Also known as speechreading, visual cues refers to being able to observe mouth, jaw and tongue movements to augment auditory information. In broader terms, things like facial expressions and gestures also help spread the effort of understanding across both auditory and visual domains and ultimately make it easier to "fill in the blanks". For hearing impaired listeners, the availability of visual cues have been shown to directly translate into increased performance in noise, contributing to their ability to perceive speech in higher levels of noise than without the visual cues. According to previous research, visual cues, specifically speechreading, can provide a 4-6 dB speech-to-noise ratio improvement in understanding in listeners^{9,10}. This may not sound like much, but in noisy environments, this translates to a significant behavioral impact. According to Summerfield, for each dB the speech-to-noise ratio increases sentence intelligibility by 10-15%¹⁰. The problem in non-face-to-face communication situations is that hearing-impaired clients are immediately at a disadvantage without the visual cues.

Noisy, reverberant and non-face-to-face communication environments are constantly in flux and unpredictable, and in many of these situations an individual's utilization of good communication strategies and high-quality hearing aids may not be enough. For these difficult listening situations, hearing aid users will require increased versatility and adaptability of their hearing instruments. At the same time, they will need something that can be integrated with their hearing aids that gives them increased control over the auditory input they receive, yielding the best results in multiple situations while remaining non-obtrusive to the hearing aid user or the target speaker(s). Finally, ease of use remains paramount, so that hearing aid users can make the most of the incoming signal.

INTRODUCING MULTI MIC AND MICRO MIC

So the question that falls to us is: how do we replicate the benefit of visual cues? While we can't replicate the visual cues themselves, we can replicate the benefit by increasing signal-to-noise ratio (SNR). Research done with ReSound's Mini Microphone has shown to give an added 9 dB SNR benefit when combined with hearing instrument microphones compared to the hearing aid microphones in directional mode alone. The SNR increased to 11 dB without the hearing aid microphones active¹¹. Even at longer distances, the Mini Mic remote microphone was able to sustain high speech recognition scores in noisy environments.

To accommodate the demands of the most difficult situations, ReSound has developed the Multi Mic and Micro Mic remote microphones. Like the Mini Microphone, these devices use ReSound's 2.4 GHz wireless technology to stream sound to any ReSound digital wireless hearing aids. Taking things a step further, they expand on the SNR-boosting advantage demonstrated with Mini Microphone by utilizing on-board directional microphone technology to reduce the incoming background noise and emphasize the speech of the target speaker. By building the microphones with wearable usage in mind, the updated design has one upward facing microphone to capture the speech of the target speaker as well as an outward facing microphone to capture and reduce

the background noise. With the addition of the directional microphone, an additional 5 dB SNR benefit compared to the ReSound Mini Microphone has been observed.

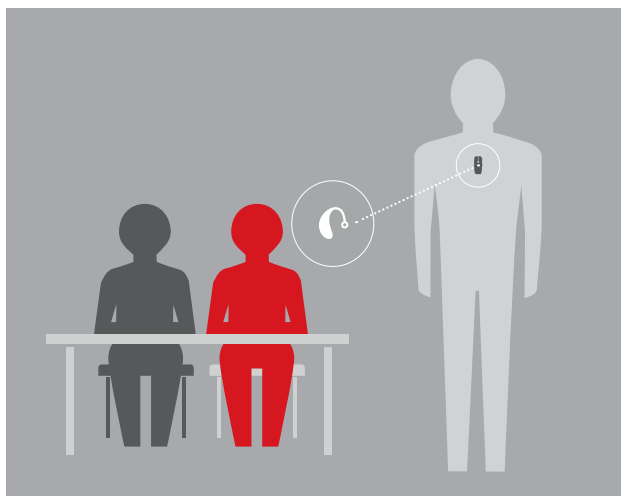


Figure 1. The Multi Mic and Micro Mic both provide a directional microphone response when worn by the person speaking and the ambient noise level is relatively high. This helps capture the voice of the talker without picking up too much background noise.

INCREASED FUNCTIONALITY FOR GROUPS

Sometimes the target speaker is actually multiple speakers. Large groups are another key listening environment where hearing aid user satisfaction needs to improve. The Multi Mic comes with a built-in accelerometer that automatically changes the directional microphone into an omnidirectional table microphone. The client simply places the Multi Mic in the center of the table and the microphone settings adjust to emphasize the speech coming in from all around the table. This will help to emphasize what is being said around the table, allowing the user to have access to the full conversation and the freedom to choose who to attend to. The hearing aid user does not need to change settings manually; the Multi Mic will automatically switch into the table microphone mode when placed horizontally on the table.

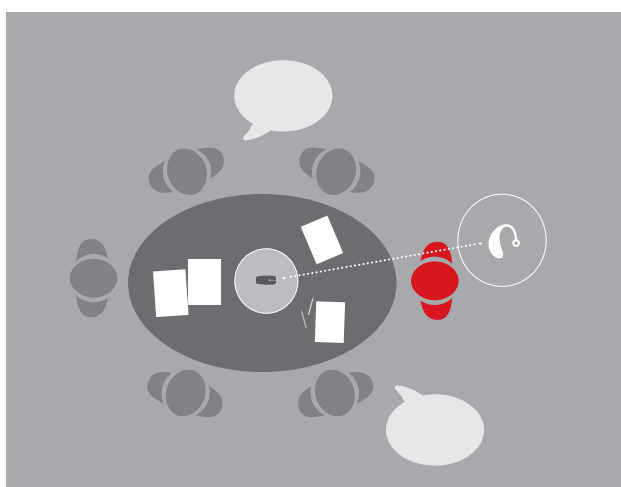


Figure 2. When placed on a horizontal surface, the Multi Mic provides an omnidirectional microphone response. This allows the voices of multiple talkers to be picked up and streamed to the user's ReSound wireless hearing aids.

INCREASED CONNECTIVITY FOR DIFFERENT ENVIRONMENTS

Certain environments require versatility from the hearing aids to ensure that the client receives the best possible sound quality and speech clarity. The Multi Mic provides increased versatility by increasing the number of ways that the client can connect to the sound environment around them. The Multi Mic will retain the 3.5 mm audio out jack available in the original Mini Microphone, and introduces two new connectivity options: telecoil (or T-coil) and an FM receiver port. The 3.5 mm audio out jack provides the same plug-and-play functionality as the original Mini Microphone, allowing for seamless, simple streaming of audio using ReSound's 2.4 GHz-based wireless connectivity.

One improvement to noisy and reverberant environments that has been gaining steam throughout the United States in recent years is the hearing loop system. Hearing loops can provide direct audio input from a microphone system to hearing aids or any other type of receiver equipped with a T-coil. A technology that has been around for decades and is widely used in many countries, loop installations are gaining popularity in the US in places of worship, playhouses, and movie theatres. This can help the wearer hear better in such environments by bringing the audio directly to the hearing aids and decreasing or completely blocking out other auditory inputs. However, T-coils have proven an issue with the miniaturization of hearing aids in recent years. A smaller device may mean making sacrifices in functionality or versatility in the name of reduced size. With the added T-coil function in the new Multi Mic, clients no longer have to sacrifice form for function. The built in T-coil allows for wearers whose hearing aids were built without a T-coil but with digital wireless capability to utilize the benefits. Because hearing aids that physically have a T-coil may not have it actively programmed, users of Multi Mic can also access loop systems even if this need was not anticipated by their hearing care professional. The user simply switches the Multi Mic to the T-coil mode and clips it on his or her shirt to quickly and effortlessly tune in to the hearing loop system. As an additional benefit, the user can place the Multi Mic in the most optimum spot for T-coil reception within the loop, move away from that spot, and still receive a clear signal via the long-reaching ReSound 2.4 GHz wireless connectivity.

The other addition to the Multi Mic's connectivity palette is the built-in Direct Audio Input (DAI) port. The most common DAIs are FM systems, which are commonly used in schools to provide hearing-impaired students access to the teacher's voice even when the teacher is behind or away from the student. FM systems have conventionally been used in the classroom because of their compatibility across hearing instrument manufacturers, their mobility – so students can take the systems with them to other classrooms – and because FM was the best, most reliable technology available to transmit sound wirelessly over distance directly to hearing instruments. However, FM systems do have drawbacks. FM receivers have to be booted in to Behind-The-Ear hearing aids, making them increasingly bulky for the wearer and are typically not compatible with custom in-the-ear products. Further, each hearing aid requires its own FM receiver, mak-

ing connectivity increasingly costly. And obviously, each individual student also requires their own FM receivers to pick up the signal. The Multi Mic's DAI port provides access to FM systems for all styles of ReSound hearing aids with digital wireless technology and only requires a single FM receiver rather than one for each hearing aid. The FM signal is transmitted to the receiver plugged into the Multi Mic, which streams the signal to the hearing aids. Since the FM receiver plugs into the Multi Mic, the hearing aids are free of bulk and still receive bilateral FM streaming. In addition, multiple students wearing digital wireless ReSound hearing aids can pair to and receive the signal from the same Multi Mic.

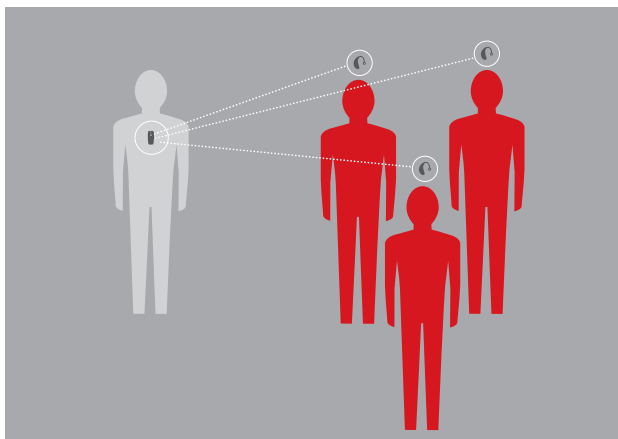


Figure 3. Both the Multi Mic and Micro Mic can stream to multiple wearers of ReSound wireless hearing aids simultaneously.

ADDITIONAL CONTROL WITH APPS

Integrating the Multi Mic and Micro Mic with either the ReSound Control or Smart apps can maximize user satisfaction and utility. Both apps provide users with personal control over the volume settings in each hearing aid for both the Multi Mic and Micro Mic and the hearing aid microphones. Each hearing aid will have an individual adjustable volume setting for the hearing aid microphones and the streaming accessories, including a mute function for each input. This can prove valuable in some of the most difficult listening environments, such as the car, when turning down or muting the hearing aid microphone closest to an open window could prove the difference. The simple user interface allows for easy switching between hearing aid programs and the Multi Mic and Micro Mic, and with the Smart app, preferred settings specifically for use with the Multi Mic or Micro Mic can be saved.

FUNCTIONALITY AND SIMPLICITY: THE MICRO MIC

For hearing aid users that are looking for the smallest, simplest, most discreet remote microphone to complement their hearing aids, the Micro Mic meets these demands. The Micro Mic works well in difficult, non-face-to-face communication environments, such as the car or in a noisy restaurant, using the same microphone and digital wireless technology as the Multi Mic. The Micro Mic will provide the same signal-to-noise ratio benefit in a smaller, simpler package for users who do not need or want the added features of the Multi Mic.

SUMMARY

With the Multi Mic and Micro Mic, ReSound is building off the strides that hearing aids have made in recent years and providing added benefit in some of the toughest listening situations, specifically addressing non-face-to-face communication. The Multi Mic will add functionality and connectivity to maximize audibility in an increased number of environments where visual cues are limited and access to the highest quality sound is paramount. In the Micro Mic, the user can choose form and function in the smaller design and still benefit from the increased signal-to-noise ratio and noise reduction from the on board directional microphones. All-in-all, the Multi Mic and Micro Mic provide hearing aid users with the functionality and connectivity to facilitate communication even in the hardest listening environments, keeping users connected to the conversation when other cues fail.

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**RESOUND
NORTH AMERICA**

8001 Bloomington Freeway
Bloomington, MN 55420
1-800-735-4327
resoundpro.com

**RESOUND
GOVERNMENT SERVICES**

8001 Bloomington Freeway
Bloomington, MN 55420
1-800-392-9932
resoundgov.com

**RESOUND
CANADA**

303 Supertest Road
Toronto, Ontario M3J 2M4
1-888-737-6863
resoundpro.com

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