The Third Ear

Personal FM Systems for Adults

You can never revisit the FM system listening technology too often. FM systems have been used with children with hearing loss in classrooms for more than 40 years and have long since proven their value in the auditory/verbal education of these children. But, what about for adults?

By Mark Ross

A personal FM assistive listening system is basically a short-range FM radio station. In its usual operation, it involves a person talking into a microphone/transmitter which then "broadcasts" the FM signal to a "radio" receiver used by the *listener*.

The use and acceptance of FM systems by adults has been sporadic, at best. While there have been a number of studies proving that FM systems can significantly improve speech perception in noisy places, the adoption rate, even among people who heard much better with the system during the study, has been abysmally low (except among some Department of Veterans Affairs subjects, who received the units at no charge).

Usually FM systems are seen as too inconvenient and too expensive. Although I have written on this topic on a number of previous occasions, it is one that is worthwhile revisiting, for two reasons:

One is that new technical developments do continue to occur, and, the second, most important reason is that the potential hearing benefits of a properly-employed FM system are as pertinent now as they were 40 years ago.

Advantages of a Third Ear

The underlying acoustical reason an FM system is beneficial is also shared by the other two types of assistive listening devices, infrared (IR) and induction loop (IL) systems. By transmitting a sound signal directly from the source to a listener, the effects of the acoustical space (distance, noise, and reverberation) between the source (loudspeaker, talker) and the listener is bypassed. While moderately poor acoustical conditions may be tolerable to normally hearing people, individuals with hearing loss are disproportionately affected by these acoustical degradations. It doesn't take much noise or reverberation to render a speech message virtually unintelligible for people with hearing loss.

Essentially, what all of these systems do is increase the speech-to-noise ratio (SNR), perhaps the most important factor underlying speech intelligibility that there is. In the case of a personal FM system, the SNR is considerably enhanced by locating the microphone close to a talker's mouth (or other sound source, such as a TV set).

A personal FM system offers listening options not possible with the other two types of ALDs (e.g., at a reception, in an automobile, a noisy restaurant, at a lecture or seminar, etc.). I call it a "third ear," one that can be detached at will and placed close to the desired sound source, thus increasing the level of the signal relative to background sounds.

The Challenges

In listening to speech, the SNR advantage produced by locating the FM microphone close to the lips is indisputable. However, going back some forty years when we first started using these systems with children, we noted a major problem, one that we are still confronted with today. While the children could hear the teacher very well, they could not hear themselves or the other children when they spoke. The FM systems in those days did not contain an environmental microphone, nor were the signals from the FM receiver directed to a personal hearing aid (earphones were used instead). From a therapeutic point of view, this was an untenable situation; to learn speech as well as possible; the children had to hear themselves.

While this situation was soon corrected, i.e., environmental microphones were now included in the body-worn FM receivers, the question remained: how to set the proper relationship between the sound level being heard via the FM microphone and that emanating from the environmental microphones. The challenge facing clinicians and consumers is to set the degree of amplification (the gain) of the environmental microphone high enough to serve its primary intended purpose, i.e., auditory self-monitoring and awareness of incidental sounds, but not so high that it obscures the desired signal arriving via the FM microphone.

This situation with children, however, is not necessarily true for an adult using an FM system. For adults, the signals arriving via the environmental microphones are less important. When adults use a personal FM system, they are focusing on hearing the signals arriving via the FM microphone rather than the hearing aid or cochlear implant microphones. And auditory self-monitoring is not much of an issue for them. Nevertheless, some environmental awareness is still desirable, although the signal arriving via the FM system must still be the dominant one. An FM advantage of +10 dB over the environmental sounds appears to be the generally recommended figure, although this can be adjusted upward or downward depending upon one's personal preference (personally, I prefer more).

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Automatic Signal Adjustment

This general setting of a +10 dB advantage should be appropriate in a fairly quiet situation, since it will ensure that the desired signal (via the FM) is clearly more audible than the background sound. But the situation will change as the level of the background sound increases. As it increases, the FM advantage will disappear since the amplified sounds arriving via the environmental microphone will begin to obscure those coming from the FM microphone. In this scenario, it would be helpful if a user could increase the volume of the FM signal only, thus preserving a positive SNR. While this is possible on body-worn FM receivers—these usually include volume controls—it is not possible if the FM receivers are incorporated within the hearing aid itself or within a mini-receiver plugged into the base

continued on page 18

The Third Ear *cont. from page 17*

of a behind-the-ear (BTE) hearing aid. Manually changing just the FM volume is not possible with these receivers. Therefore it would seem helpful if there was some way to automatically adjust the level of the FM signal as the background noise level changes. Recently, the Phonak Company introduced the Dynamic (or Adaptive) FM system to do just this.

In the Dynamic FM system, the volume level is adaptively and automatically changed as the environmental noise at the FM microphone exceeds 57 dB SPL. Once the environmental sounds exceed this point, the transmitter signals the receiver to increase the gain, thus preserving the FM advantage. Increases of up to 24 dB are possible. If the background sounds decrease, the FM gain will decrease accordingly. Once the noise is below 57 dB again, the system will resume the +10 dB advantage.

Theoretically, this appears to be a useful feature, particularly in situations where the background sounds continually vary in loudness. But unlike a number of other newly introduced hearing aid features, which sound very good theoretically, the merit of this one has been tested clinically on human subjects in two well-designed studies. One of these studies compared fixed and Dynamic FM performance for hearing aid users, while the other made the same comparison with cochlear implant recipients.

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Lise Hamlin, HLAA Public Policy Director, demonstrates an FM system to HLAA volunteer Linda Katz.

Excessive Price Tag

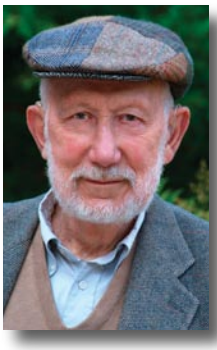
But now we come to a major reason why, in my judgment, adults have not eagerly adopted FM systems. In spite of the fact that the listening benefits have been proven time and again since their introduction in the late 1960s, and perhaps even more now with the adaptive feature, their cost is often seen as prohibitive.

The cost/benefit ratio just doesn't work for many people, at least for the systems marketed by the major manufacturers. For example, the Dynamic system described above will cost a consumer about $3,500 for two FM receivers and an FM microphone/transmitter, and this does not include the cost of late model hearing aids. This cost is too big a hurdle for people to overcome, regardless of the potential hearing benefits. There are some low-cost alternatives (which, to be fair, consumers and their audiologists have not exactly rushed to adopt either). While these may not provide the same degree of hearing benefit the Dynamic FM can, they can still be quite helpful in many types of situations.

Two of these alternatives are particularly interesting: the **Conversor** (made in England) and the **Hearit All** made by Phonic Ear in California. Both of these systems include a directional, hand-held FM microphone/transmitter and an FM receiver that is suspended around a user's neck. The signal from the receiver is transmitted via the neckloop to telecoils within the hearing aids (another good reason for telecoils!).

There is a volume control on the receiver that can be used to increase the gain in noisy places (replicating, albeit not very conveniently, the adaptive function). It used to be that the downside to using such devices was the necessity of wearing a visible receiver around one's neck; nowadays, however, with people suspending all kinds of devices around their necks, I don't think this reason is as pertinent anymore. Probably the more salient reason is that using an FM system requires consumers to "advertise" the reality of their hearing loss and the fact that they require hearing help.

For some people this is just too big a hurdle to manage. But I'm convinced that many more people with hearing loss would at least try an FM system if these systems were strongly recommended by a trusted audiologist, one who would then guide them in taking the first steps that could demonstrate their effectiveness. In short, for people with two bad ears, it can be very helpful to have a "third ear" in reserve—a personal FM system. HLM



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