Telecoils are about more than telephones

By Mark Ross

When Sam Lybarger labeled the small induction coil he used to access the magnetic leakage from telephones a "telecoil," he could not have foreseen that the ramifications of that decision would be bedeviling us some 60 years later.

In 1947, his decision made perfect sense and, when used with telephones, the term "telecoil" still makes perfect sense. But, as can be seen from the two companion articles relating to telecoils in this issue (by David Myers and William Diles), these little structures can provide auditory access to much more than telephones. As these articles demonstrate, telecoils are being employed to hear auditory signals in a wide variety of situations.

Yet, the hearing aid dispenser typically makes a decision about the need for a telecoil *only* on the basis of telephone usage. If a patient does not require a telecoil for this purpose, the hearing professional is unlikely to recommend one. But if we could change that mindset and make it known that these little coils are also effective and convenient receivers for assistive listening devices (ALDs), then their potential benefits could be fully realized in the U.S., as they have been in some other countries. This will be the focus of this article.

> *"...what hearing-impaired persons hear through their telecoils is just as important as what they hear via the microphone..."*

DESCRIPTION OF A TELECOIL

A telecoil consists of a metal rod encircled by many turns of a copper wire. When the telecoil is placed in a varying magnetic field, an alternating electrical current is "induced" in the copper wire. That is, when the magnetic field cuts across the wire, it creates a tiny electrical current in the wire. This happens because the coil converts the magnetic field into electrical energy, much as a microphone converts sound waves into electrical energy. And, in the same way that the electrical current created by a microphone retains the original speech information, albeit coded differently, so does the electrical current created by the alternating magnetic field.

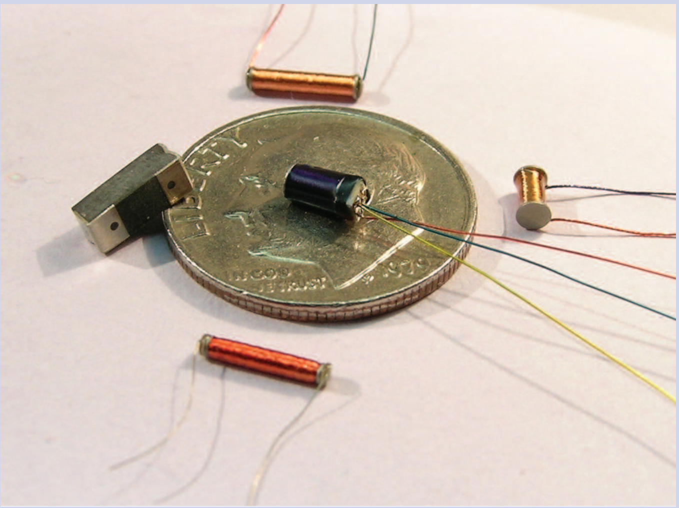

Figure 1. *Examples of current telecoils. Note that the amplified and passive telecoils are about the same size (courtesy of Tibbetts Industries).*

Generally, the strength of the inductive pick-up is determined by the number of turns of the copper wire around the metal axis rod. Longer rods permit more turns and thus more powerful telephone coils. Newer telecoils include an integrated amplifier, which makes it feasible to reduce the physical size of the coil and still operate effectively. Still, the smaller the hearing aid, the less room there is for a telecoil, and thus they are very rarely found in the smallest (completely-in-the-canal) aids (and often not needed for telephone communication, since acoustical coupling may be satisfactory). Some examples of telecoils can be seen in Figure 1.

When a hearing aid is switched to the "T" position, the hearing aid will detect only an electromagnetic field. The strength of the electrical current "induced" in the telecoil by the electromagnetic field is proportional not only to the number of turns of wires, but also to the energy in the magnetic field and to the relative positions of the telecoil and the magnetic field.

This latter consideration is particularly important. In some positions, little or no electrical current will be created in the induction coil. The magnetic field will simply pass through the coil without producing much, if any, electrical current. This is why experienced hearing aid users always experiment with the positioning of their hearing aid when using an unfamiliar telephone: to find the "hot spot" where the strongest signal from the telephone is induced in the telecoil.

We know that during telephone usage the best signal will be induced in a telecoil when the coil is horizontal relative to the faceplate of the telephone receiver. On the other hand, for listening through a loop system, the best reception occurs when the coil is vertically aligned within the hearing aid. Figures 2 and 3 illustrate these points.

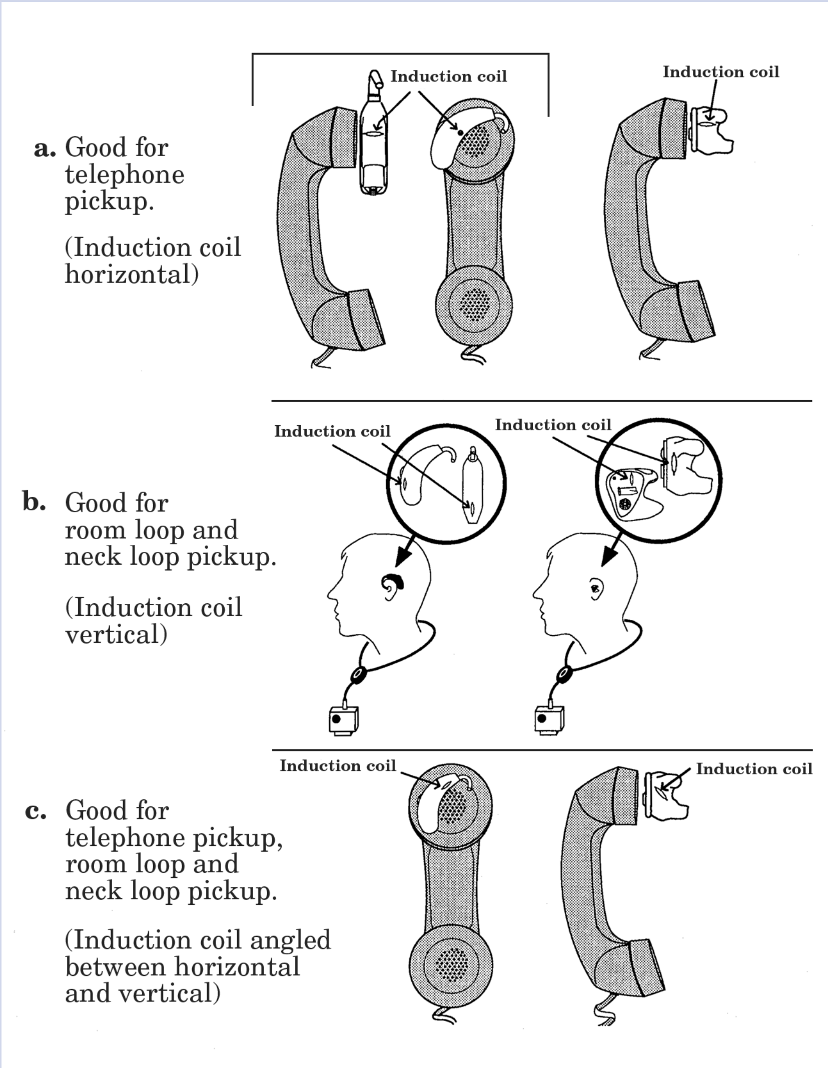

Figure 2. *Appropriate telecoil positioning for best results with a telephone and a neckloop (courtesy of David Preves).*

In both these examples, the same principle applies: In the optimum position, the magnetic field cuts across the maximum number of turns of wire. And, in both instances, the real world complicates matters. The best physical positioning for telephone communication is the poorest position for reception of the magnetic signals emanating from a loop (either a neckloop or a floor loop) and vice-versa.

Complicating this situation is that audiologists and hearing instrument specialists generally do not know precisely how a telecoil is positioned within the hearing aid. From what I understand, the telecoil in many BTE aids is often angled so as to provide acceptable, albeit not optimal, reception in both modes. The specific position of telecoils in ear-level hearing aids is more uncertain, depending on the size of the hearing aid and the room available within the shell. Insofar as telephone communication is concerned, there is no substitute for personal experimentation by the consumer.

T-COIL RESPONSE CHANGES

Hearing professionals have invested a great deal of thought and effort in ensuring that a hearing aid provides an appropriately amplified signal for a client. Scores of articles, books, chapters, etc., have been published on the precise electroacoustic target appropriate for people with varying configurations of hearing losses. While there is little professional consensus on what the precise frequency response should be, it is generally agreed that there are relevant targets.

But as soon as a hearing aid user switches the hearing aid to the "T" position, it seems that all bets are off.[1] The dispenser will have measured the microphone response of the hearing aid, perhaps with a hearing aid test box, a computer programmer, or a probe-tube microphone in the ear. Rarely, however, does a practitioner give this same careful verification to the telecoil response.

What seems to be overlooked is the simple fact that what hearing-impaired persons hear through their telecoils is just as important to them as what they hear via the microphone. Nobody consciously assumes that telephone listening is less relevant than listening through a microphone, yet this is frequently how practitioners behave.

The electroacoustic response of a hearing aid in the "T" position has rarely been clinically evaluated.[2] Overlooking the total response of a hearing aid when it is switched to the "T" position can be a problem for any hearing aid user. However, it may be particularly problematical when children use FM systems inductively coupled to their hearing aids. Fortunately, the advent of programmable hearing aids has made it easier to ensure that the frequency response of a hearing aid in the "T" position is similar to that obtained in the microphone position (Figure 4).

THE M/T POSITION

In the M/T position, the hearing aid will detect and amplify both acoustic and magnetic signals. Of course, when a hearing aid user is talking on the telephone, the M/T position is not used. An open microphone would defeat the purpose of using a telecoil in the first place (i.e., by producing feedback and perceptual interference from environmental sounds).

Initially, no hearing aid included the M/T option. But, in the 1960s, induction loop (IL) systems began to be widely employed in classrooms of hearing-impaired children. It soon became apparent that, while the IL system improved the children's reception of the teacher's voice since she used a microphone, the children could not hear themselves speak nor could they hear the other children, since their hearing aid microphones had been switched off.

Clearly, this was not good educational practice, and the need for an open hearing aid microphone became obvious. Soon

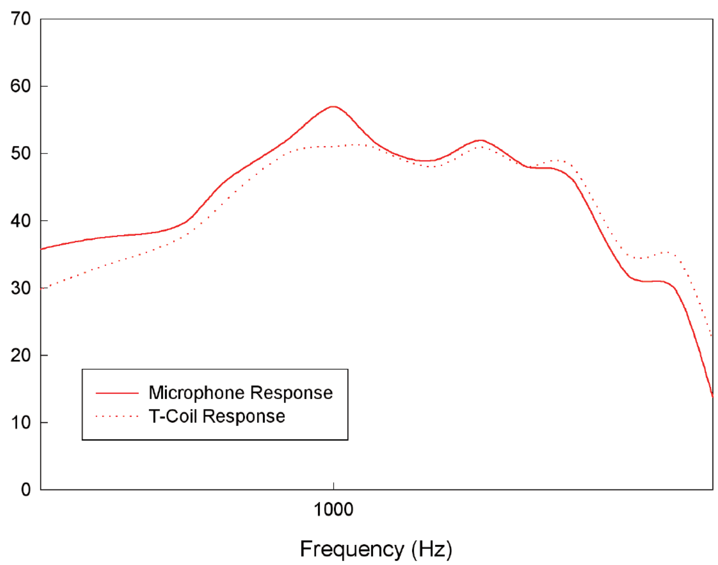

Figure 3. *Comparison of the telecoil and microphone responses of the same hearing aid.*

thereafter, manufacturers responded by making hearing aids that had an M/T position.

As FM systems replaced IL systems in classrooms, the M/T feature was again omitted from hearing aids. Now, as is evident from the Myers and Diles articles, we seem to have regressed to an earlier time (at least in this country; in some European countries, IL systems have been in continual use for over 50 years). Adults using an IL system find it convenient to hear speech directly (such as a spoken comment from a companion), rather than having to switch the hearing aid from the telecoil to the microphone position to hear the comment. Having M/T capability enables users to detect acoustic and magnetic signals simultaneously.

THE "TOUCHLESS TELECOIL" AND LOOP LISTENING

The introduction of the Touchless Telecoil in 1999 has been a great boon to some people who regularly use a telecoil to hear on the telephone.[3] It has simplified telephone usage for those who have difficulty switching to the T position. All a user needs to do is bring the telephone next to the hearing aid. This proximity engages a reed switch in the hearing aid that automatically switches it from the microphone to the telephone mode.

At first, the Touchless Telecoil did not allow a user to also access a loop, either a room or a neckloop, since the magnetic field around a loop could not activate the switching mechanism. However, within the last 2 years, in response to feedback from consumers, a manual override was devised and is now included in a number of hearing aid models using the Touchless Telecoil feature (or other, more recently introduced, features similar to the Touchless Telecoil).

A future possibility is the use of digital logic that would accomplish this switching automatically. It would combine the use of a far-field canceling (FFC) telecoil that would reject magnetic interference while automatically detecting telephone usage, switch to loop mode when sensing an appropriate uniform field, and then default to the microphone mode in the absence of either a telephone or loop system magnetic field.[4]

A "CATCH-22"

A common objection to routine inclusion of telecoils in hearing aids is that, except for telephones, there are few opportunities in our society to employ them. So, if a hearing aid wearer doesn't need a telecoil to use the telephone, the person is unlikely to be given one. But, if many more looped venues existed, there is little doubt that more hearing aid dispensers would recommend telecoils. But—and this is the "Catch-22"—as long as relatively few hearing aids contain telecoils, then public facilities and individuals have little incentive to install loops. The inclusion of one (either one) depends on the frequent presence of the other.

Fortunately, the situation is not quite as dire as the above may suggest. In fact, two surveys reported on in this issue of *The Hearing Journal* (on pages 7 and 42) indicate that approximately half of the hearing aids dispensed in 2005 contained telecoils, which is substantially more than the 30%-35% figure frequently cited.

Given this trend, any facility that provides an inductive loop (IL) system should have an audience prepared to take advantage of it. Furthermore, as Myers demonstrates in his article, if more public sites had IL systems, more hearing aid dispensers would begin recommending them and more consumers would ask for them.

THE TELECOIL AS ALD

It takes only a little reflection to appreciate the advantages of a telecoil over traditional FM or IR systems. As long as the consumer has his or her hearing aids on, the "receiver" for an assistive listening system (ALS) is always handy. It is not necessary to remove one's hearing aid or to borrow and return a receiver supplied by a facility. Furthermore, when using one's own hearing aids, a person can be assured that the system is working appropriately and that the hearing aid programming options are retained. All a consumer has to do is enter the looped facility and switch the hearing aids to the T position, or to M/T if simultaneous acoustic access is also desired. Nothing could be more convenient.

Ditto for public facilities, since they need not be concerned with the logistics of caring for and checking receivers in and out. Once a loop system is installed and tied to an existing PA system, the facility can ignore its presence (other than arranging for appropriate signage that announces the availability of a loop system). This is an advantage that facility managers will appreciate. Indeed, the reluctance of facility managers to install assistive listing systems (despite being required to do so by the Americans with Disabilities Act) often reflects their desire to avoid the problems involved in the logistics of caring for the receivers.

Installing an IL system, particularly in a large listening area, does involve complications and variables not found with an IR or FM system. The level of ambient electromagnetic interference (EMI) has to be assessed and the occurrence of magnetic overspill by the loop controlled. While it may be impossible to reduce or eliminate the former, the latter can be well controlled by installing either a cancellation loop or a phased array loop (as opposed to a simple perimeter loop).

A cancellation loop is a perimeter loop, but one arranged in a figure 8. Adjusting the size and shape of one end of this type of loop can markedly reduce magnetic spillover. A phased array loop, on the other hand, consists of two loop arrays overlaid on top of each other. Magnetic spillover is reduced by adjusting the precise relationship between the two arrays.[5]

The key consideration in selecting and installing an appropriate loop is to have a skilled installer available. It is this person's responsibility to ensure that the loop is inconspicuous, that the magnetic field is contained within the loop, that signal losses due to metal work are compensated for, and that field strength is relatively equal at all locations within the loop.

Information about knowledgeable installers can be obtained from vendors (listed on hearingloop.org). Or, as Diles points out, anyone with basic handyman skills and the ability to follow the simple instructions in his article can usually install a personal TV loop in a patient's home or office.

THE AUDIOCOIL

Suggesting that a telecoil be included in a hearing aid for purposes other than telephone usage often seems to produce cognitive dissonance. For some reason, many people find it difficult to accept that a "telecoil" can be used to access electromagnetic signals from various other sources as well.

By changing the label to something more general—my suggestion is "audiocoil"—we do not restrict to a single function the way we think of the coil. The ability to communicate on the phone without using inductive coupling would no longer preclude recommending an audiocoil.

In this instance, what would be most relevant would be the audiocoil's role as an assistive listening system receiver. Accessing telephones would be just another, albeit very important, function of the audiocoil. In brief, other than with CIC aids, there seems to be no down side to routinely including audiocoils in hearing aids.

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REFERENCES

1. Takahashi G: Programming the telecoil: A case study. *Sem Hear* 2005;26:109-113.
2. Ross M: Telecoils: Issues and relevancy. *Sem Hear* 2005;26:99-108.
3. Yanz JL, Preves D: Telecoils: Principles, pitfalls, fixes, and the future. *Sem Hear* 2002;24:71-80.
4. Marshall B: Personal communication, 2005.
5. Palm F: Personal communication, 2005.