# Telephone Communication for the Hearing Impaired: Methods and Equipment

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*Until recently, telephone communication by the severely or profoundly hearing impaired population received very little emphasis. Special procedures and equipment to assist the speech or hearing impaired individual exist but have not been adequately publicized. A review of the literature indicates that there are 4 approaches to telephone communication used by the hearing impaired person: [a] using an intermediary to help with the call, [b] using prearranged codes, [c] using teleprinter (TTY) equipment, [d] using residual hearing. In addition to the procedures, the hearing impaired person may benefit from special auditory, visual, or tactile equipment in conjunction with using the standard telephone. Specific equipment is described.*

Most of us take use of the telephone for granted. We pick up a telephone, dial a number, and use our speech and hearing to communicate. For speech or hearing impaired people, telephone communication is a challenge and a frustration. The severely or profoundly hearing impaired population needs special guidance in order to overcome the communication problems related to the use of a telephone.

There is little discussion of the various methods used by the hearing impaired population to achieve telephone communication (Castle, 1976a, 1976b, 1977a; Crammatte, 1968; Jamison, 1974; Leadership Training Program, 1966). The literature has focused primarily on equipment as a solution to the telephone usage problem (Bellefleur, 1976; Boothroyd, 1975; Flanagan, 1968; Gendel, 1974; Hughes, 1967; Jamison and Crandall, 1974; Nelson, 1970; Rupp, 1974; Smith, 1963, 1974; Smoski and Hoshiko, 1976; and Whitney; 1965). It is true that many hearing im-

paired people are unaware of the benefits derived from a hearing aid, certain telephone equipment, and other special devices in relation to their use of the telephone. However many audiologists, speech pathologists, and educators of the deaf are unaware of the various kinds of telephone communication problems encountered by the hearing impaired and possible solutions to those problems.

*Methods of Telephone Communication*

> To the deaf person, the telephone is a constant reminder of his handicap and of his dependence upon others for its use. It also stands as an invisible barrier to his vocational advancement, for he has found from sad experience, that in employment he is considered for promotion only to positions which do not require the use of the telephone (Mortensen, 1976, p. 32).

Until recently there was very little mention of the importance of telephone communication for the hearing impaired employee. The hearing impaired adult, out of necessity, has developed some strategies to deal with telephone communication problems. There are four approaches to telephone communication frequently used by the hearing impaired population. Depending on his needs and communication skills, a hearing impaired person may: (a) ask a third person to make the entire telephone call or to listen for the response only after he talks, (b) talk but listen for a prearranged code response, (c) use the teleprinter (Magsat, MCM, TTY, TV phone, etc.) equipment, or (d) talk and listen for himself.

*Involving a third person.* Crammatte (1968), in a study of 87 professionally employed deaf people, reports that inability to use the telephone is the major communication problem facing the deaf employee. The deaf employees in the study describe how they use a hearing intermediary to assist with telephone calls at work. Forty-six (53%) professionally employed deaf people report that the telephone is part of their job. Among this sample of 46 employees, eight (17%) ask a third person to make the telephone calls and do not become involved in the activity, 32 (70%) stay at the telephone with the third person to receive the information and relay the replies, and six (13%) use their own speech for the call with the third person relaying the replies. The deaf respondents explain that in order to succeed with the use of an intermediary, they must carefully prepare the content of the telephone message and be able to anticipate the replies of the third person who may relay the telephone message by orally repeating, fingerspelling, or writing the message as it is spoken. In addition, the respondents mention some of the problems that may occur when a third person is involved in the telephone conversation: (a)

unintentional omissions, confusions, or misunderstandings; (b) emotional feelings or reactions by the third person may not be transferred; (c) lack of privacy; and (d) the hearing impaired person is placed in a dependent position of asking others to do the telephoning.

*Code systems.* Another approach to telephone communication is the use of a visual or auditory code system if the hearing impaired person has intelligible speech (Leadership Training Program, 1966). A frequently used approach is with a "yes-no" code that depends on the phrasing of appropriate questions by the hearing impaired talker. The hearing impaired person initiates the call, controls the conversation, and has the responsibility for giving information and asking questions. The hearing person responds with a prearranged code. Typically, the conversation has a specific topic of discussion and is relatively brief. This approach is successful with family, friends, and business or professional contacts who know the hearing impaired individual. Also the yes-no code can be used for conversations with strangers. There are two problems however: (a) the questions must be phrased clearly and without ambiguity in order to be answered by a yes-no code, and (b) this type of code limits spontaneous interaction between both people, particularly by the hearing person.

In 1963, the Leadership Training Program at California State University at Northridge initiated a telephone training program in conjunction with use of a visual code indicator, the Speech Indicator. This portable device, the size of a cigarette package, is held next to the telephone handset while the deaf person asks questions that can be answered by a yes-no code. The deaf person watches for one, two, or three movements of the meter needle indicating "no," "yes-yes," or "please repeat" in response to the question. Unfortunately, this device is no longer available. Future availability will depend on the amount of interest from the hearing impaired community (Jones, 1977).

Code systems which do not require intelligible speech, such as the use of Morse code or special code arrangements with the Touch-Tone® telephone, can be used to send and receive information over the telephone (Flanagan, 1968; Nelson, 1970; Smith, 1965). These codes however, require training and practice before the transmission becomes relatively efficient. Using a code system often requires more time, patience, and perseverance than other communication forms.

*Teleprinter communication.* Within the past 10-15 years, a printed form of telephone communication gave the hearing impaired population the opportunity for unlimited interaction by telephone (Bellefleur, 1976). In 1964, Dr. Robert Weitbrecht, a deaf physicist, developed an acoustic modem/coupler that allows a teleprinter to transmit and receive typed information from one location to another through standard telephone lines. In order to be compatible with each other, teleprinters must use (a)

the five-bit Baudot code, (b) audio-tone frequencies of 1400 and 1800 Hertz, and (c) an audio-tone transmission rate at 45.5 bits per second. These machines run at speeds of up to 60 words per minute and are not directly compatible with computer terminals at present.

To communicate by teleprinter, one person dials the number of another person having compatible equipment, places the telephone in a special coupler, and waits for the other person to answer the telephone. The person answering places his telephone is a special coupler and begins typing. Simultaneously, the same words are printed out by the other teleprinter. A hearing impaired person using this type of equipment could have local and long distance telephone communication with any other person having a compatible teleprinter with acoustic coupler.

Publicity regarding this kind of equipment has promoted the use of teleprinters in various emergency facilities, crisis centers, and law enforcement agencies. In some cities, teleprinters have been purchased for use in churches, community service organizations, government offices, libraries, telephone company offices, vocational rehabilitation offices, and for hearing impaired employees in business and industry. Amtrack and the Internal Revenue Service can be called using teleprinter devices with a toll-free 800 area code number. Also, several areas in the country have teleprinter news, weather, and answering services. There is a growing awareness of the potential that teleprinter devices offer for personal, business, and emergency communication needs.

*Using residual hearing.* The National Technical Institute for the Deaf is providing post-secondary deaf students with the opportunity to prepare for semi-professional and professional level employment. As part of the preparation for technical employment, NTID is looking at ways deaf people can overcome telephone communication problems. Our objectives focus on innovative techniques to enable deaf people to participate in various telephone communication situations at work and socially. In addition to training with codes and teleprinter equipment, NTID students are encouraged to maximize their use of residual hearing over the telephone. Two courses are available to students based on their communication abilities.

One course emphasizes oral/auditory telephone conversations with strangers for students with better speech, hearing, and language skills (Castle, 1976a, 1976b, 1977a). These students learn to analyze the reasons for their specific telephone communication problems and to use various strategies to be sure information is clearly understood. These strategies include repeating the information, spelling names, using code words to help understand the spelling, asking questions about the information, saying numbers individually, etc. The strategies serve to clarify information within the sentence that is not understood. Use of a hearing aid

and/or an amplified telephone handset offers the student additional loudness over the telephone making it easier to hear the other person without straining to listen. Table 1 lists the oral/auditory strategies students learn to use during the course.

*Table 1.* Strategies taught to students at NTID

| Strategy | Explanation |
|---|---|
| REPEAT | Say it again |
| REPHRASE | Say it again in a different way |
| SPELL | Say each letter in the word |
| CODE WORDS | Use a familiar word that starts with the letter spelled |
| DIGITS | Say each number in the series individually |
| ALPHABET | Say the alphabet until you reach the correct letter |
| COUNTING | Say the numbers in order until you reach the correct one |
| KEY WORD | Spell the important word in the sentence |

A second course has been designed for students with very limited hearing, regardless of speech ability, to emphasize teleprinter conversations and use of prearranged codes on the telephone. If the student has speech that can be understood by family or people who know him, he can give information or ask specific questions relying on a code response. The code method can be prearranged or explained at the time of the telephone call.

Since a visual Speech Indicator is not available, students are encouraged to explore their auditory or tactile discrimination for several codes over the standard telephone. Any one of 4 codes may be selected as the preferred response to a question over the telephone: (a) voice reply of "no, yes-yes, please repeat" spoken slowly; (b) tapping a specified number of times on the telephone mouthpiece; (c) blowing air a specified number of times into the telephone mouthpiece; or (d) asking the person to hang up and then call back allowing a specified number of rings. For the student who does not use amplification and cannot discriminate among the rhythm patterns, a telephone call-back can be used as a code. By placing a hand on the telephone or watching a telephone signaling light, the student can feel or see the number of times the telephone rings in response to the question. For the student using a hearing aid and an amplified telephone handset, the detection of a basic one-, two-, or three-

beat rhythm pattern can represent a code for "no," "yes-yes," or "please repeat" whether he is listening for a voice reply, tapping, or the blowing of air.

Preliminary impressions from the NTID telephone training program suggest that a variety of auditory (or possibly tactile) information can be recognized over the telephone by a deaf person, regardless of the extent of hearing loss, if both a hearing aid and an amplified handset are used. Speaking ability, rather than hearing ability, appears to be the primary limitation in the independent use of the telephone. As either speaking ability or speech perception become progressively more limited, a deaf person tends to depend more heavily on strategies, codes, a third person to make telephone calls for him, or the use of teleprinter equipment. Table 2 describes the restrictions imposed on telephone communication by hearing, speech, and language abilities of the hearing impaired person. The speech and hearing descriptors used in the table are based on research (Johnson, 1976) and clinical experiences with deaf students at NTID (Castle, 1976a, 1976b, 1977a).

*Table* 2. The effect of hearing, speech and language impairments on ability to participate in telephone communication.

| SPEECH AND LANGUAGE | HEARING | | |
|---|---|---|---|
| | Discriminates 1, 2, or 3 Syllables in Limited Vocabulary | Understands Many Familiar Words and Sentences | Understands All or Most Words and Sentences |
| Understood by Most People | -Talks to people who know him but depends on codes for listening<br>-Typically prefers third person for calls requiring extended communication<br>-Uses teleprinter communication often | -Talks but depends on strategies and codes for listening<br>-Length and topic of calls may be restricted by listening skills<br>-Topic of conversation controlled by deaf person<br>-Typically requires third person for calls to strangers | -Talks and listens with occasional use of strategies<br>-Length and topic of calls are unrestricted<br>-May require third person for selected calls to strangers |
| Understood Only by People Who Know Him | -Depends on strategies and codes for talking and listening<br>-Requires third person for most calls<br>-Uses teleprinter communication often | -Depends on strategies and codes for talking and listening<br>-Length and topic of call restricted because of speaking and listening abilities<br>-Topic of conversation controlled by deaf person<br>-Requires third person for most calls | -Typically prefers third person for calls to strangers because of speaking ability |
| Cannot be Understood | -Depends on use of teleprinter equipment<br>-Requires third person for calls to people without teleprinters | | |

## EQUIPMENT TO USE WITH THE TELEPHONE

There are a number of commercially available devices that can assist the hearing impaired person in telephone communication, radio and television enjoyment, and everyday living. Except for a few publications (Castle, 1977b; Gendel, 1974; Hughes, 1967; Rupp, 1974; Whitney, 1965), the information on these devices has not been readily accessible to the hearing impaired public or the professional working with the hearing impaired person. Frequently the devices are expensive, not easily available for consumer trial or comparison prior to purchase, and there is a lack of information with regard to suitability for people with different amounts of hearing loss or other physical limitations. For example, the ringing of the telephone frequently is not loud enough for a hearing impaired person. The telephone company can install bells of different pitch or loudness or a signal light that shows when the telephone is ringing. In addition, some commercial manufacturers have multiple-use devices that can be used to turn on a lamp, a vibrator, or a fan when the telephone doorbell rings or when a baby cries. Table 3 shows categories of equipment that can facilitate distance communication for individuals who require single or combined sensory devices: auditory, visual, or tactile.

*Table 3.* Equipment that facilitates distance communication for the hearing impaired population.

| Auditory | Visual | Tactile |
|---|---|---|
| Personal hearing aid | Signal lights | Vibrating paging devices |
| Built-in or portable telephone amplifiers | Teleprinter equipment | Braille-TTY |
| Telephone bells and gongs of different pitch and loudness | Electronic handwriters | Code-Com |
| | Vistaphone, Picture-phone | |

### *Auditory*

Hearing impaired people who use the standard telephone usually depend on some kind of amplification. There are two basic pieces of equipment that will help the hearing impaired succeed on the telephone: (a) a hearing aid; (b) an amplified telephone handset; or (c) both a hearing aid and an amplified handset.

*Telecoils.* Many hearing aids incorporate a special telephone setting which is designed to work in conjunction with the magnetic leakage from telephone receivers. Sound is transmitted within the magnetic field generated between the hearing aid telecoil and the telephone receiver. Other sounds or conversations in the same room are not amplified allowing the hearing impaired person to concentrate maximally on the telephone conversation. In addition, using the telecoil setting eliminates the problem of acoustic feedback. There are some potential drawbacks however, the hearing impaired person typically will not hear his own voice when using the telecoil setting. He will be able to hear and monitor the loudness of his voice however through the telephone. The telecoil setting may not produce the same loudness or quality as found with the microphone setting on the hearing aid. Electrical interference from nearby motors, transformers, and fluorescent lights may be picked up as static on the telecoil setting.

On some telephones (e.g., public pay phones or Trimline® models) there is insufficient magnetic leakage to enable the hearing impaired person to hear when using the telecoil setting on his hearing aid (Gladstone, 1975; Goldberg, 1975; Smith, 1974). A portable battery operated Adapter placed on the telephone receiver increases the magnetic field to permit use of the telecoil setting. In that way, an Adapter can increase the loudness of the incoming voice. The Adapter can be obtained from a local hearing aid dealer.

*Amplified handsets.* The telephone company can replace the standard telephone handset with an amplified handset for an additional fee. The transistorized amplifier built into the handset allows the hearing impaired person to increase the loudness of the voice coming over the telephone. When the volume is set at maximum gain, the amplifier increases the loudness of the incoming voice as much as 25 to 30 dB (Flanagan, 1968; Hammer, 1964). When the volume control on the amplifier is set at the minimum gain position, it is comparable to the standard handset.

A portable slip-on amplifier, which is battery operated, offers a convenience factor to the deaf person who wants to be able to use different telephones without installing a built-in amplified handset. The portable amplifier can be obtained through a local hearing aid dealer or found in the music-TV department of some stores. Informal evaluations of the portable amplifier by some NTID students suggest it may not have as much gain as the built-in amplifier obtained through the telephone company and, therefore, may not be strong enough for some profoundly hearing impaired people.

Contrary to popular belief, however, the amplified handset offers substantial assistance to the profoundly hearing impaired individual. Students previously enrolled in the telephone course at NTID report that

the additional gain supplied by an amplified handset makes it easier to hear the other person without straining to listen. The amplified handset gives students more confidence knowing there is additional gain if they are talking long distance, if their hearing aid battery is weak, or if they are talking with someone that has a soft voice. Ninety-five percent of the NTID students who use their residual hearing on the telephone consistently depend on the amplified handset (with or without their hearing aid).

*Problems and solutions.* Using a hearing aid and/or an amplified handset gives additional loudness to compensate for the hearing impairment. The need for additional gain however may cause a problem of acoustic feedback which interfers with the telephone conversation. There are three typical causes of feedback over the telephone: (a) the earmold may not fit snugly in the ear of the hearing impaired person; (b) the volume on the hearing aid or on the amplified handset may be too high; or (c) the hearing aid case may be interfering with the transmission of sound because of the way the handset is held.

Feedback due to the earmold will not occur when the hearing impaired person uses the telecoil setting. However, if the individual uses the microphone setting for telephone communication a well-fitting earmold should be obtained. If the earmold is not causing feedback the hearing impaired person needs to reduce the volume on the amplified handset or hearing aid. The hearing impaired person who relies on both kinds of amplification has to find a balance between the amount of volume needed from the hearing aid versus that from the amplified handset without causing feedback. Finally, moving the telephone handset slightly away from touching the hearing aid case may eliminate the feedback.

It is very easy for feedback to occur when using an amplified handset at or near full volume. When the high pitched whistling sound feeds into the telephone, a hearing person may have difficulty understanding the conversation because feedback can take place at the same time the hearing impaired person is talking. Many hearing impaired people are unaware when acoustic feedback exists, because it occurs within a high frequency range of 2000-4000 Hertz (Skadegard, 1977). Thus, the hearing impaired individual needs to be told when feedback is happening in order to reduce the gain of the instrument.

Sometimes a hearing impaired person does not realize that a bad connection, e.g., static, loss of loudness, or cross-talk, can cause telephone communication problems. A bad connection may occur at either end of the telephone conversation and will interfere with the ability of the hearing and/or hearing impaired persons to understand the conversation. A hearing impaired person needs to be told that the common solution is to explain the problem, hang up, and dial the number again. Table 4

describes the problems experienced by hearing impaired people along with solutions in relation to use of amplification on the telephone.

*Table 4.* Problems encountered by deaf listeners with equipment used for telephone communication.

| Problems | Equipment | Solutions |
|---|---|---|
| Feedback | Hearing aid | Keep handset away from aid |
| | | Well-fitting earmold |
| | | Use telephone setting |
| | | Reduce gain |
| Feedback | Amplified Handset | Reduce gain |
| Too Soft | Telephone | Use amplifier and hearing aid |
| | | Change hearing aid battery |
| | | Use amplified handset |
| | | Use hearing aid |
| | | Use Adapter |
| Bad connection | Telephone | Hang up and call back |
| Environmental noise | Hearing aid | Use telephone setting |
| | | Reduce room noise |

*Visual*

The availability of a printed form of telephone communication offers the hearing impaired an opportunity for independent use of the telephone. There are a number of different portable and stationary teleprinters and couplers on the market. The older reconditioned equipment is large and bulky but less expensive than modern teleprinters. While surplus teletypewriters are becoming more difficult to obtain, the cost of new teleprinter equipment has limited the number of hearing impaired people who can afford to buy it. One manufacturer however, will rent a semiportable device for a reasonable monthly fee. There is an increasing amount of information being published regarding these devices and the use of this equipment by deaf people. Teletypewriters for the Deaf, Inc.,*

*Teletypewriters for the Deaf, Inc., P. O. Box 28332, Washington, D.C. 20005.

a non-profit organization, has a number of regional representatives who can inform the hearing or hearing impaired person about various teleprinters and signaling devices and how they can be obtained.

For certain hearing impaired populations, a device that does not require typing skills may be useful. There has been some interest in electronic writing equipment which can use telephone or direct wire connections to send and/or receive handwritten messages across any distance. This type of equipment often is used in hospitals, industry, and business to speed communications. In addition, technical information can be sketched or diagrammed during the conversation. This type of device may have application in special types of situations that face the hearing impaired at home or work. There are several companies such as Victor Graphic Systems, Inc., Telautograph Corp., and Talso Systems, Inc. that distribute the Electrowriter,® Telepen,® and Telenote,® respectively.

The unlimited availability of face-to-face telephone communication rather than the standard telephone system would permit the hearing impaired population to use any combination of speech, speechreading, hearing, sign language, or fingerspelling along with facial experssion and gestures. The Picturephone® developed by Bell Laboratories and the Vistaphone® developed by Stromberg Carlson have made face-to-face telecommunication feasible. NTID, on an experimental basis, installed 30 Vistaphones on the Rochester Institute of Technology campus to facilitate telephone communication among faculty, staff, and students. There is no doubt that it is the preferred mode of telephone communication among the deaf users on campus. Unfortunately, this type of telephone communication is not available to the general public. Stromberg Carlson recently discontinued manufacturing the Vistaphone, but the Picturephone continues to be evaluated by Bell Laboratories. At present, the cost of the equipment, because of the number of wires and cables needed for the video transmission, appear to be explanations for lack of general availability. Research on laser systems for transmission of optical communication however, are ongoing and appear to offer encouragement for video-telecommunication in the future.

### *Tactile*

Several devices have been designed to make telephone communication possible for the deaf-blind. At least two pieces of equipment are commerically available at this time: the Code-Com®and the Braille-TTY. Other devices are under development at the Helen Keller National Center for Deaf-Blind Youth and Adults (Kruger and Rosenfeld, 1976).

The Code-Com® is a non-portable attachment to the telephone that converts sound signals into visual or tactile signals. Using a yes-no code or Morse code to receive information, the deaf person can see or feel the

pattern while a deaf-blind person can feel the incoming message. To send a message, the deaf or deaf-blind person can speak or use Morse code. The Code-Com® is available through the Bell Telephone Company.

A Braille-Teletypewriter allows a deaf-blind person to communicate with other standard teleprinters by converting the incoming types conversation in Braille while the outgoing message is sent in standard typed form. The deaf-blind person reads telephone conversation by moving his fingertips across the raised dots on the paper. The Braille Phone-TTY is available through Phone-TTY, Inc.*

Radio pocket paging is a form of distance communication in use by the hearing population. Pagers can transmit a verbal message, a tone, or a vibrating signal. Vibrotactile paging devices make it possible to contact a profoundly hearing impaired person within the radius of the equipment by dialing a special telephone number and transmitting a vibrating signal to the pager. The vibrating signal substitutes as a coded telephone call to alert a hearing impaired person (a) to telephone for more information or ask a third person to telephone for him, (b) to go to a prearranged location, or (c) to perform a certain activity. At NTID, vibrotactile pagers are being used to contact deaf staff serving in crisis support roles and deaf students serving as dormitory residence advisors during evening shifts. The Student Safety Unit (SSU) at Rochester Institute of Technology is evaluating the use of vibrating pagers in conjunction with teleprinter equipment for use by deaf SSU members. Thus, when a vibrating page is received, the deaf member goes to the nearest teleprinter and telephones for more information. Paging equipment may be obtained through local distributors listed in the Yellow Pages of the telephone directory.

*A Growing Need.* The hearing impaired population is in the early stages of coping with problems of telephone and distance communication. Use of special equipment such as telephone amplifiers, signaling devices, teleprinters, radio pagers, etc., can offer the hearing impaired a variety of options for the communicative process. Frequently the hearing impaired and their families are unaware of these alternatives and whether or not the selection of a particular device would facilitate the distance communication.

The logical resources for providing information and training related to telephone communication would be educators of the deaf and hearing impaired, audiologists, speech pathologists, and vocational rehabilitation counselors. At present, however, one might question whether this group of professionals is prepared to offer the training and advice. Perhaps local telephone companies, hearing aid manufacturers and their representatives, and organizations of the deaf could become involved in the dissemination of information to the hearing and hearing impaired public by

*Phone-TTY, Inc., 14-25 Plaza Road, Fair Lawn, New Jersey 07410.

advertising, displaying, selling and/or renting the various devices. Hearing impaired consumers need to have an opportunity to compare and evaluate the equipment that is available with respect to their own needs and level of hearing.

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