MacAid:
A Computer Application in
Aural Rehabilitation

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MacAid was developed to augment current hearing aid orientation procedures through the use of an interactive computer program. The MacAid program provides a self-paced review of basic hearing aid information and listening strategies. It presents information on anatomy and physiology of the ear, components of in-the-ear and post-auricular hearing aids, hearing aid maintenance, and basic communication strategies. A computer tutorial is provided that illustrates HyperCard buttons and fields as well as how to use a computer mouse. A record of performance on MacAid review questions is maintained by the computer for later analysis by the audiologist or other appropriate professional. Applications of MacAid to the clinical setting are presented.

As the number of individuals using amplification grows, additional aural rehabilitation (AR) programs will be necessary. However, to reduce hearing health care costs it will be important to find ways to increase aural rehabilitation services while limiting increases in direct professional service time. Interactive computer programs may well meet such a need. Studies have shown that computer-based diagnostic and therapeutic systems may achieve results equal to that of direct professional contact (Bankowitz, Lave, & McNeil, 1992; Finkelstein, Johnson, & Lilly, 1991; Nykanen, Cowdhury, & Wigertz, 1991).

AR has been described as the procedures used to improve the overall communication ability of hearing-impaired persons (Nicolosi, Harryman, & Kresheck, 1978). Services often include provision of amplification, hearing aid orientation, and the discussion of communication strategies. In an effort to educate clients, traditional AR procedures have included active and passive techniques. Active processes typically occur when the audiologist works with the client on a personal basis and are most common. Passive techniques, such as watching video tapes, are generally used for group situations. Active learning processes can be time consuming and thus not cost effective. Passive methods are more cost effective, but at the risk of reduced information retention. Microcomputers enable the use

of both methods. Programs can be developed that actively involve the client yet require minimal professional involvement. That is, they keep the learner involved with the material and provide individualized instruction without professional contact for the duration of the instruction.

Informational material for hearing aid users can be easily adapted for computer interactive hearing aid counseling. Teaching clients how to use hearing aids and listening strategies necessary for optimal benefit are just two examples. These areas, typically discussed when a hearing aid is dispensed, must be fully understood if the hearing aid user is to obtain maximum benefit from the amplification. Family members or friends of the hearing aid user often also need information about hearing aids. The microcomputer is perfectly suited for this type of instruction and various adaptations have been described (Amerine, 1992; Bull & Cochran, 1992; Fausti, Schaffer, Olson, Frey, & Henry, 1993; Fischer, 1992; Fournier & Margolis, 1992; Lauter, 1991; Palmer, 1992a, 1992b; Sims, Kopra, Dunlop, & Kopra, 1985; Sims, Scott, & Myers, 1982).

SYSTEM REQUIREMENTS

MacAid is compatible with any Macintosh computer running System 7.0 or higher and HyperCard software (Apple Computer, 1990). The graphics were designed for display on a standard 9-in monitor but larger monitors may be used. HyperCard and MacAid software require at least 8 MB of disk space and at least 1 MB of RAM.

The audio component of the program uses the Macintosh internal speaker. Output differences as great as 20 dB SPL between Macintosh computer models have been measured. That is, a Macintosh LC II was found to have a maximum output of 40 dB SPL at the listener's ear as compared to a Macintosh IIfx which had a maximum output of 60 dB SPL at the listener's ear. Therefore, it is important that each computer be evaluated for optimal audio performance and that the room acoustics are considered prior to using MacAid. The use of a sound amplification or a headphone system is suggested to reduce audio level differences. The program audio should be set to a comfortable listening level for most users. The audio portion can be adjusted to comfort or eliminated using the Macintosh sound control panel.

THE MACAID PROGRAM

MacAid is a self-paced, interactive hearing aid orientation program. It was developed using Macintosh HyperCard software and contains eight sections: basic anatomy, components of in-the-ear (ITE) hearing aids, components of behind-the-ear (BTE) hearing aids, care and use of ITE hearing aids, care and use of BTE hearing aids, communication strategies, performance review, and a tutorial on computer use. A complete review using MacAid for one style of hearing aid takes approximately 1 hr. Sections may be reviewed one at a time and range from approximately 10 to 20 min in length.

Initially, the MacAid program prompts the audiologist to enter identifying information and hearing aid use history of the client. This information will appear on the MacAid response form and provides useful documentation of MacAid performance to be maintained in the client's records. If no record of performance is necessary, this step may be omitted and the client may proceed directly to the main menu of the MacAid program.

Figure 1 illustrates the MacAid main menu. From this menu the client may select any topic for review; however, it is arranged in a manner to encourage a specific review order (hearing aid components, care of the hearing aid, listening strategies, and then ear anatomy). The client may return to the main menu at any time during MacAid to select additional topics for review.
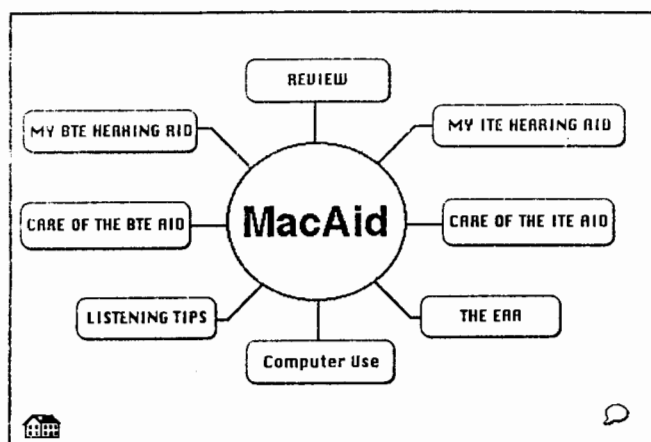
Figure 1. Illustration of the MacAid main menu. From this menu sections of the MacAid program may be accessed. The program user can return to this menu at any time during the program.

From the main menu, the client should select a review of either ITE or BTE hearing aid function. Figure 2 provides an example of how information is presented in both text and graphic format. Frequent audio reinforcements in the form of digitized speech, noise, and cartoon character sounds are also provided. These provide an entertaining aspect to the program, which may enhance learning. In this example, an ITE hearing aid is shown with traditional landmarks identified. By using the computer mouse to "click on" a hearing aid landmark, more information is presented from pop-up boxes or scroll fields (see Figure 3). In this example, the client selected the battery compartment.

Care and use of hearing aids is an important aspect of the MacAid program. Descriptions of basic hearing aid maintenance are provided including battery use and insertion (see Figures 4 and 5). As previously mentioned, the text is
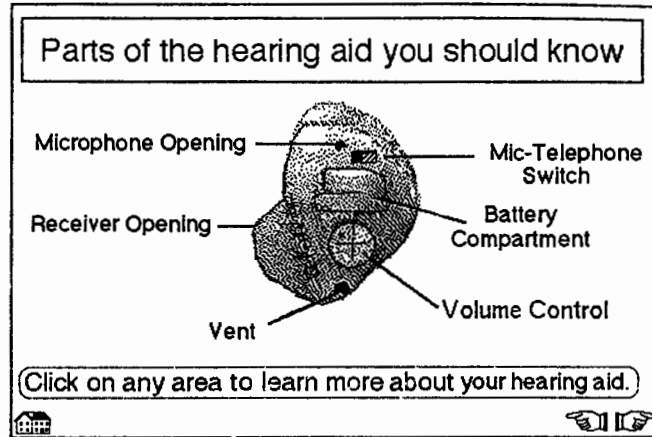
Figure 2. My ITE Hearing Aid provides information on in-the-ear hearing aids.
This figure illustrates the basic hearing aid landmarks presented.

supplemented by illustrations of the information presented.

Throughout the program there are questions regarding the material presented. The questions serve to reinforce the information learned and to identify those areas requiring additional explanation. Figure 6 represents the type of questions asked regarding battery insertion. The question asks whether the clients have difficulty inserting and removing the battery from their hearing aids. If they respond no, they are not having problems, then they are given positive reinforce-
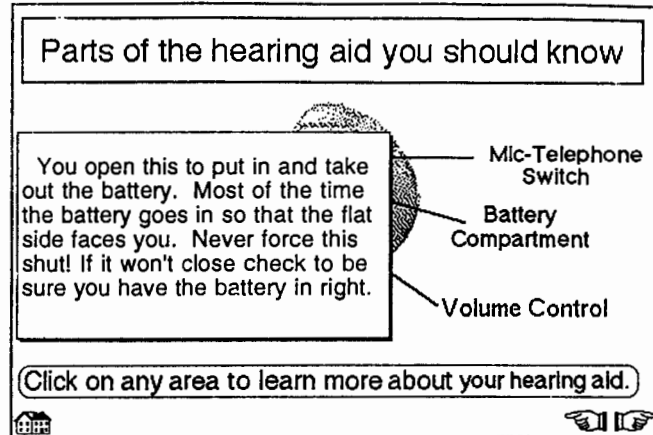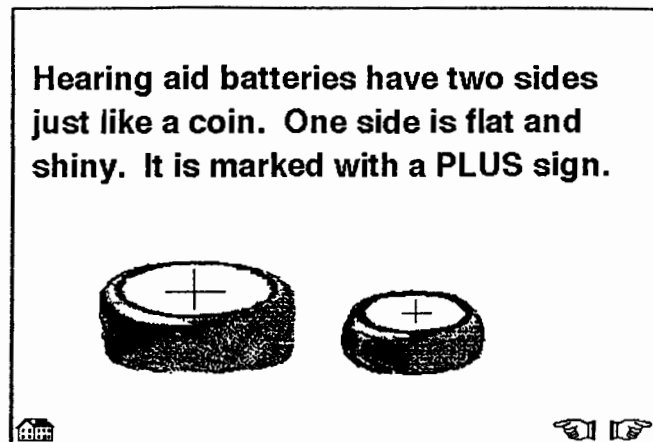

Figure 3. By using the computer mouse to "click on" a hearing aid landmark, additional
information is presented. In this illustration, the program user would
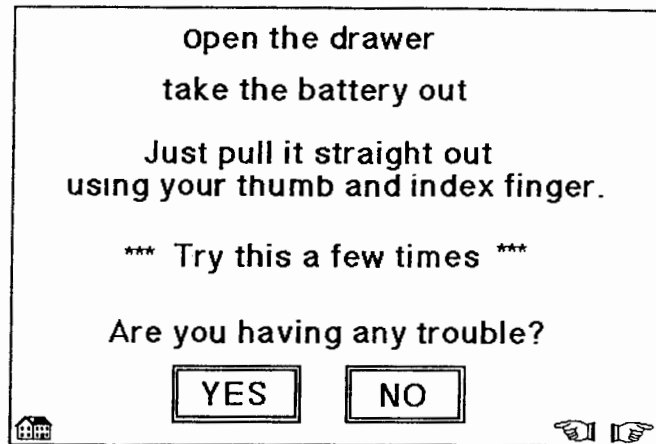have selected the battery compartment of the hearing aid.

Figure 4. An example of hearing aid battery information as presented by MacAid. Note how the illustrations serve to reinforce the written information.

ment and told to continue in the program. If they respond yes, they are having problems, they immediately review that information and are given a description of common mistakes and strategies to improve the skill.

The MacAid section on the anatomy of the ear provides a description of the ear and how it functions. An objective of this section was to help clients understand why hearing aids do not return hearing to normal. Descriptions of hair cell
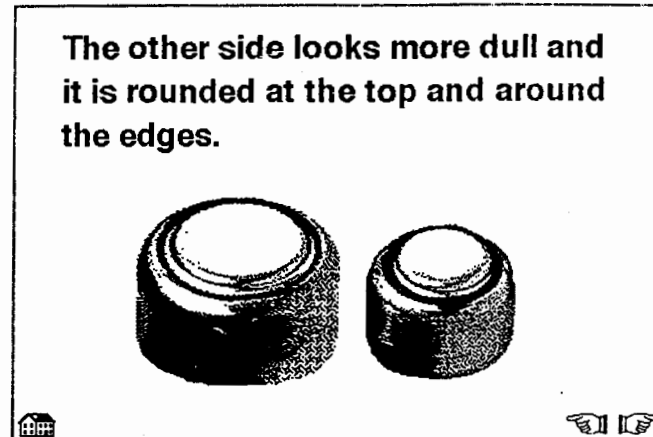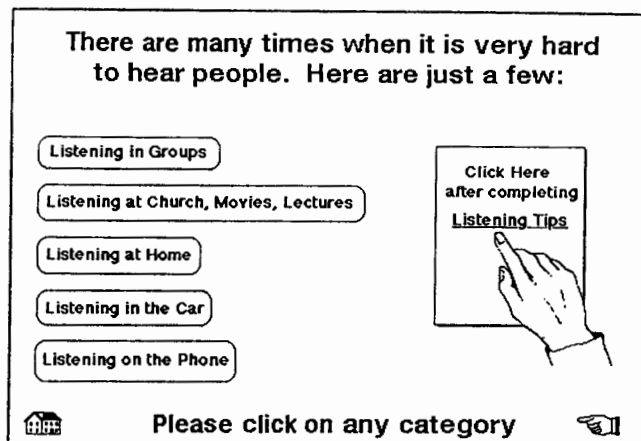

Figure 5. A continuation from Figure 4, this illustration demonstrates how MacAid presents similar information in several formats to increase comprehension by the program user.

Open the drawer

take the battery out

**Just pull it straight out
using your thumb and index finger.**

*** Try this a few times ***

Are you having any trouble?

| YES | NO |

Figure 6. An example of MacAid review questions which are presented throughout the MacAid program. In this example the user is asked if they have difficulty inserting the battery into their hearing aid. If they respond no, the program continues.
If they respond yes, the information is automatically reviewed.

damage and related effects on cochlear mechanics are provided. Basic anatomical vocabulary used by audiologists and physicians is listed. By equipping clients with the correct terminology, communication is facilitated between the client and the health professionals.

The final section, titled Listening Tips, provides common communication strategies for the hearing impaired (see Figure 7). Topics discussed include

**There are many times when it is very hard
to hear people. Here are just a few:**

(Listening in Groups)

(Listening at Church, Movies, Lectures)

(Listening at Home)

(Listening in the Car)

(Listening on the Phone)

**Click Here
after completing
Listening Tips**

Please click on any category

Figure 7. An example of the categories discussed in the section Listening Tips. The program user can select one or more categories for review. Review questions for Listening Tips are presented following completion of the material.

listening in groups, in large auditoriums, at home, in the car, and on the telephone. Clients are provided with information to improve communication and then with examples of how to apply that information. For instance, the program may suggest looking at a speaker's face when trying to listen. It then instructs clients to have their family members enter the room where they are located before talking. As with the other sections, review questions are provided to reinforce correct learning and to identify areas requiring further explanation.

MACAID SUGGESTED REVIEW

MacAid was designed to augment current hearing aid orientations and does not replace individualized instruction from the audiologist. It does enable a more efficient use of the professional's time by identifying areas that the client does not fully comprehend. This is one of the unique benefits of using MacAid over traditional hearing aid orientation alone. It provides a way to monitor comprehension and retention of information presented by the audiologist. Incorrect responses to the review questions are combined into a single list on the MacAid response form. These topics should be reviewed with the patient through individual sessions (see Figure 8). The user's name and hearing aid history are included on the left portion of the form. The completed form may be printed and placed in the client's records for future reference.

CLINICAL APPLICATIONS

MacAid was designed as a hearing aid orientation program for new hearing aid users. However, it may be appropriate for several clinical applications. The program can be used in pre-evaluation counseling. Clients who are interested

Figure 8. The MacAid Response Form as viewed on the computer monitor. Evaluation date, client name, hearing aid history, and MacAid review questions are included.

in obtaining information on hearing aids may use portions of the program to learn more about how hearing aids work and what is required to care for them. It may also help produce realistic expectations through the listening tips section. MacAid is well suited for the client who makes repeated appointments with the audiologist for re-instruction on hearing aid use. It allows the client to review a portion or all of the information of interest without requiring the audiologist to be present. MacAid may also be incorporated into long term aural rehabilitation programs. It can be used to supplement information provided in group settings if someone needs additional instruction. It also serves to help all members in the group review basic information before developing new communication strategies.

Persons other than hearing aid users may also benefit from exposure to Mac-Aid. Spouses, children, or parents of the hearing aid user often need instruction in hearing aid use and care. It is possible to have the family member or friend use MacAid while the client is being seen by the audiologist. Thus, a single appointment may be used for counseling both the client and the family.

CASE REPORTS

Case 1

A 66-year-old woman was seen for a hearing aid evaluation. Her evaluation and hearing aid were purchased by a local community support group. The woman reported a long-standing history of difficulty understanding speech. She had never considered using a hearing aid prior to the present evaluation. Audiometric results were consistent with a moderate to severe sensorineural hearing loss bilaterally. A unilateral moderate gain hearing aid was selected and the hearing aid fitting was scheduled following receipt of the custom earmold.

A student clinician, supervised by a certified audiologist, provided the initial hearing aid fitting and orientation. The clinician demonstrated how to insert and remove the battery from the hearing aid, how to insert and remove the hearing aid from her ear, and basic care and maintenance. Limited information was provided regarding listening situations and strategies to employ for maximum benefit.

The client was then seated in front of a Macintosh computer with the MacAid program. The woman stated she had never used a computer before but was interested in learning more about her new hearing aid. The clinician demonstrated how to use the computer mouse and how to open fields of information by clicking on buttons.

At that point, the clinician let the client take control of the computer mouse. Minimal prompting was required before the woman began scrolling through the cards in the MacAid stacks. She stated she was "having fun" and especially enjoyed "all the buzzers and bells" (auditory reinforcements).

Through the course of the program MacAid identified several areas where the client was having difficulty remembering information presented. For example,

she could not correctly insert a battery into her hearing aid, nor did she correctly identify the hazard of perspiration damage. Using the MacAid suggested review, the clinician identified which information the client did not remember from the initial hearing aid orientation. They were then able to repeat information on only those topics that were difficult for this client.

These results suggest that MacAid can be used independently by adults with limited or no computer experience. This client found the program to be entertaining as well as educational. She indicated that others in her family should also review the program. In general, this client was a successful user of the MacAid program.

Case 2

A 94-year-old woman was seen for a hearing aid evaluation. Her evaluation and hearing aid were purchased by a local community support group. The woman reported a long-standing history of difficulty understanding speech and she had worn a hearing aid in her left ear for several years. Results of audiometric testing indicated a severe to profound sensorineural hearing loss in the left ear and no measurable hearing in the right ear. A unilateral high gain hearing aid was selected and the hearing aid fitting was scheduled following receipt of the custom earmold.

A student clinician, supervised by a certified audiologist, provided the initial hearing aid fitting and orientation. The clinician demonstrated how to insert and remove the battery from the hearing aid, how to insert and remove the hearing aid from her ear, and basic care and maintenance. The woman experienced difficulty manipulating the earmold and hearing aid battery. She stated she had relatives that would be available to help her as needed.

The client was then seated in front of a Macintosh computer with the MacAid program. The woman indicated an apprehension of using the computer by herself. The clinician stated she would stay with her if she requested and proceeded to demonstrate how to use the computer mouse and HyperCard buttons and fields.

The woman would not scroll through the program independently. She requested that the clinician manipulate the computer mouse for her. She also preferred for the clinician to read the information from the MacAid program to her, although it was established she could read the information herself.

If questions arose they were answered by the clinician rather than by the client exploring the MacAid program. Therefore, no record of items reviewed was obtained by the computer program. Also, the client elected to "skim through" large sections of the program, indicating she had worn a hearing aid for years and did not need to be told how to care for the device.

These results confirm that MacAid, like all remediation procedures, must be selected based on individual client needs. This was one of the least successful attempts at using MacAid for independent, individualized instruction. It has been included, however, to illustrate that even in a dependent situation MacAid may provide structure for counseling that is not readily available otherwise. It

allows both the hearing specialist and the client to identify important topics and then collectively decide if a review is desired. Thus, even in a difficult situation, the program may be viewed as successful.

CONCLUSION

MacAid presents information typically provided in a hearing aid orientation. In addition, communication strategies are described with examples of application provided. MacAid users are able to use the computer program in a self-paced manner and to repeat the program as often as necessary with minimal interaction by the hearing health care specialist. Areas difficult for a particular patient to comprehend are identified, via the program, for one-on-one instruction.

FUTURE DIRECTIONS

Trial use of MacAid in various clinical settings is currently in progress. Final modifications will be made based on the clinical trials. Next, studies designed to evaluate the efficacy of MacAid will be conducted. Efficacy data are necessary before MacAid can be recommended as a diagnostic and therapeutic program for general use. Commercial availability will follow when these needs have been met.

ACKNOWLEDGEMENTS

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