A Survey of Microcomputer Applications in Aural Rehabilitation

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There are several types of computer-based education in aural rehabilitation that are described: (a) computer-managed instruction, (b) computer-assisted instruction, and (c) computer-assisted interactive video. Hardware, software, and support resource options for computer-based education are discussed. Appendices provide information on software for audiology applications and sources of special video-audio-computer interface cards.

The proliferation of computers used for education is astounding. For example, half of the 5.7 million households that have computers use them for educational purposes (Popular Computing, 1984). In 1980, only 21% of all United States high schools owned one or more computers for student use. By the fall of 1985, that figure had risen to 86% with some 325,000 computers installed. The typical high school owned five computers (Schneiderman, 1984). Molar stated, "It used to be that you couldn't have a school unless you had books and a library; now you can't have a school of excellence without having a computer or computer-based system" (Popular Computing, 1984, p. 35).

Although the computer revolution is upon us, there is work to be done.
before computer-based education lives up to its potential and is something more than an automated and animated work sheet. The broad term, computer-based education (CBE), has recently been used to include computer-assisted instruction (CAI) and computer-managed instruction (CMI). Another term, computer-aided learning (CAL), has also surfaced.

CBE began in the 1960s and followed the behavioral self-instructive models of the time. There are three important differences between CBE of the 60s and now. First, CBE is currently divided into CAI as the instructional component and CMI as the administrative and learning management component. The second difference is that both CAI and CMI have moved from large, expensive mainframe computers to microcomputers. Third, the use of videotape and videodisc under computer control, termed computer-assisted interactive video (CAIV) instruction, has greatly enhanced CAI as an educational tool.

The purpose of this paper is to discuss the scope of CBE and the application of computer technology to aural rehabilitation. Applications that incorporate computer-assisted interactive video (CAIV) are highlighted. Also, an overview of the computer hardware, software, and support resources required in aural rehabilitation is provided.

**COMPUTER-MANAGED INSTRUCTION**

CMI uses a computer to (a) gather and summarize student data, (b) store and retrieve demographics and test data, and (c) monitor progress toward instructional objectives. Smaldino and Traylor (1984) are developing a microcomputer case management system which encourages graduate students to focus on sequencing in aural rehabilitation. Case history information and data from diagnostic tests of auditory and visual perception, manual dexterity, language, and cognition are combined with hearing-aid performance measures. A printout shows a recommended, stepwise sequence of aural rehabilitation activities. Harlan (1982) and Lotterman (1985a) also developed a series of microcomputer programs for reporting clients' aural-logic data and case history information, including speech-language development.

Grassman, Sidors, and Garaway (1983) applied "precision" teaching principles to computerized sign language instruction. A data base containing features for motion, placement, handshapes, and linguistic content was established for each sign presented during the course. Students' speed and accuracy of expressive and receptive on a series of one-minute tests is entered into a computer. A printout of student progress, with reference to the performance standards, is obtained.

Rushakoff (1984) listed several programs that allow speech-language-and hearing clinicians to generate individual education plans (IEP) and maintain therapy data logs. An example of a commercially available package to generate IEP reports is the Beryman and Johnson (1984) program: Demarest and
Erdman (1984) adapted BASE II, a commercially available database management system, for use with a self-report inventory they are developing. Reed and Miller (1984) described administrative uses of computers for graduate education in speech and hearing. Their mainframe software applications include reporting student clinical experiences in a format conforming to ASHA certification requirements. The software also can generate reports of client services by type of disorder and clinical practice site. Client demographics and billing information are other features available.

In general, whenever CAI becomes operational in a curriculum, there will be a need for CAI to generate reports so that instructors can monitor student attendance and performance on a regular basis. These reports should include only essential information that does not vary the teacher in data. To improve instructional efficiency, items which are either too easy or too difficult can be easily culled after accumulated student performance data have been examined. Depending on the design of the lesson, performance can be measured by the number of correct responses on the response time required for a correct answer (Nice, Scott, & Myers, 1982).

COMPUTER-ASSISTED INSTRUCTION

CAI provides direct instruction with feedback to learners on their performance. CAI usually supplements classroom or group instruction, providing reinforcement and drill that teachers cannot conveniently provide on an individual basis.

Advantages of Computer-Assisted Instruction

CAI has all the advantages of programmed individualized instruction, plus the potential for interaction with learners. Rate of instruction is dictated by students' skills and knowledge of material as well as by their learning styles. Feedback to students concerning performance can be provided instantly because computer programs can constantly analyze progress and coach students on better strategies for solving problems in exercises.

Computer languages such as LOGO, developed by the Massachusetts Institute of Technology's (MIT) artificial intelligence laboratory, are being used to stimulate formation of mathematical and geometric concepts, spatial relations, and sequential logic processes in young children. The computer is used as a tool for exploration of concepts, rather than as a drill and practice machine. This practice has recently been termed computer-aided learning (CAL).

CAI also allows teachers to enhance mastery of the lesson by every student. This may be done by repeating instruction until a criterion level of performance is achieved, however, this design is not good CAL. Instruction should provide alternative approaches to learning the skill or concept when students are initially unsuccessful.

The popularity of videogames, which generate a drive for mastery, has
resulted in attempts to incorporate the videogame approach into CAI. According to Dwyer and Dwyer (1986), videogames thoroughly engage players because they provide action activities that are competitive and challenging and involve fantasy. Players also receive immediate feedback regarding performance. With these elements, CAI can motivate students toward mastery of skills or concepts being taught. Fast-paced, game-like lessons with interesting graphics require highly skilled programming. One must be careful not to slow student progress by bogging the computer down in elaborate graphics routines. Readers are directed to Shutey's (1984) thorough treatment of CAI.

Applications in Auditory Rehabilitation

In this section, three basic types of CAI are described: (a) drill and practice, (b) tutorial, and (c) simulation.

**Drill and Practice.** Once a concept has been explained, students must practice in order to improve retention and build functional use of the information. Auditory training and speechreading training often involve drill and practice (Widen, Erdman, Morgon, & Pires, 1981). CAI can make this essential activity effective and one that students perceive as helpful.

Mill and Thomas (1983) designed a five-program set for evaluation and treatment of auditory comprehension and memory impairment in language-impaired adults and children. Objects are represented and coupled with speech synthesizer output for drill and practice. There is a good control of stimulus parameters and student performance data, including response time.

Using the PLATO mainframe system, Saul and Simpson (1980) developed tactile speech perception training for profoundly deaf children. Natural speech stimuli were recorded on a computer-controlled disk and then converted into tactile patterns by a prototype 20-channel display worn on the abdomen. Students felt single words while viewing their graphic representations. A touch screen was used to ask for repetition or to enter a discrimination response. Previously learned words were later presented in short sentences with a four-choice response format.

Sims et al. (1982) reported on the use of CAI at the National Technical Institute for the Deaf (NTID). Their first effort included random access of audiotape stimuli for discrimination of telephone signals. A later project involved auditory vowel discrimination on the PLATO system as part of basic auditory training.

Right (1981) developed a graphic representation of mouth shapes for speechreading drill and practice. Students type a word or phrase on the computer keyboard and see the mosaic shapes for each phoneme in sequence. Co-articulatory influences on mouth shape are not part of the program. A member of computer-supported programs to represent articulation and provide visually to deaf learners are reviewed by Bratge and Houde (1982).

Honech (1985) is using a speech-recognition device, Voice Entry Terminal (VET), developed by Scott Instruments, primarily for articulation and len-
guage therapy. A commercial software program designed for teaching foreign languages will be modified to be used with this system.

Tutorial. Tutorial lessons in CAI are instructional modules that develop concepts by presenting, for example, definitions, descriptions, examples, and problem-solving activities. In general, tutorial CAI exercises are more content-, rather than skill, oriented. An example is the Pushkarev (1986a) Microcomputer Assisted Study Program in Anatomy and Physiology of the Speech and Hearing Mechanism. This set of software was written by speech and hearing faculty in SuperPLOT authoring language on the Apple II with color graphics to provide a self-study supplement for basic anatomy courses in graduate communication disorder programs. Laterman (1985b) developed a number of computer modules for support of introductory graduate-level coursework in audiology. Topics reviewed include diction notation, audiometric interpretation, masking, and immittance.

Simulation. Simulations test the application of learned concepts in a quasi real-life situation. It is challenging to instructional developers because important circumstances for problem solving should be anticipated and included in the program. Some graduate training programs are using microcomputer simulations of hearing testing to provide students with practice with masking and diagnosis of site of lesion (Cinnamon, 1984; Lotterman, 1985b).

A simulation of a job interview, developed at NTID, uses a videotape under computer control and represents one use of CAIV (Croin, 1979). The purpose of the simulation is to help students assume responsibility for successful communication despite hearing loss. Students fill out a job application on the computer screen via the keyboard. Then, prerecorded video segments of the interviewer asking questions are shown. Depending on the students' answers, various other video sequences are seen. Thus, each student has a unique path through the simulation and may or may not "get the job" in the end.

INTERACTIVE VIDEO

CAIV instruction enriches CAI with motion, color, and sound. Video images under computer control are presented to students who interact with the computer. Presentation of a particular sequence of images from videotape or videotext is dependent upon students' previous responses.

Uses of Videotape

A concerted effort to apply videotape to speechreading instruction has been made at NTID to supplement group instruction with self-instruction (Jacobs, 1975; Sims, 1976). Drill materials cover familiar expressions and job-related sentences. Among the advantages of using instructional television for speechreading, Jacobs (1982) listed three: (a) group instruction can be supplemented with individual training, and (b) a variety of poor lipreaders and therefore of better lipreaders in a group situation is relieved.
Observations of students using these self-instruction videotapes indicated the need for computer assistance. For example, when students wanted to repeat a stimulus, a minimum of 30 seconds was required or the tape to be manually stopped, rewound, and replayed. Consequently, students seldom repeated individual items and mastery of the material could not be assured.

Subsequently, VTID developed an interactive system to control videotape, called the Data Analysis Video Interactive Device (DAVID) (Sims, vonFeldt, Dowdley, Hitchcock, & Meyers, 1979; Cohen, 1979). Further development of the DAVID system (now renamed, Dynamic Audio Video Interactive Device) included sign language instruction (Newell, Sims, & Meyers, 1983; The DAVID hardware consists of a random-access video controller (BCD 232 LINK) and a modified videotape recorder (JVC BR 6400). The host computer (Apple IIc) uses one to three disk drives to store the lesson, student, and program data.

About 100 Pomona college students at VTID use the microcomputer-based system each quarter. There are over 2,400 everyday, job-related, and English syntax practice sentences presently recorded. Depending on their reading skill, students use one of three response formats: multiple choice, fill-in-the-blanks, and open set (with or without audio). Programs include a "help" function which gives a hint about the sentence topic and a letter or word that was incorrect or missing from the response. Use of the help function is monitored, and the program coaches the student in its use where the student is having difficulty obtaining the correct answer. All of the students' keystrokes, response times, and instructional paths through the lesson are stored on disc.

Pre- and posttest measures of reading gain, as well as students' attitude toward computer-assisted drill, compared favorably to videotape drill without computer control (Sims et al., 1979). In addition, Sims (1984) studied tabulations of response times, number of requested replays of the stimulus, and number of help requested in order to obtain a correct response. All of these measures showed a downward trend, indicating that students became more skilled at the task over the course of the drill.

Uses of Laser Videodisc

The videodisc is an LP record-like storage medium for audio visual materials (Alberty Educational Communications Corporation, 1983, p. 5). The type of videodisc discussed in this section is the laser videodisc—a laser, instead of a needle, is used to retrieve the information from the disc. Both still-frame and motion sequences can be stored on the disc from sources such as film, photography, film, and videotape. These images are etched onto a master videodisc. At the present time, videodiscs cannot be erased once they have been produced. Although both videotape and videodisc players, under external computer control, can randomly select segments to be played, the videodisc is unique because (a) no stylus touches the videodisc, (b)
there is no wear on the disc, and (c) video segments can be accessed quickly and accurately.

Kopra, Dunlop, Kopra, and Abrahamson (1985) reported on a computer system and software designed for an Auditory-Visual Laser Videodisc Interactive System (ALVIS) which is used for drill and practice in speechreading CAI. The system includes a laser videodisc player, microcomputer, keyboard, video monitor, two microflop disk drives, dot-matrix printer, external amplifier and attenuator with associated accessories, and earphones. Twelve lists of 25 sentences each were standardized and arranged in order from easiest to most difficult in speechread. These five-to-eight-word sentences were recorded on one-inch videocassettes and then pressed on videodiscs.

ALVIS is being used experimentally in a program of aural rehabilitation which includes speechreading instruction for postlingually hearing-impaired adults. The goal is to examine the effects of supplementary drill with a CAI system on the development of speechreading skill. Presentation of a talker saying each of 300 sentences is under software control by ALVIS. During a lesson, each sentence is presented a maximum of five times; the first presentation is without any clues. In one condition, ALVIS clue words, no sound is used, and word class are printed on the video monitor. In a second condition, ALVIS clues, auditory clues accompany the visual stimuli.

One of the first uses of interactive videodisc in the education of deaf children was reported by Brawley and Peterson (1983) at the California School for the Deaf at Riverside. Language and reading skills are taught via ten intervention formats, Brawley and Peterson (1983) stated, "The student is automatically branched through . . . activities, which require him or her to acknowledge captions appearing on the screen; sequence events; recognize correctness of syntax; respond to questions; and categorize, spell, capitalize, punctuate, and construct sentence and questions" (p. 686). An interface card permits the computer to combine computer-generated text and student tasks with external video. The student primarily uses a light pen to interact with the system, but uses the keyboard for spelling tasks. The same video sequences can be used for many different reading levels, language concepts, and instructional objectives because instructions and captions are not on the videodisc but are inserted by the computer program.

Costs

The cost of producing a 30-minute videodisc may be too high for rehabilitation facilities. Some commercially available videodiscs produced for educational or recreational purposes could be repurposed (St. Lawrence, 1984). Repurposing is the use of a disc for a purpose different from the one for which it was originally intended, for example, music education. In one visual rehabilitation project, a Sony demonstration disc is being used to train patients to listen to increasing levels of sound, both while viewing the speaker and without viewing the speaker, as the speaker continues to talk (Kopra, Kopra,...
Abrahamson & Dunlop, 1985). The advantages of replication are reduced cost and variety of materials; the disadvantage is the difficulty in applying these materials. For instance, it may be difficult to find a videodisc that has sentences and speaker position appropriate for speechreading drill.

Differences Between Videotape and Videodisc
When one contrasts videotape and videodisc for CAI instruction, a number of advantages and disadvantages become apparent. Magel (1985) commented, "There are major differences that can be measured in dollars, image quality, seconds, minutes, and feet" (p. 31). Current availability, cost, durability, flexibility, and access time are factors to be considered.

Videotape players are widely available in educational and service facilities where videodisc players are rare. Videotapes are easily reproduced; videodiscs are not. However, videodisc technology has been applied widely in the Armed Forces and in industry. Over 3,700 videodisc players are used by the Armed Forces for the education of military personnel and the operation of complicated equipment such as tanks. Videodisc Monitor, 1985). In the automobile industry alone, 15,500 videodiscs are used for training, demonstration, and development. It is apparent then that, in large-scale applications, videodisc materials become highly efficient, as well as effective. The cost of hardware is about the same for videotape and videodisc (Magel, 1985), but if materials need to be updated frequently, or if less than 10 copies are needed, then videotape is considerably less expensive.

Preparation of Videodiscs
A commercially available optical disc recorder (Panasonic TQ-202) for on-site production of videodiscs is commercially available for $30,000. Each non-erasable 15-minute disc costs $750. Discs recorded on this machine are not compatible with other videodisc players.

To prepare a standard video-disc of the kind used in business and entertainment, a videotape master must be made of professional studio quality. Many individuals in audio rehabilitation do not have access to television production facilities that are capable of professional preparation of videotapes, nor do they have the funds to purchase this type of service. Magel (1985) quoted a vice president of a major producer of interactive medical programs:

For high-end video, there is no significant difference in production costs between interactive tape and disc. To achieve similar professional results, the elements of writing, talent, directing, lighting, and sound are the same. The cost difference comes in the post-production activities such as careful editing. (p. 38)

Another expensive item in the preparation of videodiscs is the mastering charge. The current cost of pressing a master videodisc from a 35-minute one-inch videotape is approximately $2000. Replications (dubs) of this master
cost about $20 each. By ordering 100 or more replications of a master, the cost of videodiscs may be the same as the cost for an equal number of videotapes (Scannell & Brenner, 1981).

Unlike videotapes, videodiscs can be handled extensively without damaging them; there is no image deterioration, wear, or stretching. One can "freeze" a single frame on a videodisc playback and display it indefinitely without any damage to the videodisc. The 3M Company estimates the longevity of the disc at 600 years (McComb, 1983). However, the fact that videodiscs contain permanent information that can be erased at will is a more flexible medium for some applications. For slides, videodiscs are superior: 54,000 slides can be stored on a 30-minute videodisc. On videodisc, each slide would have to be recorded for as long as the slide is to be presented. Despite differences in storage capacity, with a computer both media can achieve comparable interactivity.

The distinct advantage of the laser videodisc is immediate and precise accessing of any frame in any order (random access) or in any mode, for example, still frame (normal speed) or slow motion. The average time from the first to the 54,000th frame does not exceed 5 seconds. In contrast, accessing a single frame on a videotape is a sequential process because the tape must wind past the player's head. To fast forward a videotape from the beginning to the end of a 30-minute segment takes 3 minutes. Rewind takes 15 minutes. However, videotape access time can be reduced with careful editing. By placing the more frequently used items at the center of the tape and working outward from the center, less time will be needed to access the programmed frames. With videodiscs, geographic location does not usually make any difference because access times are so short. The instruction need for high speed access is greater when the storage view is shorter (less than 10 seconds) and when access will be random as in a look-up or directory type application. If longer stimuli are used, or the instructional path is fairly linear, then videotape access is adequate.

COMPUTER HARDWARE, SOFTWARE, AND SUPPORT RESOURCES

A computer system in an aurial rehabilitation setting requires careful planning. Decisions concerning hardware, software, and support resources must be made concurrently because the computer system functions as a unit and will be only as strong as its weakest link. The first step in selecting a system is evaluating the aspects of the aurial rehabilitation program which can benefit from computer assistance. Then, any existing software relating to program goals should be examined. If existing software meets the needs of the program, hardware may be purchased which executes the software of choice. This sequence is specified because computer hardware is relatively inexpensive when compared to time and dollar costs for computer programming.
If no useful software exists, then the computer hardware purchased will be derived from a listing of all specifications required of the CS&E activities which are to be developed. A consulting computer systems analyst will be of great help in this regard.

The audience who will use the system should be identified. If instructors, instructors, and college students will be the primary users, then only the basic educational requirements need to be addressed. However, if young children, older adults, or persons with special handicapping conditions are to be hands-on users, then system design must be consistent with their abilities. Specifications should include how the system is to interact with the computer, for example, by typing a sentence, pushing a key for closed-set responses, or moving a cursor on the screen. Besides age and physical limitations, computer sophistication, typing experience, and the physical layout of the environment need to be evaluated.

The physical demands of a computer work station are not the same as those of a typical secretary's desk. Common problems are (a) high light levels, produced by typical overhead fluorescent lighting and sunlight, which often cause glare on a monitor, (b) poor seating, which causes back and arm aches, (c) high noise levels from a printer, and (d) inadequate storage space (Cutler, 1984; Lowell, 1985). The work station layout in aural rehabilitation can also become complex because of numerous peripheral devices.

Hardware

Aural rehabilitation requires special storage devices, such as videotape and/or laser videodisc systems, that yield high-quality audio and video images for use in speechreading, auditory training, and other CAI applications (Kopra, Dunlop, & Kopra, 1984; Siers, Snell, & Clayman, 1984). Although each system in a stand-alone operation may work well, special interface boards may be required to place video playback units under computer control. In Appendix A, sources and general specifications for some of these video interface boards are listed.

Usualy, the most neglected computer peripheral device is the monitor. Monochrome displays are best for text editing and may produce characters in amber, green, or white on a black background or in reverse video. Color monitors are best for graphic displays and live-action video. Simultaneous use of graphics and text is desirable, then one might consider the newer monitors which are switchable from high-resolution, RGB color, to composite video input from the video playback.

Eighty-column displays are best for text monitors that offer higher resolution are easier to read. Resolution is commonly measured in lines (Cirz, 1985) or in pixels (picture elements or dots). Another factor which affects resolution is the computer's character matrix generator which defines how many dots are used to create each character (Couch, 1984). This number can range from 35 to 300 dots per character. One must be aware that some computers may
not be able to generate a sufficient character matrix to adequately use the
capabilities of a high resolution monitor. A simple way to observe differences
in resolution is to plot a circle on the monitor screen. Lower resolution screens
show a choppier step-step view, while higher resolution systems have a more
gradual curvature. Some computer systems allow selection of different levels
of resolution. Through software commands, different screens or modes can be
used, allowing higher or lower levels of graphic resolution. These different
screens will produce texts of 20, 40, or 60 columns.

For further information, the reader is referred to (Chial (1985a)) to learn
about (CPUs, memory), storage devices, output devices, and interfaces.

Software

Appendix 9 lists many software packages currently available for audiolo-
agal applications including drill and practice in hearing testing, hearing
aid preselection database routines, and CAT in anatomy and physiology.
Detailed program description, critiques of program function, and compati-
bility constraints for software related to speech and hearing are provided in the
software review section of Assist and the Journal for Computer Uses in Speech
and Hearing. Reviews of general application software (word processing and
database management programs) can be found in popular computer maga-
zines such as Byte, PC World, Incider, etc., and Personal Computing.

As suggested by Chial (1985b), it is always good practice to evaluate soft-
ware thoroughly prior to purchase in order to ensure that it produces the
desired results and is hardware compatible. Software for special applications,
such as speech, language, and hearing, is usually only available for hands-on
demonstrations at conferences and conventions. However, one can easily
consult others who may have used the software and who can provide an un-
biasd opinion of its performance. Jackson (1984) also advises buyers to be
aware of hardware requirements. A $50 software package can become very
expensive if $500 worth of special boards or other peripherals is needed to fully
use the material. Furthermore, Rushkoff (1984b), warns the user to deter-
mine if a specific hardware brand is required to use the software. He noted
that some software packages which access speech synthesizers will run only
on particular brands of speech synthesizers and not on others.

Much of the available special purpose software is for speech pathology
programs. With the exception of several hearing aid selection routines, few
application programs are being used in aural rehabilitation. Some software
is being more generally applied. The Aphasia I, II, III program distributed
by Parrot Software have been used by several institutions for teaching lan-
guage to the deaf (F. Weiner, personal communication, September 24, 1985).
As the current interest in computer use in aural rehabilitation continues,
more software will be adapted and developed.
Support Resources

Support resources may include personnel to set up and operate the equipment, technical support to provide hardware modification and repair, and programmers to edit and prepare special software. Programmer support will continue to be a necessity in the near future as few application packages are commercially available that apply directly to speech and hearing (Rushakoff, 1985). This paucity of software means that a significant amount of time must be spent in adapting software developed for other applications or creating one's own software for aural rehabilitation.

Other support is required in the areas of reference publications and special interest groups. Many journals and magazines concerned with computer applications in general review software and hardware, provide answers to specific interface and application problems, and explain how specific tasks can be accomplished more efficiently. The annual computer conference of the American Speech-Language-Hearing Foundation highlights new software and hardware and provides hands-on evaluation. Local special interest groups and electronic bulletin boards are also good sources of information.

FUTURE APPLICATIONS

As the computer grows in popularity in speech and hearing centers, users will continue to find new and unique ways to use this tool. In addition to word processing and database applications, there are many teaching, clinical, and research areas for development. Computer assisted case history taking, assessment, and management of intervention strategies such as is being developed by Smaldino and Treagor (1984), could systematize the rehabilitation process. Korey, Abramson, Dunlop, and Kopra (1985) also are beginning to use a computer modified version of the Hearing Performance Inventory toward this end. CAI or CAIV programs could be developed for training clients in the use of coping strategies when communication fails, and for hearing aid orientation.

Jagger and Fifer (1984) stated that CAIV instruction with laser videodisc technology is a logical adjunct for training clients to use cochlear implants as lipreading aids. Boothroyd (1983) has begun using interactive videotape in a lipreading tracking procedure for cochlear implant users at the university level, aside from the academic uses now in place, applications of CAIV may include simulation of real-life experiences for students, for example, case history interviews, counselling of clients and their families, and interaction with clients who are difficult to test. CAIV programs for training sign language would also be helpful. (Newlin, Sims, & Myers, 1983).

Research

CAI and CAIV permit a degree of control over the rehabilitation process which can facilitate research. Methodology and stimulus variables can be
studied free from teacher/clinician and scientist presentation effects. For example, with CAV, one can record scanned access to preformed video
segments with control of every video frame (1/30 of a second). This permits
detailed study of a speechreading stimulus and the influence of frame rate on
speechreading training. Any number of visual perceptual tasks can be pro-
grammed and compared. For example, experiments using discrimination, recog-
nition, and/or comprehension paradigms could be compared for instruc-
tional effectiveness (Sirs, 1985). Koppe, et al., (1984) have begun to use a
programmable attenuator in the audio circuit of a Sony CAV/TV computer
system. If sound is used, any desired intensity can be programmed for audic
itory training or auditory/visual tasks.

With all the technical promise offered by CBE, there must be a significant
amount of research required as to its effectiveness in actual rehabilita-
tion. CBE will be as short lived as other educational fads if it fails to consider
validity of learning to be as important as the content and process of instruc-
tion. This implies that CBE authors should commit themselves to long-term
ecological studies which demonstrate efficacy.

While considering future applications of the tiny new high technology
device, one must still keep in mind the fact that the old devices still work and
still perform important functions. In the rush to have the latest gadgetry, old
standbys will probably continue to be the workhorses until and after new
technology is in place. Also, one should never expect that CAI will be better
than individual therapy with a seasoned clinician. CAI is only as good as the
programmer makes it and considerably less flexible than a clinician when a
client acts in unpredictable ways. When it is not feasible to have one-on-one
therapy for extended periods of time, high-quality CAl, which has been proven
effective, is a reasonable alternative.

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Computer-to-video interfaces are often used for educational and training purposes. They allow the integration of visual and auditory elements, enhancing the learning experience. These interfaces can be integrated with other technologies, such as multimedia and virtual reality, to create interactive learning environments.

**Appendix A**

**COMPUTER-TO-VIDEO INTERFACES**

The following sources provide computer-to-video (videodisc/videotape) interface cards. Prices are variable ($150 to $300), and other options are available. Authoring languages are provided with most interface boards; some are included in the purchase price. The list is taken from Parker (1984) and Lowry (1984).

- **Allen Communications**
  140 Lakeside Plaza II
  3225 Wiley Post Way
  Salt Lake City, UT 84116
  (801) 373-7800
  System: Mac II, II+, IIIe, IBM-PC
  Requires RS-232C serial port

- **Alphaset Systems, Ltd.**
  Suite 322
  11436-108 St.
  Edmonton, Alberta, Canada
  TEL: 403-451-5761
  System: Mac II, III, IIIe

- **BCD Associates, Inc.**
  205 Broadway, Tech Center
  7515 N. Broadway Ext.
  Oklahoma City, OK 73116
  405-443-4278
  System: Mac II, III, IIIe, IBM-PC in emulation mode, or any RS-232C serial port computer

- **Cavi Systems**
  26 Trumbull St.
  New Haven, CT 06511
  203-562-4697
  System: Apple II, III, IIIe, IBM-PC

- **Videonics Monitor**


APPENDIX B

SOFTWARE FOR AURALOGICAL APPLICATIONS

1. Computer-Assisted Instruction
      Lake City: College Hill Press. $295.
      Technical Institute for the Deaf. (public domain software; Multi-stage version available at
      $50 each. Apple III and IIe).

2. Digital Controls
   5335 Oakbrook Pkwy. #200
   Norcross, GA 30093
   800:441-3112
   System: IBM-PC
   Requirements: RS-232C serial port

3. Friedman's Educational Computing Consultants (MECC)
   360 North Lexington Ave.
   St. Paul, MN 55101
   612:418-3500
   System: Apple II, III, IIe
   Nov. Manna Graphics Corp.
   279 Canstotage St. #5
   Burlington, MA 01803
   617:272-3944
   Requirements: RS-232C serial port

4. Synapse Inc.
   1933 West 8 Mile Road
   Detroit, MI 48235
   313:272-3302
   System: Apple II, IIe, III, IIe
   Video Vixen Associates, Ltd.
   7 Waverly Place
   Marlboro, NJ 07746
   201:377-0302
   System: Apple II, IIe, III w/Il-evaluator card
   Whitney Educational Services
   1777 Borel Place, #4c
   San Mateo, CA 94402
   415:311-5116 or 415:370-7017
   System: Apple II, III, IIIe, IBM-PC
video interface card, and videotape player.)


2. Data Base


3. Evaluation


