Computerized Laser Videodisc Programs for Training Speechreading and Assertive Communication Behaviors

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Three laser videodisc programs are described for training the communication skills of hearing-impaired children and adults. They are designed to provide analytic and synthetic speechreading practice and to encourage assertive communication behaviors. During therapy, students are trained to use repair strategies when they do not understand an utterance. For example, they may ask that a talker rephrase a sentence, repeat or simplify it, say a key word, and/or say two sentences. Children also receive practice in speechreading school-related vocabulary and using repair strategies in a school setting. This report describes exploration, discrimination, and identification training modules; and outlines the test battery designed to assess the efficacy of training.

Many educational and medical centers routinely provide audiovisual training to new hearing aid users and cochlear implant clients. The former group must learn to speechread with their aids, while the latter must revive auditory memories and relate a qualitatively new signal to speech. When training does occur, it is typically in a favorable setting, with good lighting, a quiet room, and a skilled therapist. In the past 10 years, computer use has enabled manipulation of these variables.

Advantages of computer technology include the versatility of the microcomputer and its capability to control complex protocols tailored to individual needs. The computer also allows interactive learning in which successive stimuli are determined by previous responses. The clinician need not be present and training can be scheduled at the client's convenience (unlike with group therapy), thus reducing clinical costs and facilitating full client participation. Summerfield (1983) has suggested that "among the advantages of computer-aided instruction may be its ability to encourage at least some novice lipreaders to relax, precisely because they are interacting with a television rather than a live teacher" (p. 167).

Computerized instruction in aural rehabilitation has been used for auditory training

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(Sims, Scott, & Myers, 1982), language and reading lessons (Brawley & Peterson, 1983), speechreading training (e.g., Sims, 1978), and sign language instruction (Newell, Sims, & Myers, 1983). Kopra, Dunlop, Kopra, and Abrahamson (1985) have also used laser videodisc material for speechreading training. (See also Sims, Kopra, Dunlop, & Kopra, 1985.)

The purpose of this report is to describe three computer-controlled laser videodisc programs for training speechreading skills and assertive listening behaviors. These programs have been developed at The University of Iowa Hospitals and are currently being evaluated with hearing-impaired individuals.

GOALS OF THE SPEECHREADING TRAINING PROJECT

Our audiovisual training project has four goals:

1. *Assess whether computerized instruction improves audiovisual recognition of words and sentences.* Although the project aims to enhance an individual's ability to recognize speech audiovisually, there has yet to be consensus as to whether speechreading training is beneficial or how speechreading skills should be taught (see Ross, 1987). One goal of the project is to determine whether computerized instruction improves speechreading skills, and to compare the effectiveness of analytic and synthetic types of training.
2. *Develop situation-specific skills.* Hearing-impaired individuals rarely encounter ideal listening settings in everyday life. Since many seek speechreading training precisely because they are experiencing situation-specific listening problems, the project is designed to help clients cope with these individual problems.

   By learning to speechread situation-specific vocabulary such as "doctor," "appointment," and "waiting room," hearing-impaired individuals might communicate better in a doctor's office. The individuals can also learn to anticipate problems in a particular setting such as the talker looking down at an appointment book. They may feel less anxious if they expect these difficulties and may be more likely to respond successfully if they have practiced in the therapy setting.
3. *Rectify communication breakdowns.* Increasingly, aural rehabilitation therapists emphasize assertive communication behaviors as part of their training programs (e.g., Kaplan, Bally, & Garretson, 1985). They teach clients how to use "repair strategies" when they do not understand a talker. These include telling the talker to repeat a sentence, rephrase it, simplify it, or spell a keyword. The project provides practice in a clinical setting, and this may build confidence in implementing strategies in the real world and selecting them appropriately. For instance, if nothing was understood, a hearing-impaired individual might ask the talker to "Repeat what you just said." On the other hand, if all but the last word was understood, the individual might ask, "What was that last word?"
4. *Optimize talker characteristics.* Hearing-impaired individuals often interact with talkers who are unaware of their unique communication needs. For example, a normal-hearing talker may not know that chewing gum, speaking in profile, or standing before a bright window can create speechreading difficulties. The project aims to teach clients how to recognize these behaviors and instruct the talker in a graceful manner, while feeling confident in doing so.

PROGRAM DESCRIPTION

Training Station

The training station includes (a) an AST Premium 28C PC computer[1], (b) an IBM Infowindow display unit, and (c) a Pioneer LVD 6000 Laser videodisc player. The Infowindow unit is a high resolution color display capability unit with a built-in 13-inch touch-screen. A built-in stereo mixer drives the two speakers, but an external amplifier may be hooked up instead. The system is diagrammed in Figure 1. There are only three pieces, interfaced via simple two-way cable connections, for ease of assembly, disassembly, and transportation.

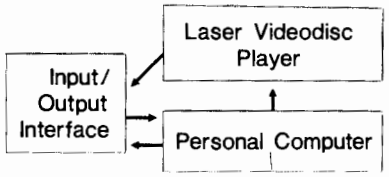

Figure 1. Hardware configuration for the laser videodisc training programs.

Training Activities

We have developed three audiovisual speechreading training programs using laser videodiscs. The training materials were filmed by a professional audiovisual studio crew.

Program 1 emphasizes analytic training, while Program 2 emphasizes a synthetic approach. Program 3 provides situation-specific communication practice for hearing-impaired children and simulates a school day. Material for this disc was filmed on location (i.e., in a home, on a bus, in a school, and at a fast food restaurant).

Program 1: Analytic speechreading training. The program consists of eight audiovisual exercises, graduated in difficulty, requiring discrimination and identification of the consonants /b, d, g, p, t, k, m, n, v, f, s, ʃ/.

The first exercise presents consonant ensembles with members from different viseme groups, such as /b, d, g/ and /p, t, k/. In the next six exercises members are from the same viseme groups, such as /p, b, m/ and /t, d, s, n/. The final three exercises present ensembles of 6-10 different consonants. Each sound is paired with a particular color, so as to maintain interest and facilitate training for individuals who might be poor readers. Two different talkers (one male and one female) appear throughout training.

Each exercise has three training modules. Module 1 presents consonants (C) and vowels (V) in /CV/, /VC/ and /VCV/ formats. The vowels are /a, u/. Module 2 presents single words that begin with the target consonants. All words can be illustrated (e.g., "pan," "bus"). Module 3 presents the monosyllabic words from Module 2 in a carrier phrase context (i.e., "That's a/the _____.").

[1]The AST Premium 286 PC is configured with a 1.2 megabyte of RAM, math coprocessor, a 40 megabyte hard disk, one high density floppy drive, enhanced graphics adapter with 128K graphic memory, a general purpose interface bus (GPIB) controller card for communicating with the Infowindow, and one serial and one parallel communications port.

Each module presents three training activities. The *Exploration* activity provides self-initiated exposure to the stimuli. For example, if the ensemble includes /ba/, /ab/, /bu/, /ub/, /pa/, /ap/, /pu/, and /up/, these items would appear in print in individual boxes on the computer touch-screen. Below each box is a circle in the consonant's assigned color. (In modules 2 and 3, picture illustrations appear instead of the circles.) When the student presses a circle, that item is presented (i.e., a talker appears on the screen and speaks the item), along with a visual reinforcement. This procedure continues until the student has made 20 selections (the student may choose an item several times). As such, students are active participants in the training, and can experience the items which seem most difficult. A typical sequence of selections might be /ba/ followed by /bu/, /bu/, and /ub/. Here the student has chosen to compare /b/ in two different vowel contexts and two different syllable positions.

In the *Discrimination* activity, a talker appears and recites either two different items or the same item twice. Figure 2 presents the "same/different" monitor display that appears next. The student touches the appropriate half of the touch-screen. An incorrect response leads to repetition of the items (talker appears again); a correct response leads to a visual reinforcement (such as a smiling face) and then to presentation of the next pair.

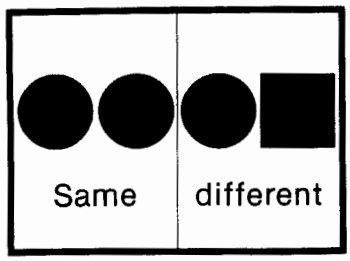

Figure 2. The monitor screen that accompanies the Program 1 discrimination task.

For the *Identification* activity, the stimuli are presented six times each in random order. The talker appears on the monitor and utters a member of the ensemble, followed by a printed list of the ensemble. When the items are nonsense syllables, a circle in the consonant's assigned color appears below each one. Real words are illustrated as exemplified in Figure 3. The student touches the screen to respond. If the response is incorrect, the monitor prompts, "Try again," and presents the talker repeating the same item. When the student eventually identifies it, the item is spoken again, followed by a visual reinforcement.

After the identification activity, the student completes an exploration activity for each item that was misidentified. For example, if the syllable /pa/ was identified as /ma/ and then /ba/ during the identification task, all three syllables would be presented on the touch screen. With this training, the student can compare those items that he or she is most likely to confuse.

Program 2: Synthetic speechreading training. Program 2 provides synthetic audiovisual training and focuses on developing assertive communication behaviors. The program consists of 160 "primary sentences" that can be illustrated. They are divided evenly

Figure 3. The Program 1 monitor display that appears when a student must identify a monosyllabic word.

into eight exercises and are spoken by one of 10 different talkers. Two of the talkers are children (ages 8 and 12).

Each exercise has two modules: (a) Communication breakdown and (b) Exploration. In the *Communication breakdown* module, a talker appears and recites a primary sentence (e.g., "The football game is over."). Afterward, four pictures appear on the touch-screen. One picture illustrates the sentence; the others are foils. Some (or all) of the foils relate to one or more of the words in the primary sentence. For instance, for the example sentence above, one foil shows two children playing a game and another includes a beachball. Pictures are used to avoid forcing the student into a mode of verbatim responding.

The student touches a picture to respond. If incorrect, five repair strategies are offered: (a) "Say that again." The same talker appears and repeats the sentence. (b) "Simplify the sentence." The talker utters a simpler sentence with approximately the same meaning as the original sentence. Simplification is accomplished by eliminating words and/or substituting infrequently-used words with ones of higher usage (e.g., "The game is over."). (c) "Say two sentences." The talker says two sentences, using the same key-words in both sentences and providing additional information (e.g., "The men played football. The football game is over."). (d) "Say one important word." The talker repeats a primary content word in the sentence (e.g., "football"). (e) "Rephrase the sentence." The talker paraphrases the sentence (e.g., "The game is finished."). Figure 4 presents the symbols associated with each repair strategy.

If the student again responds incorrectly, the sequence continues until the student identifies the correct picture. Note that students control the talker's behavior by selecting the repair strategies. In this respect, they are active rather than passive participants in the training program.

For the *Exploration* module, the student views a primary sentence and then must

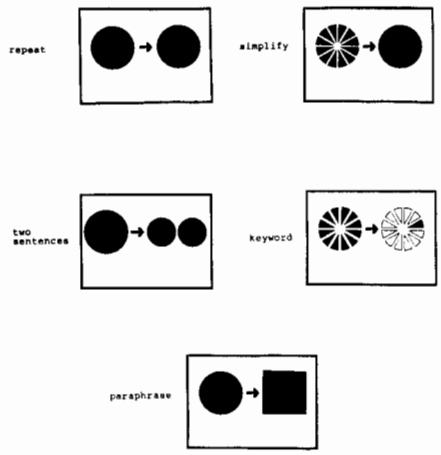

Figure 4. Symbols used on the monitor for five communication repair strategies.

select a repair strategy symbol (i.e., "rephrase," "simplify," "keyword," "two sentences," "repeat"). The sentence variant associated with the repair strategy is then shown. The student is to select a second strategy and then views another variant. During this training, the text of the primary sentence and variants is printed after they are produced by the talker, who then repeats them a second time. During this module, the student learns what information each repair strategy might elicit, and may contrast different strategies.

For more skilled speechreaders, the program may be altered so that four printed sentences are presented as possible responses instead of illustrations. The four sentences for a particular presentation become more alike in appearance as training progresses.

Program 3: Situation-specific speechreading training for children. Program 3 consists of 132 sentences divided into 11 exercises and provides communication practice in home and school settings. Each exercise presents a different setting that a hearing-impaired child might encounter during a school day: breakfast, a bus stop, bus, math class, science class, art class, music class, physical education class, birthday party, school library, school cafeteria, and a fast food restaurant. The talkers who appear throughout training are often children, ranging in age from 7 to 13 years old. The adult talkers represent teachers, a bus driver, parents, and a cafeteria worker.

The training protocol is modified from Program 2 to fit each setting. Occasionally (on average, every fourth sentence), sentences are presented with a "communication difficulty," as when a talker speaks while chewing. In these instances, the child may choose an additional repair strategy, "Don't chew," and the sentence is repeated by the same talker without chewing. The five repair strategies described for Program 2 are also available with their associated variant sentences spoken with or without the communication difficulty. Sometimes the talker speaks in profile. In these instances, the child may request, "Look at me." The talker then repeats the sentence full-faced, as if the talker had turned toward the child. Other communication difficulties include running water, looking down while talking, and standing by a window. One difference between this program and Program 2 is that the sentence illustrations and foils are still photographs rather than artistic illustrations. All repair strategies are presented orthographi-

cally and pictorially.

At the beginning, mid point, and toward the end of an exercise, the child views a 10-second film clip that establishes the setting. For instance, children walking toward a cafeteria line appear at the beginning of the cafeteria exercise; children seated at a cafeteria table are shown midway through the exercise; and a group of children carrying their lunch trays are shown near the conclusion. The scenes are filmed from the child's point of view so that the child may feel a part of the scene.

EVALUATING THE EFFECTS OF TRAINING

Ideally, a test battery should meet several criteria. First, it should focus on the skills that were trained during therapy. Second, it should provide an index of success in the real world, outside of the clinical setting. Finally, the battery should separate the effects of training a particular skill (such as speechreading) from the effects of learning a particular task (e.g., performing a same-different task while sitting in a sound-proof booth). We suggest that clinicians use several different measures of success and use test procedures that differ (at least somewhat) from the training activities.

We evaluate the effectiveness of training with computerized tests and questionnaires. They are administered immediately before and after training, and then six months later. The purpose of testing is to determine whether clients have improved their speechreading skills (the first goal described earlier) as indicated by sentence and consonant identification and whether they can rectify communication breakdowns in favorable listening conditions (the third goal). The evaluation data include:

1. The Iowa Laser Videodisc Sentence Test (Tyler, Preece, & Tye-Murray, 1986). This test presents 100 sentences spoken by 20 talkers (10 males and 10 females). Each talker says five sentences. Clients respond by reciting aloud as much of a sentence as they can. They receive no feedback. This procedure differs from the Program 2 training exercises in that clients must repeat sentences rather than identify a corresponding illustration (or printed text).
2. The Iowa Consonant Confusion Test. This test contains 13 /iCi/ utterances spoken by a male talker. Clients respond by touching one of 13 alternatives on the monitor touch-screen. This procedure differs from the Program 1 training exercises in the number of response alternatives (13) and vowel context.
3. Repair Strategies Test (Tye-Murray, Purdy, & Tyler, 1988). This test evaluates how well clients can instruct a talker when they do not (completely) understand a sentence while communicating in favorable conditions. Prior to testing, clients read a written description and see an audiovisual example of five repair strategies. For testing, clients first try to identify a sentence stimulus. If the client does not recite all words correctly, he or she then must select one of the five strategies described for Program 2. The option occurs, after which the talker repeats the original sentence. The client again recites as much of the sentence as possible. The client's performance is scored by the percentage of words repeated that were not correctly identified after the first sentence presentation. Sentences which were identified completely after the first presentation are not scored. If the repair strategy selection provided useful information, the percentage will be above 0%.
4. Repair Strategy Documentation. When a subject responds incorrectly in Program 2 and Program 3, the computer records which repair strategy was selected and whether it led to a correct response. The information indicates relative frequency

and effectiveness of strategy selection. The same information is collected during the Repair Strategies Test to see if a client's pattern of repair strategy selection changes after training as compared to before training.

5. Questionnaire. We have developed preliminary versions of two questionnaires. They are specifically designed to assess speechreading needs and abilities and a client's use of repair strategies. One questionnaire is designed for adults (Tye-Murray, Purdy, Shum, & Tyler, 1988), and one for the parents and teachers of children enrolled in training. The questionnaires include statements regarding (a) the clients' (or parents' and teachers') subjective impressions of their speechreading skills, (b) clients' subjective impressions of how their hearing aid enhances speechreading, and (c) whether clients feel competent in remedying situations in which they do not understand a sentence in favorable listening conditions. Impressions are collected for different talkers and settings, and for an auditory-only and audiovisual situation. Respondents indicate their agreement on a scale of 1 ("I completely disagree.") to 100 ("I completely agree.") with statements such as the following (adult questionnaire):

   1. I am in a quiet, well-lit room. I am talking with only one person. I have difficulty speechreading if the person is:
      a. _____ an adult male family member or friend
      b. _____ an adult female family member or friend
      c. _____ an unfamiliar adult male
      d. _____ an unfamiliar adult female
      e. _____ a child
   2. Someone talks to me while I am listening to the radio. Even with the noise from the radio, I can speechread the talker if the person is:
      a. _____ an adult male family member or friend
      b. _____ an adult female family member or friend
      c. _____ an unfamiliar adult male
      d. _____ an unfamiliar adult female
      e. _____ a familiar child
      f. _____ an unfamiliar child
   3. I am in a quiet room talking to someone in a high-quality telephone. I have difficulty understanding if the person is:
      a. _____ an adult male family member or friend
      b. _____ an adult female family member or friend
      c. _____ an unfamiliar adult male
      d. _____ an unfamiliar adult female
      e. _____ a child

   The subcategories indicate whether training effects have generalized to several talkers. By comparing the responses to statements #1 and #3, speechreading enhancement can also be indexed. If an individual benefitted from training, then we might expect larger score differences between statements #1 and #2 after training, as compared to before training. The questionnaire can also be used to determine candidacy for speechreading training and to determine whether training affected auditory-only listening performance.

   The questionnaire also contains statements that assess whether clients feel competent to remedy situation-specific listening problems and how well they can speechread situation-specific vocabulary (Goal 2). In addition, it assesses how

well a client can instruct a talker to alter inappropriate speaking behaviors (Goal 4). Clients indicate their agreement on a scale of 1 to 100 with statements such as the following (adult questionnaire):

1. A man is doing something that makes him difficult to speechread (covering his mouth with his hand, speaking behind me, chewing gum, standing in front of a window, etc.). I would ask him to alter his behavior if the person is:
   a. _____ an acquaintance
   b. _____ a doctor
   c. _____ a gas station attendant
   d. _____ a storekeeper
   e. _____ a banker
   f. _____ a cashier
2. I am playing cards with a group of friends and acquaintances. The dealer says something, but I understand only a few words. I ask the dealer to:
   a. _____ repeat the sentence
   b. _____ say it in a different way
   c. _____ simplify the sentence
   d. _____ tell me what the sentence is about
   e. _____ elaborate
   f. _____ I do not say anything
3. I am at a Christmas party, talking with several people. Someone in the group says something that I do not understand. I ask the person to say it differently if the person is:
   a. _____ an employee (if applicable)
   b. _____ a supervisor or boss (if applicable)
   c. _____ an unfamiliar male
   d. _____ an unfamiliar female
   e. _____ a male friend or family member
   f. _____ a female friend or family member
   g. _____ I do not say anything

FINAL REMARKS

The laser videodisc training programs may have additional applications. If the visual signal is turned off, Program 1 may be used for auditory training. Additional software can be written so that the materials in Program 2 can be used for speechreading testing rather than speechreading training. Finally, teachers who interact with hearing-impaired children may wish to participate themselves in Program 3 without an audio signal. Through this activity, they may gain insight into the special listening needs of hearing-impaired individuals, and become more aware of their own communication behaviors.

We are currently testing Program 2 with hearing-impaired children and adults. The computer software for Programs 1 and 3 is under development. Although we are presently interested in assessing each program individually, a comprehensive aural rehabilitation program might include training with all three discs.

ACKNOWLEDGEMENTS

The authors were supported by the Easter Seal Research Foundation, NIH Grant No. CDRIPO1NS204660IAI, Grant RR59 from the General Clinical Research Resources, NIH, the

Iowa Lions Sight and Hearing Foundations, and the University of Iowa Video Center. We thank Phyllis Harper-Bardach for her assistance in developing the training materials and Joan Huntley, Michael Bertschy, and Suzanne Purdy for sharing their technical expertise. Thanks also to Carol De Filippo for her very helpful editorial remarks, and to Adrienne Rubinstein for comments on an earlier version of the manuscript.

Information about obtaining copies of the laser videodiscs and/or the speechreading questionnaires can be obtained by writing the first author.

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