A Computerized Treatment System for Chronic Aphasic Patients

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We have experienced a considerable growth in the number of chronic aphasic patients at our clinic over the past few years. We are constantly looking for ways of providing speech services for these patients both to maintain and to improve their communicative abilities. Ways of extending services beyond individual and group treatment and counselling have in the past included judicious use of homework assignments and programmed lessons as well as speech-aid machines such as the Bell and Howell Language Master, and most recently, the use of therapy devices over the telephone, called Telecommunicology (Vaughn, 1980).

In addition to addressing the language needs of our chronic aphasic patients, we encourage them to take an active role in the treatment process. Studies have shown that giving some behavioral choices and responsibilities to individuals such as the institutionalized elderly in an otherwise dependent situation has a marked positive effect on satisfaction and physical well-being (Bengtson, 1973). Therefore, we support and promote individual decision-making and the expression of personal preferences by the patients whenever possible in the course of their speech treatment activities.

With these points in mind, our Speech Pathology Service at the Los Angeles Veterans Administration Outpatient Clinic acquired an Apple II Plus microcomputer eleven months ago for the purpose of providing additional language treatment to our chronic aphasic patients. The microcomputer appears to be particularly suited for providing supplementary speech treatment. It has the ability to evaluate a response, make limited decisions, follow appropriate contingencies, present textual material, color graphics and sounds, and store and display patient data. Selection of a microcomputer over a larger mini- or mainframe computer was influenced by the ease of programming, relatively low cost, and availability of the microcomputer.

Computer-assisted instruction (CAI) has been used in educational settings with increasing frequency and success (e.g., Apple PILOT, 1980). Several recent studies have utilized microcomputers in the treatment of aphasia. Colby, Christinaz, Parkison, Graham and Karpf (1981) developed a portable microcomputer for the dysnomic patient that can both facilitate the identification of a target word and produce that word via synthesized speech. Mills (1981) used an Apple II Plus computer to generate language treatment through modification of commercially available educational programs and development of other programs, such as auditory comprehension tasks,using a speech digitizer. Seron, Deloche, Moulard and Rouselle (1980) used a computer terminal to present a spelling activity to aphasic patients, with the aid of a clinician. In a related area, Telage (1980) developed a computer program to help analyze articulation errors.

This study is an initial evaluation of the feasibility and effectiveness of using a microcomputer to provide adjunct individual speech treatment to chronic aphasic patients. Reading problems were reported and diagnosed in all our aphasic patients, regardless of the severity of their overall language impairment. Consequently, we developed a computerized system for testing reading ability, teaching and drilling various reading skills, and recording task performance at each session.

The Computerized Aphasia Treatment System (CATS) incorporates several fundamental reading activities into a computerized format. CATS consists of a diagnostic reading test (Table 1), five reading treatment tasks and one math task (Table 2) and retrieval programs to display patient performance over time. All programs were written by the investigators in Applesoft, the Apple's version of BASIC. BASIC is a widely available and relatively easy-to-use computer language.

Table 1. Computerized diagnostic subtests.

Matching Identical Letters, Numbers and Words
Identifying the Function of Objects (Words)
Identifying Associated Words
Identifying Synonyms
Identifying Words that Rhyme
Understanding Sentences
Understanding Paragraphs - Immediate
Understanding Paragraphs from Memory
Identifying Correct Grammatical Structures
Solving Simple Arithmetic Problems

Table 2. Computerized treatment tasks.

Functions	- Identify the Function of Objects
Question Words	- Identify the Meaning of Who, What, etc., in Context
Hangman	- Spelling Words Correctly
Sentences	- Identifying Correct Grammatical Structures
Short Stories	- Understanding Short Paragraphs
Math Drill	- Adding and Subtracting Numbers

Minimal intervention was required by the clinician during administration of treatment materials. After selecting the appropriate computer disk, subjects placed the disk into the computer's disk drive and turned on the computer which automatically accessed the first program on the disk. Subjects then would select the desired treatment task and indicate the number of task items they wished to attempt. Treatment items within tasks were presented in random order by the computer to minimize any learning-order effect. Most treatment tasks were multiple-choice and required the subject to select one key to respond. Subject feedback during the task consisted of a variety of appropriate positive and error statements incorporating the subject's name. Following completion of each task, subjects indicated whether or not they wanted additional treatment items, another treatment task or simply to stop. Subject performance for the task was then automatically stored on the disk. Two additional programs retrieved and displayed patient data from the above test and treatment tasks.

METHOD

Subjects

To demonstrate the feasibility and potential effectiveness of CATS, a single-case study was designed. The subjects were seven adult men, diagnosed as aphasic by two speech pathologists using standardized aphasia tests (Table 3). Two subjects, #6 and #7, dropped out of the study after a few weeks. Subject #6 complained of difficulty in reading the text displayed on the screen; visual-spatial problems are consistent with his low Ravens score and history of right hemisphere impairment. Subject #7, a fluent aphasic patient, had in the past told us of his lack of desire to work with programmed material or any other activity that did not involve direct and individual interaction with a clinician. The performance data presented in this study represents the efforts of the remaining 5 subjects.

Table 3. Description of subjects.

S#	AGE (YR)	TPO (YR)	LESION			BDAE Type	PICA			RAVEN CPM
			Side	Site	Type		OA	VRB	RD	
1	39	1-3	L	F	Neoplasm	Anomic	13.6	14.2	13.8	35
2	63	9-3	L	T-P	Occlusive	Anomic	13.4	13.8	14.7	36
3	63	22-0	L	F	Occlusive	Broca	11.8	12.2	13.2	34
4	66	18-0	L	F	Occlusive	Mixed	13.1	11.3	14.6	30
5	55	5-0	L	F	Occlusive	Broca	12.5	12.4	12.6	29
6	61	3-4	R	F	Hematoma	Mixed	13.7	13.9	13.5	21
7	66	4-6	L	T-P	Occlusive	Condu	12.6	12.6	14.6	35

Procedures

At the beginning of the study, the Reading Comprehension Battery for Aphasia (RCBA) (LaPointe and Horner, 1979) and portions of the Doren Diagnostic Reading Test of Word Recognition Skills (Doren, 1973) were administered to all seven subjects. In addition, all subjects took the computerized reading test. The computerized reading test required the clinician to interact with the subject in much the same manner as in more traditional testing situations. That is, the clinician presented materials and recorded responses—in this case, via the computer keyboard—while the subject was required only to point to the correct response displayed on the television monitor screen.

The treatment phase consisted of two-to-four 20-60 minute computer sessions per week for eight to twelve weeks. The computer sessions usually preceded or followed 30-60 minutes of routine speech treatment conducted by a speech clinician. At the end of the treatment phase, the pretreatment reading tests, including the computerized reading test, were readministered.

RESULTS

Changes in reading ability were assessed in two ways: comparing pre- and posttest reading scores and examining scores on treatment tasks. Although little change occurred in pre- versus posttest performance on the RCBA and Doren tests, some improvement took place on the computer test (Table 4). Three of the five patients increased their post-computerized reading test scores by 11 or more points. Although some change may be attributed to increased familiarity with the computer, the degree of improvement among these patients suggests that actual learning took place. The computerized test did have the greatest variety of language subtests. Test-retest reliability assessments of the computer test will be conducted in the future in order to determine the significance of the changes.

Table 4. Overall performance for pre- and posttesting.

S#	RCBA (Max=100)		Doren (Max=200)		Computer (Max=168)	
	Pre	Post	Pre	Post	Pre	Post
1	95	96	190	192	161	164
2	97	96	184	185	152	164
3	77	78	137	131	124	138
4	85	87	159	168	142	144
5	81	86	156	158	145	156
$\bar{X}$	87.0	88.6	165.2	166.8	142.4	153.2

Examination of individual performance over the eight to twelve weeks on specific treatment tasks reveals considerable differences among patients. Generally, patients worked more often on tasks they found challenging. As accuracy increased, latency of response decreased and the number of items attempted per session increased. For Subjects #1 and #2, both mildly impaired anomic aphasic patients, initial performance on treatment tasks was high. For these patients, treatment appeared to provide an opportunity for continuous responding and high accuracy. For the remaining three, who were moderately impaired nonfluent aphasic patients, initial scores on some tasks, such as Functions, Question Words, and Short Stories (Table 5) were generally low. Over the treatment period, these patients showed steady improvement.

DISCUSSION

The results of this study indicate that a microcomputer without special modification can be used to provide supplementary individualized reading treatment for both mildly- and moderately-impaired aphasic individuals. Mildly-impaired patients benefit primarily from the language stimulation provided by the computer-assisted treatment. Moderately-impaired patients also appear to benefit significantly from the specific instructional components of the programs.

Table 5. Performance on tasks for each subject.

S#	Sessions	Items	B-Line	Mean	S.D.
Functions					
1	2	10	100	100.0	--
2	3	16	100	100.0	--
3	10	145	80	84.2	12.1
4	7	110	80	95.0	8.4
5	6	48	100	97.8	4.9
Question Words					
1	3	46	100	100.0	--
2	8	97	100	94.7	7.7
3	9	110	30	41.9	19.9
4	8	125	50	67.6	11.8
5	5	93	60	84.7	6.7
Short Stories					
1	10	98	100	96.7	7.1
2	4	59	93	93.3	11.6
3	6	85	80	71.4	12.0
4	10	184	62	95.2	6.7
5	6	62	70	82.8	15.0

We have also found that the microcomputer enables us to give the patient a more active role in treatment. Making the patient responsible for some aspects of his treatment can contribute to developing or maintaining a degree of self-confidence and autonomy. As mentioned earlier, all patients quickly learned how to start the computer, and how to select materials. In addition, aphasic patients at this level of functioning are capable of deciding how long they want to spend on each computer task as well as what type of task on which to work. The computer-assisted treatment experience provides situations that require independent behavior, judgment and decision-making on the part of the patient.

Although our data suggest that the microcomputer is effective for speech treatment, its role is both limited and specific. As previously mentioned, two of the seven patients did not complete the treatment phase of the study—one had visual-spatial difficulties affecting reading the TV screen and the other insisted on only individual, face-to-face treatment with a clinician. In addition, we want to emphasize that computer-assisted treatment is not intended to replace basic speech treatment procedures. Instead, it is one of many modalities for language treatment and its availability is designed to increase the treatment flexibility of the clinician.

Although the pre/post changes in reading test scores were small, remember that these individuals are all stable, chronic aphasic patients with an average post-onset time of nine years. We did not expect substantial reading improvement after participation in the program for only eight to twelve weeks.

However, the increases in the posttest scores on the computerized reading test raise expectations for considerable improvement in reading after more practice on the reading tasks. One of our next projects is to conduct a long-term study specifically to address this issue.

Future program development of CATS will focus not only on more rigorous evaluation of existing treatment tasks, but also on exploiting some of the unique features of the microcomputer. A reading treatment program utilizing tachistoscopic presentations of varying durations and requiring no additional hardware has already been developed at our communications laboratory. Use of a screen-oriented light pen to simplify patient response requirements is also under investigation. This latter development may make CATS appropriate for more severely-impaired aphasic patients. We have also developed a program that utilizes a printer to create individualized homework tasks for the patients. These opportunities to create effective and efficient treatment material for aphasic patients is both challenging and exciting.

In the last year we have developed therapies which have real potential for advancing the language skills of chronic aphasic individuals. We perceive this as the beginning step in a continuing effort to develop and evaluate computer-based treatment programs. It is our hope that we can continue the tradition of our profession in providing quality care to speech patients.

ACKNOWLEDGMENT

This research was supported in part by the Audiology and Speech Pathology Service, Los Angeles Veterans Administration Outpatient Clinic. The authors wish to thank Marsha Davidoff, Mike Bogdanoff, Ellen Cryder, and Anne Griggs for their assistance and suggestions. We also wish to thank Bettye Smith-Kleovoulos for her continuous support in this project.

To obtain a diskette containing the Applesoft programs described in this study, please contact: R.C. Katz, Ph.D., Audiology and Speech Pathology Service, Veterans Administration Outpatient Clinic, 425 South Hill Street, Los Angeles, CA 90013.

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DISCUSSION

Q: You let the subjects choose their own therapy from a variety of programs. Have you tried developing sequential programs for specific goals?

A: Initially our objective was simply to imitate a set of therapies one might find in individual treatment. What can be done is to design the program so as to substitute the next higher level task when criterion is reached for a particular task.

Q: Can this system be hooked up over home terminals to provide home-based programs?

A: The patient with a microcomputer in his home can use these programs. They can be purchased by the patient or loaned to the patient by the speech clinic. The speech clinician can check on the patient's progress at regular intervals by calling the patient on the telephone and connecting the clinic's and the patient's microcomputers via a set of telephone modems. In addition, specific instruction could be given at that time to the patient.

Q: Have you found any commercially available programs on the market for aphasic patients?

A: No. A lot of material is just not appropriate for our aphasic patients due to level of difficulty, level of interest, formatting, or response requirements. Speech and language clinicians working with aphasic patients can probably be the most successful developers of the needed software. Because BASIC is relatively easy to use, a clinician could write programs for patients and share or trade the more successful programs with other clinicians.

Q: Did it take long to train the subjects to use the computer?

A: Subjects required about three sessions of training on the microcomputer before they could operate it without supervision. Operation was explained and modelled and questions were encouraged and answered. Intervention from the clinician was quickly faded although help was provided when requested. Also, the on/off switch on the Apple II is on the left side, making it easier for our subjects with right hemiparesis to turn the machine on and off. In addition, the programs were designed to deal with a number of predictable subject operation errors by providing the subject with certain error-handling messages and by accepting only a specific range of responses, such as only accepting numbers 1 through 5 on a task with five choices.

Q: I would like to comment that whatever else comes out of all this computer work with patients, one very important fact is that it allows these folks to do the kind of thing that makes them more independent. I really applaud your motive that they have some personal decision-making and involvement in what they are doing. That is a very good part of it.

A: Thank you.