The Application of Microcomputers for the Treatment of Aphasic Adults

Felice L. Loverso
Veterans Administration Medical Center and Department of Neurology, University of Missouri Medical School, Columbia, Missouri

Thomas E. Prescott
Veterans Administration Medical Center, Denver, Colorado

Marilyn Selinger
Levy and Associates, Denver, Colorado

Karen M. Wheeler and Randall D. Smith
Veterans Administration Medical Center, Columbia, Missouri

Microcomputers in the rehabilitation of brain damaged patients continue to win popularity in some clinical settings. Cost effectiveness, operational efficiency and increased treatment time without additional human resources are the salient features which bolster their acceptance and application. Yet data based research in speech and language pathology concerning treatment efficacy remains sparse.

In the most recent literature there are a few investigations which support the use of microcomputers as a supplement to the traditional treatment environment. These include work by Katz and Nagy, 1982, 1983; Mills, 1982; Seron, Deloche, Mouland and Rouselle, 1980. For example, Mills (1982) utilized a microcomputer to present auditory comprehension treatment tasks to a chronically aphasic adult. Mills concluded that improved performance on the Token Test (DeRenzi and Vignolo, 1962), the Porch Index of Communicative Ability (Porch, 1967) could be attributed to the interaction between the patient and treatment administered via microcomputer. In 1982 Katz and Nagy used a microcomputer to administer a series of reading activities to five aphasic adults. While the results of this study indicated improved performance for the computer program itself, little to no change was observed on the Reading Comprehension Battery for Aphasia (LaPointe and Horner, 1979) or the Diagnostic Reading Test of Word Recognition Skills (Doren, 1973) following treatment. In a study designed to enhance attention of memory functioning in aphasic adults, Katz and Nagy (1983) presented a computerized flash card drill to five left-brain-damaged aphasic patients. As in their previous study, improved performance was noted without generalization to standardized posttests. From these data the authors concluded that, through computer control, a combination of activities can be utilized that provide both general language stimulation and specific learning through drills. Some caution, however, should be taken when reviewing these data. The designs implemented to examine the use of microcomputers fall short in determining their efficacy in rehabilitation. Small numbers of subjects and poorly defined baselines appear to be just a few of the factors plaguing this research to date.

While Katz, 1984, takes the more pragmatic and conservative approach of viewing existing programs as only drills with no specific intervention goals, authors such as Skilbeck, 1984; Bracey, 1983; and Lucas, 1977, advocate the computer, rather than the clinician, as the primary treatment medium. In this age of advanced technological applications to almost every phase of our professional lives there appears to be an urgent necessity to know the efficacy of treating patients with microcomputers. It is unfortunate, however, that many clinicians are getting into the computer business without collecting efficacy data first. Additionally, in spite of this lack of efficacy data there does not seem to be an effort to establish treatment programs. The available software for microcomputers do not address communicative strategies nor provide the artificial intelligence necessary for establishing functional skills by the aphasic adult. Instead, software and the software industry continue to perseverate at a drill level.

The purpose of this investigation is to examine whether the microcomputer or the clinician is more effective in teaching aphasic patients a criterion performance.

METHOD

Subject. The subject for this investigation was a 52-year-old male who sustained a single left hemisphere lesion four months prior to his inclusion in this study. EEG results at one week post onset showed left temporoparietal slowing. No visual or motor deficits were noted. Initial medical history suggested global aphasia progressing to Wernicke's within three weeks. PICA data revealed a markedly to severely aphasic adult at one month post onset. On admission to our facility, approximately three months post onset, the patient had progressed to the moderate range of severity, as measured by the PICA, with Western Aphasia Battery results indicating Wernicke's aphasia and CT scan results consistent with a Perisylvian infarct. RCBA scores resulted in an overall score of 44.

Treatment Stimuli. The treatment approach utilized in this investigation incorporated the "verb as core" method (Loverso, Selinger and Prescott, 1979). In this approach, verbs are presented as pivots and wh-questions provide strategic cues to elicit sentences in an actor-action-object framework. There are six hierarchical levels to this program: Level IA, copying and repeating an actor plus action; Level IB, choosing a correct actor from an array with verbal and graphic output of the combination required; Level I, self generation of actor plus action combinations both verbally and graphically; Levels IIA, IIB, and II are identical to the first three levels, with the exception that a recipient to the action is required. Thirty verbs which were controlled for frequency and imageability were used at each level. Frequency was controlled by utilizing the Thorndike and Lorge (1944) word lists 400A-400B, while imageability was controlled by the use of words from both Van der Veur's (1975) and Paivio's et al. (1968) scales.

For the clinician, all actor, action, and recipient stimuli were presented on 5" x 8" cards with wh-questions on 3" x 5" cards. All six treatment levels were programmed on a microcomputer with verbal and visual capabilities. The microcomputer and clinician treatment packages were identical in terms of number of stimuli, type of stimuli, modality and randomization of presentation, type of feedback and scoring.

Procedures and Equipment. Using a within subject alternating treatment design with multiple probes, a baseline from five sessions was established for both the clinician and microcomputer. Time of day for each treatment was alternated as was the clinician. Once baseline was established, the patient received Level IA via both the microcomputer and from a clinician daily until criterion was reached. Once criterion was reached (3 times with 90% accuracy) at any level the next level of treatment began. Baselines continued daily on all untreated levels. Following completion of any level, weekly maintenance probes (of 10 stimuli) were administered until the termination of the investigation. All stimuli and wh-cues within tasks for both treatment mediums were randomly presented. Additional measures constituting external baselines and probes included an initial PICA and one PICA after completion of each overall treatment level to measure generalization.

The equipment for the computer phase of this investigation consisted of an Apple IIe microcomputer with dual disc drive, Apple monitor, dot matrix printer and an Echo II voice synthesizer. The apparatus for the clinician phase consisted of two homosapiens of near normal intelligence equipped with index cards.

RESULTS AND CONCLUSIONS

The results are presented in Table 1 and Figure 1.

Table 1. Number of sessions to meet criteria.

Treatment Level		Clinician	Microcomputer
IA		8	14
IB		7	20
I		4	3
IIA		4	3
IIB		3	20
II		10	7
	Total	36	67

Figure 1 presents baseline, treatment and maintenance probe phases. The one- and three-month maintenance probe data are not included in the figure. Figure 1 suggests that the clinician was more efficient in bringing this patient to criterion than was the computer. For Level IA (the initial treatment level) the patient reached criterion with the clinician in 8 sessions, versus 14 sessions on the computer. On Level IB, 7 sessions were recorded for the clinician mode while the patient never reached criterion on the computer. Treatment at this level was stopped after a predetermined 20-session effort. At Levels I and IIA, four visits for the clinician and three for the computer were necessary for the patient to be successful. For Level IIB the patient spent 3 sessions with the clinician, whereas on the computer 20 sessions were again recorded without reaching criteria. At Level II the patient required ten visits with the clinician and seven with the computer. It took 36 total sessions with the clinician versus 67 visits with the computer to complete the treatment program.

Examination of the maintenance probes shows that the patient upheld his performance at all clinician-presented treatment levels with the exception of the first probe on Level IB and the first two probes on Level I. For the computer, maintenance of behavior was also established at all levels except for the first three probes on Level IB and probes 1 and 2 on Level IIB. Following these probes, maintenance was established across all other levels and behaviors. Maintenance was also established over a three-month period following treatment. External PICA probes indicated clinically meaningful (and $p < .01$) differences between levels from baseline to completion of the

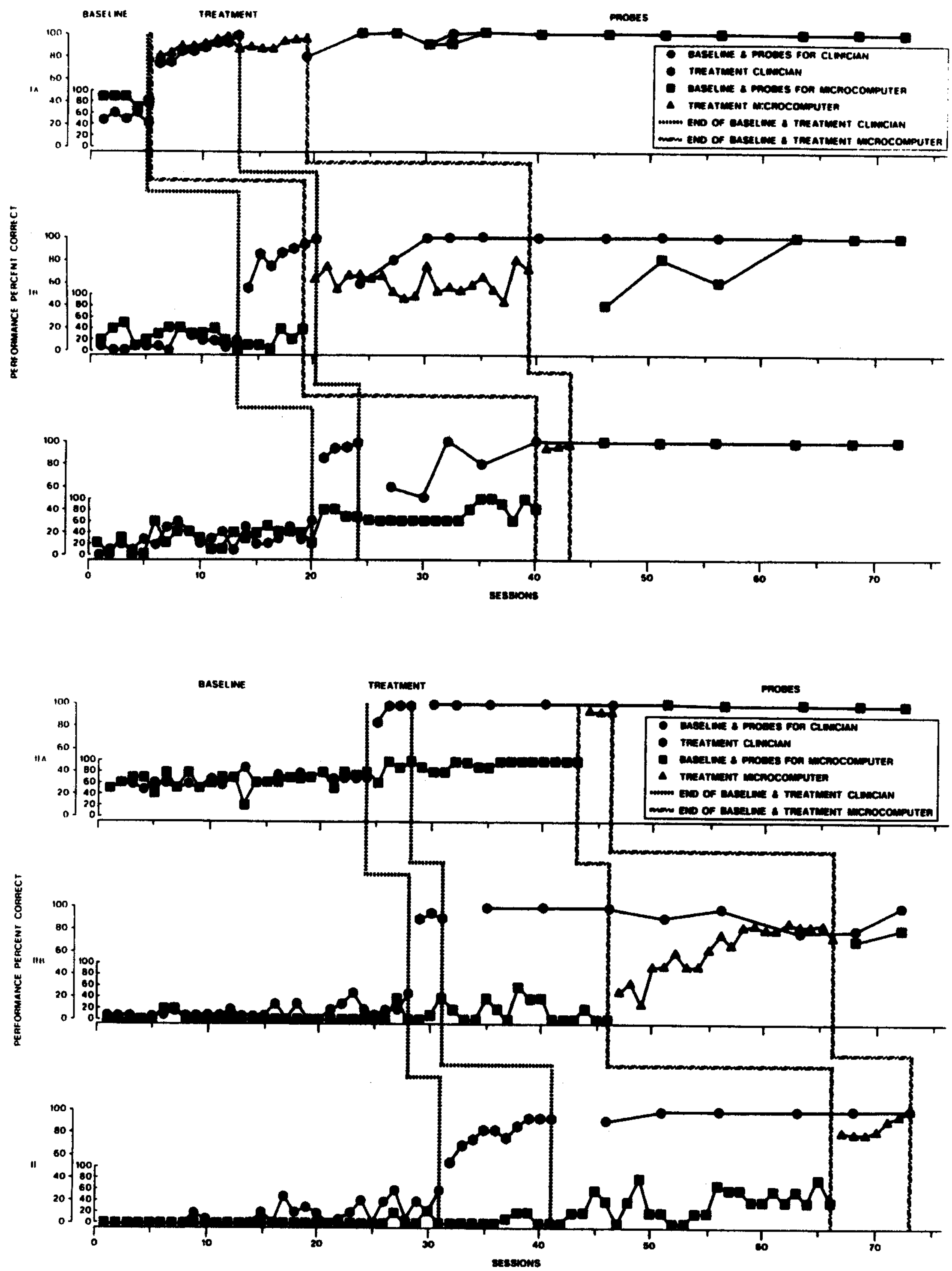

Figure 1. Multiple baseline alternating treatment design for clinician and microcomputer. Top: Levels IA, IB, I. Bottom: Levels IIA, IIB, II.

treatment program. Maintenance of PICA overall at 3 months post treatment was also established. Ninety-nine percent point to point interjudge reliability was established for scoring.

This investigation provides replication of the verbing program by Loverso, Selinger and Prescott in 1979. The microcomputer was shown to be an effective treatment instrument for this patient. These data indicate that a smaller number of total visits were required by the patient with clinician based treatment than with computer based treatment. The patient was able to reach criterion for all six levels of the treatment hierarchy when a clinician presented the stimuli. For the computer mode, the patient was able to reach criterion for Levels IA, I, IIA and II while failing at Levels IB and IIB. Maintenance was observed across all clinician treatment levels and all computer treatment levels except on Level IIB for both modes of presentation. Analysis of variance and Tukey Tests indicated statistically significant ($p < .01$) improvement between PICA overall scores. These mean overall scores ranged from 6.63 for test administration at the initiation of the study to 13.07 for Test 6. All differences between tests were statistically significant ($p < .01$) except between Test 3 (overall mean 11.08) and Test 4 (overall mean 11.59) and between Test 5 and Test 6 (overall mean 12.62 and 13.07, respectively). These results suggest significant improvement (as measured by the PICA) from initiation of the study to its termination. These gains were maintained by this patient for three months following termination of treatment. PICA and probe data for both modes of presentation indicated maintenance of overall communicative abilities as well as maintenance of treatment task behaviors.

Although the clinician was more efficient in terms of the number of visits required to learn the task, the microcomputer was shown to be an effective, but slower, treatment tool. This study implies that treatment administered by a microcomputer is viable, and could allow a solution to a chronic resource allocation problem. Future research needs to focus on measuring the effects of this program with more subjects, more types of aphasia and the effects of elimination of Levels IB and IIB on performance. The authors currently are investigating these dimensions.

ACKNOWLEDGMENT

This research is supported in part by the Medical Research Service of the Veterans Administration.

REFERENCES

Bracy, O.L. Computer Based Cognitive Rehabilitation: In Cognitive Rehabilitation, Vol. I. Indianapolis: B&B Publishing Co., 1983.

DeRenzi, E. and Vignolo, L. The Token Test: A sensitive test to detect receptive disturbances in aphasics. Brain, 85, 1962.

Doren, M. Doren Diagnostic Reading Test of Word Recognition Skills. Circle Pines, MN: American Guidance Service, Inc., 1973.

Katz, R.C. Using microcomputers in the diagnosis and treatment of chronic aphasic adults. Seminars in Speech and Language, Vol. 5, 1, 1984.

Katz, R.C. and Nagy, V.T. A computerized approach for improving word recognition in chronic aphasic patients. In R.H. Brookshire (Ed.), Clinical Aphasiology: Conference Proceedings, 1983. Minneapolis, MN: BRK Publishers, 1983.

LaPoint, L.L. and Horner, J. Reading Comprehension Battery for Aphasia. Tigard, Oregon: C.C. Publication, 1979.

Loverso, F.L., Selinger, M. and Prescott, T.E. Application of verbing strategies to aphasia treatment. In R.H. Brookshire (Ed.), Clinical Aphasiology: Conference Proceedings, 1979. Minneapolis, MN: BRK Publishers, 1979.

Lucas, R.W. A study of patients attitudes to computer interrogation. International Journal of Man-machine Studies, 9, 1977.

Mills, R.H. Microcomputerized auditory comprehension training. In R.H. Brookshire (Ed.), Clinical Aphasiology: Conference Proceedings, 1982. Minneapolis, MN: BRK Publishers, 1982.

Paivio, A., Yuille, J. and Madigan, S.A. Concreteness, imagery and meaningfulness values for 925 norms. Journal of Experimental Psychology, 76, (1, Pt. 2), 1968.

Porch, B.E. Porch Index of Communicative Ability: Administration, Scoring and Interpretation. Palo Alto, CA: Consulting Psychologists, 1967.

Seron, X., Deloche, G., Moulard, G. and Rouselle, M. A computer-based therapy for the treatment of aphasic subjects with writing disorders. Journal of Speech and Hearing Disorders, 45, 45-58, 1980.

Skilbeck, C. Computer assistance in the management of memory and cognitive impairment. In B.A. Wilson and N. Moffat (Eds.), Clinical Management of Memory Disorders. London: Aspen Systems Corporation, 1984.

Thorndike, E.L. and Lorge, I. Teachers Word Book of 30,000 Words. New York, NY: Teachers College, Bureau of Publications, Columbia University, 1944.

W. van der Veur, Imagery rating of 1,000 frequently used words. Journal of Educational Psychology, 67, 44-56, 1975.

DISCUSSION

Q: Did you suggest why you think the computer was slower?

A: The most striking difference I saw between both modes of presentation was that when the clinician provided stimulation to the patient it (the rate of stimulation) was much more controlled. For the computer presentation the patient himself controlled the stimulus presentation by hitting the space bar or the return key. This particular patient seemed to have some difficulty timing the incoming stimuli. I think he was setting himself up to be less accurate by not giving himself enough time between the verb, the wh-question, the response, and the feedback. For example, he often made a spelling error and wouldn't wait to see what the correct response should be. He would go on to the next stimuli rapidly. The other obvious thing which contributed to differences between the modes of presentation was probably live voice versus synthesized voice. In this experiment we were using an Echo II voice synthesizer with a female voice provided within the Echo II system's repertoire.

Q: Is there greater flexibility with the clinician than what you might find with the computer?

A: Yes.

Q: Would you comment on the fact you didn't get generalization across levels? Are you going to make adjustments in your program, or do you have any feel for whether or not an alternating treatment design can help you evolve the program into a more efficient strategy whether it is with a clinician or a computer?

A: Yes, I think the alternating treatment design can do that. I do think, though, that based on the results we have here and the results we got in

1979, Levels IB and IIB are somewhat ineffective. We were unwilling prior to this study to get rid of those levels based on the performance of one patient. I would like to continue with this basic hierarchy until more data are in because it just seems to make sense that we go from copying to a choice format to self generation of a subject-verb-object combination.

Q: Could you say something about the quality of the patient's responses? Were there any qualitative differences in either error responses or within the range of correct responses that you got across your two modes?

A: I don't think so.