TEL-COMMUNICOLOGY AND ITS USE IN EVALUATING THE AUDITORY COMPREHENSION ABILITIES OF ADULTS WITH APHASIA

by

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ABSTRACT

The present study was designed to investigate the efficacy of using TEL-C delivery to supplement aphasia auditory comprehension evaluation. A total of 24 male subjects were tested; 12 subjects had been diagnosed as aphasic for a minimum of 6 months and 12 non-aphasic subjects acted as controls. An auditory comprehension examination which consisted of yes/no questions, paragraph comprehension questions, and repetition tasks was presented to each subject on two consecutive days. Half of the subjects in each group were first tested using TEL-C delivery while the others received traditional evaluations (i.e., face-to-face). On the second day of testing the presentation modes were interchanged. The two test scores achieved by each subject were statistically analyzed in relation to the variables "group," "order," and "mode." As a "group," the aphasics scored significantly lower than the control subjects on each of the four auditory comprehension subtests. The specific "order" in which the presentation modes were used to introduce the experimental stimuli had no significant influence on the responses made by either group of subjects on any of the tasks. In general, the particular "mode" that was used to present the test stimuli was not significantly related to the experimental results. However, on the word and sentence repetition task, the aphasic subjects achieved a significantly higher score under the traditional evaluation condition. In contrast, the non-aphasic subjects obtained a significantly higher score on the TEL-C digit repetition subtest. It was speculated that the telephone served

to direct the subjects' attention to the task at hand which resulted in them receiving a superior rating under the TEL-C condition.

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CHAPTER I

REVIEW OF LITERATURE

Tel-communicology (TEL-C) is an innovative health care delivery system designed to supplement traditional rehabilitation. Practitioners who utilize this system provide their patients with supplemental treatment or evaluation through the use of specially designed telephonic devices (Vaughn, 1976).

TEL-C was developed with the intent of increasing the availability, accessibility, and cost-effectiveness of rehabilitation services to Veteran's Administration (V.A.) patients. According to Vaughn, Kramer, and Ozley (1983), the use of TEL-C could increase the availability of services to patients who are being served by hospitals with no speech pathologist on staff. TEL-C delivery could increase the accessibility of services to patients who lived great distances from a medical facility or for those whose medical or financial condition prohibited extensive travel. TEL-C supplemental treatment has also proven to be cost-effective. During the first year of operation, the Birmingham V.A. Hospital's TEL-C program cost only one-twelfth of the amount previously required to reimburse patients for their travel expenses. Vaughn maintains that widespread use of TEL-C would allow V.A. hospitals to monitor patient progress on a long-term basis, and would increase the accessibility of consultants.

A 3-year study is currently underway at the Birmingham V.A. Hospital to determine the efficacy of using TEL-C procedures in treating aphasic patients compared to traditional therapy techniques.

This research is apparently the first of its kind. The study is designed to include two groups of aphasics who are selected on the basis of 12 criteria. Both groups are seen for 5 hours of individually structured therapy each week for a 6-month period. One group is treated entirely through the use of TEL-C while the other receives traditional intervention. The progress made by each subject is documented at 6-week intervals and is based on the results of a battery of tests. Both groups are evaluated under standard testing conditions at three field centers. The feasibility of using TEL-C procedures to supplement or extend traditional aphasia evaluation has not been investigated; and that is the purpose of this paper.

A review of the literature reveals a general deficit in controlled research investigating the efficacy of nontraditional aphasia <u>evaluation</u>. Therefore, the support for the current study comes from three categories of research concerning nontraditional aphasia <u>therapy</u> techniques. Automated treatment programs can be considered similar to TEL-C procedures in that neither requires direct contact between a patient and the clinician. It will be shown that aphasic subjects respond favorably to automated visual discrimination tasks which involve nonverbal stimuli and nonverbal responses, and to automated naming tasks which consist of multisensory stimuli and verbal responses. Their responses to automated auditory comprehension tasks composed of verbal stimuli and verbal responses are inconsistent. However, in a number of the studies, the aphasics can be distinguished from the control subjects on the basis of their verbal responses to the verbal stimuli. Therefore, the auditory comprehension evaluation that is used in the current study is also comprised of tasks which require verbal stimuli and verbal responses.

Automated Visual Discrimination Tasks

One of the most widely researched methods of automated instruction developed for use with aphasics was the visual discrimination teaching machine first introduced by Yasuko Filby and Allan Edwards. In their 1963 study, Filby and Edwards devised a four-step, nonverbal match-to-sample task which served as an introduction to a 118-item, form-discrimination program. Twelve aphasic subjects were first trained to press two response buttons. Next, a sample stimulus and one comparison stimulus were projected onto a glass screen. The aphasics were taught to press the button that corresponded to the portion of the screen on which the latter stimulus appeared. In Steps 3 and 4, two different comparison stimuli were used. The aphasics were instructed to use the response buttons to select the stimulus that matched the sample on the basis of its color or form. Ten of the aphasic subjects completed the pre-training successfully. The aphasics and an age-matched, non-aphasic control group then participated in the experimental program which involved discriminating abstract forms of increasing complexity. After the program had been completed, the number of errors which had been made by the members of each group were compared and no significant differences were revealed. The aphasics' high success rate was attributed to the self-pacing, gradual progression and immediate feedback offered by the teaching machine.

Filby, Edwards, and Seacat (1963) made use of the visual discrimination apparatus to present a program of printed words to a group of aphasics (48% mean loss on SKLAR) and an age-matched, non-aphasic control group. The length of the words, their similarity and frequency of occurrence were systematically varied to determine the influence such factors had on the subjects' responses. Other aspects of Filby and Edwards's form discrimination program (pre-training, response shaping, etc.) were retained. The accuracy and the latency of the subjects' responses were determined. The latency data revealed a significant difference between the groups as well as a significant interaction between group membership and word length. In terms of accuracy, the aphasics' scores were not significantly different than those of the control group. The lack of response complexity required by the teaching machine was cited as a possible explanation for the aphasics' favorable performance.

Rosenberg (1965) devised a five-part program to train aphasics to discriminate features of alphabet letters through the use of Filby and Edwards's visual discrimination apparatus. The study involved 34 male subjects; 24 aphasics (42% mean loss on SKLAR) who participated in three sessions and 10 age-matched controls who were seen once. Initially, the two groups were trained to respond to a match-to-sample task which was identical to that used by Filby and Edwards (1963). Next, the subjects were given five pretests, each of which corresponded to a section of the training program, and their response latencies were noted. The final pre-training step consisted of the administration of the SKLAR Aphasia Evaluation Summary. During the second session, the aphasics were randomly assigned to two subgroups. Each member of the true training group received automated training on the two program sections which corresponded to the pretests on which his response latency had been the most deviant. The false training group was given instruction on the two programs which least required remediation on the basis of their latency scores. The session concluded with the administration of a posttest from each section of the program and a verbal transfer task which consisted of single letters, nonsense syllables, and words. The testing procedures were repeated after approximately one week to check for the subjects' retention. Results of the study caused Rosenberg to suggest that both aphasic subgroups had improved their response latency as a result of intervention. They also exhibited general transfer to verbal items and had maintained overall improvement for at least one week.

In their visual discrimination research, Rosenberg and Edwards (1965) noticed a tendency for aphasic subjects to touch a comparison stimulus as it appeared on the screen before pressing the corresponding response button. The investigators suggested that such behavior may contribute to an increase in their subjects' response latency and modified their apparatus accordingly. The lower portion of the glass screen was divided into quadrants, each representing a different response alternative. Five aphasic subjects (45% mean loss on SKLAR) completed a five-step training procedure designed to shape their ability to discriminate a stimulus on the basis of its component parts. The program was reintroduced 7 to 10 days after its completion to test for the subjects' retention. At that time, the aphasics scores represented a 79% improvement over the accuracy scores they received during initial training. The automated program made it possible to shape aphasics' ability to complete a task which had frequently been thought to be unteachable.

In summary, automated visual discrimination programs which involve abstract forms, printed words, or features of alphabet letters are viable alternatives to direct therapy with aphasics. Past researchers have reported that their subjects exhibit a reduction in response latency and/or error rate on subsequent visual discrimination tasks as a consequence of automated training. Transfer to verbal items and maintenance of response have also been noted.

Automated Naming Tasks

Based on the premise that multisensory stimulation is a preferred method for eliciting language from adults with aphasia (Boller & Green, 1972), Keenan (1966) hypothesized that Language Masters would be appropriate for use as a supplement to direct intervention. He developed two sets of Language Master cards which were to be used in a nine-step program designed to evoke noun, verb, or number referents from anomics. On the face of the first set of cards, a referent was displayed visually (picture), and graphically (written word) along with a visual representation of a foil item. On the reverse side of the card, the visual and graphic representations of the referent were reproduced to allow the patients to check the accuracy of their responses to three identification tasks. The remainder of the program consisted of six recall tasks which involved the use of the second set of Language Master cards. On these cards, the foil item was no longer pictured on the face, and only the graphic representation of the referent appeared on the reverse side. In Keenan's opinion, his program was effective because of its extreme flexibility. A patient had the opportunity to work on a specific task, in various settings, without requiring continual supervision. Keenan reported that, in general, his patients had reacted favorably to the Language Master approach and had shown improvement in their recognition, imitation, and recall abilities.

Gordon (1968) devised an automated program in which multisensory stimulation was used as a means of improving the naming and articulation abilities of anomics and dysarthrics. Slides of 16 common objects were projected onto a screen while the objects' names were presented through headphones from audiotape recordings. The subjects voluntarily imitated the objects' names at the word level and in the context of phrases. Gordon reported a number of clinical observations which she attributed to the group therapy experience. The aphasics' ability to use words spontaneously and to detect errors in their speech had apparently improved. They reportedly produced fewer jargon and misarticulated responses and were more receptive to traditional therapy after being exposed to audio-visual treatment. Such a program was considered appropriate for use with aphasics because it allowed them to progress at their own rate and permitted them to practice on each item before responding.

Wepman and Morency (1963) also used a multisensory approach to stimulate verbalizations from a group of aphasics who had been unresponsive to traditional stimulus-response techniques. A film projector and tape recorder were set up in the waiting room of the University of Chicago Speech and Language Clinic. Prior to their scheduled appointment, the patients were free to select and view a filmstrip and to tape-record themselves relating its content. During the therapy sessions, the recordings were analyzed and the content discussed. Wepman and Morency felt that their patients experienced less frustration directing comments to a machine than they did interacting with a therapist. The aphasics could work at their own pace and could function independently. The special interests of each individual could be accomodated by the filmstrips and speech practice could be extended into the patients' homes. In general, aphasics with semantic or syntactic difficulties responded the most positively to the use of the filmstrips while global or jargon aphasics and those with pragmatic deficits had little or no success.

In summary, multisensory stimulation in the form of Language Master cards, tape recorders with slides, or filmstrips have been used to improve aphasics' recognition, imitation, recall, and articulation abilities and to stimulate verbalizations. The unique features which have made automated procedures especially appropriate for aphasia therapy have been discussed.

Automated Auditory Comprehension Tasks

Holland (1969) described a three-part automated procedure which had been used to train aphasics to repeat related and unrelated words, digits, and sentences of increasing length and complexity. The point at which the subjects began a particular section was determined by the results of a pretest. The first two parts of the program were presented twice; auditory and visual stimuli were initially combined and then auditory stimulation was used alone. In Part 3, the stimuli were entirely auditory and were introduced by a teaching machine. The aphasic subjects were expected to repeat each item and then to rate the quality of their verbal product by pressing one of two buttons. A third button could also be used to replay a tape of the subjects' responses for their further analysis. The aphasics were re-evaluated after the training program had been completed. Each of their scores represented a significant improvement over that which had been achieved at the time of the pretest. Apparently, the teaching machine had been used successfully to improve the auditory memory span of the aphasics involved in Holland's study.

Sarno, Silverman, and Sands (1970) introduced 31 severe aphasics (overall FCP score below 31%) to a variety of automated therapy tasks which included auditory comprehension. The subjects were each given 10 pretests which corresponded to the 10 sections of the experimental program. The aphasics were then divided into three groups on the basis of type of management they were to receive. One of the groups was treated through the use of programmed instruction, the second received traditional intervention, while the third group was given no formal therapy. A teaching machine was used with the first group to introduce the visual recognition, writing, auditory comprehension and one of the three oral production tasks. The other production exercises were presented by a video-recorder or a Language Master.

It was particularly noteworthy that an initial attempt had been made to use a Language Master to present the auditory comprehension programs. However, the subjects found the device to be distracting and a live voice was therefore substituted. The nonprogrammed sessions for Group 2 were developed around a specific vocabulary by individual speech clinicians. It had been hypothesized that programmed instruction would be the preferred approach to therapy because it allowed for systematic structure, gradual progression, and multiple repetitions. However, on 8 of 10 terminal measures, including auditory comprehension, there were no significant differences between the three groups. For the remaining tasks, the nonprogrammed groups' performance was superior. The use of automated procedures was not proven to be more effective than traditional techniques as a means of presenting the therapy tasks in the Sarno et al. study.

Green and Boller (1974) devised an auditory comprehension evaluation that was composed of yes/no questions, information questions, and commands. They administered the test under four experimental conditions to 16 Wernicke and global aphasics and a control subject. The stimuli were delivered by direct speech and by tape recorder and were generated both from in front and from behind the subjects. Each person's responses were judged for their accuracy as well as for their appropriateness. It was determined that the position from which the stimuli were introduced had no significant effect on the subjects' behavior, and that the aphasics displayed no evidence of significant learning from one test period to the next. However, the mode of presentation did have a significant influence on the aphasics' performance. In all cases, the responses elicited by live voice were superior to those directed at the tape recorder. The aphasics' difficulties reportedly could not be attributed to poor tape quality or to ambient noise. Instead, Green and Boller suggested the following:

> "In normal behavior, of course, it is quite possible to exchange messages from a distance, to use radios, loud speakers, and tape recorders instead of direct speech. But the ability to communicate in this way is quite likely an aspect of comprehension not to be taken for granted. It involves mechanisms of decoding which may be disturbed by brain damage. Surely these mechanisms are primitive, and it would be of value to determine their role in the child's development of speech, say, in his ability to use the telephone." (p. 144)

It was difficult to draw any firm conclusions from the results of the automated auditory comprehension research. In Holland's study the aphasic subjects were able to repeat progressively longer and more complex words, digits, and sentences as a result of automated training. In contrast, Green and Boller were unsuccessful in their attempt to use automated procedures to elicit responses to questions or commands from Wernicke or global aphasics. Results from a third study were unequivocal; the use of automated procedures had been neither more nor less effective than traditional techniques in training severe aphasics to comprehend words and sentences.

Research concerning three different approaches to automated aphasia therapy had been reviewed. Each of the automated tasks which has been described is related to the current TEL-C auditory comprehension evaluation study. The automated visual discrimination research is the least similar because it involves nonverbal stimuli and responses. However, it suggests that under optimal conditions, aphasics can complete therapy tasks without requiring direct contact with another individual. The automated naming research more closely resembles the current TEL-C auditory comprehension study because both procedures require the subjects to make verbal responses. The feature that distinguishes the two approaches is that the automated naming tasks provide patients with multisensory stimulation which may enhance the aphasics' comprehension to a greater degree (Gardner & Brookshire, 1972) than the verbal stimuli used in the current study. Of the three automated therapy tasks, the auditory programs are the most similar to TEL-C auditory comprehension evaluation since both procedures are designed to provide verbal stimulation for the aphasic patients and to elicit verbal responses in return.

In conclusion, past research indicates that aphasic subjects respond favorably to automated visual discrimination and automated naming tasks. The nonverbal or multisensory stimuli which are inherent to these approaches provide an optimal condition for aphasics' comprehension. The proficiency with which aphasics respond to automated auditory comprehension tasks is less clearly defined. One group of subjects reacted positively to an automated repetition task while another group experienced difficulty answering yes/no questions which were presented by automated means.

The purpose of this study was to investigate the feasibility of using a TEL-C procedure, by comparing TEL-C auditory comprehension aphasia evaluation with the more traditional approach (i.e., face-to-face). The hypothesis statements were:

1. Non-aphasic subjects will achieve TEL-C auditory comprehension evaluation scores that are not significantly different from their traditional evaluation scores.
2. Aphasic subjects will achieve TEL-C auditory comprehension evaluation scores that are significantly different from their traditional evaluation scores.
3. Aphasic subjects will achieve TEL-C and traditional auditory comprehension evaluation scores that are significantly different from non-aphasic subjects.
4. Aphasic subjects will exhibit no significant learning effect from one test presentation to the next.

CHAPTER II
METHODS AND PROCEDURE

Method

In studies investigating the efficacy of aphasia treatment, the experimental method has typically involved a between-group design. This approach may be less than optimal for use in aphasia research for at least three reasons (LaPointe, 1977). First, it may be unethical to assign subjects to a no-treatment group to act as controls for the subjects receiving management. It may be impossible to control for the multitude of variables which would be encountered when assigning subjects to groups. Finally, the influence of spontaneous recovery may obscure the effects of therapy (Wertz et al., 1981). Similar difficulties could arise when assigning groups for research investigating the efficacy of aphasia evaluation procedures. Consequently, the present study has been designed so that every subject received a full evaluation under both experimental conditions. The TEL-C evaluation scores obtained by each subject were compared on an individual basis to those achieved during traditional evaluation. In this way, the subjects acted as their own controls and the methodological weaknesses which had been encountered in previous research were minimized.

The auditory comprehension evaluation that was used in the current study was comprised of 15 yes/no questions (e.g., Do apples grow on trees?), 15 word and sentence repetition tasks (e.g., Bed... Bed), six digit repetition tasks (e.g., 5, 3...5, 3), and eight paragraph comprehension questions (e.g., Did Mr. Jones get to the station on time?), that had been taken directly from the Boston Diagnostic Aphasia Examination, The Minnesota Test for Differential Diagnosis of Aphasia, and the Western Aphasia Battery (see Appendix B). The test stimuli were restricted to those that involved verbal stimuli and verbal responses because this paradigm had been used successfully in past research to distinguish aphasic and non-aphasic subjects.

Subjects

The subjects were 24 males between the ages of 40 and 80 whose scores on a 10-item auditory comprehension pretest ranged from 80-100% (See Appendix A). Group 1 consisted of 12 subjects who had been diagnosed as aphasic for a period exceeding 6 months. These individuals had been treated by a speech pathologist and had been dismissed from direct service. No attempt was made to categorize the subjects on the basis of aphasia subgroups (Broca, global, etc.) because as of yet, no restrictions have been made concerning the specific type of aphasic who may or may not respond to TEL-C delivery. The 12 subjects in Group 2 displayed no history of brain damage as revealed by review of their medical records. Specific demographic information was not used for the purpose of subject selection for either group. However, the following characteristics were considered after the evaluation had been completed to determine their influence on the results: age, educational level, primary language, hearing acuity, pre-morbid handedness, type of aphasia, etiology, time post-onset, source of subject.

Procedures

An auditory comprehension evaluation which consisted of yes/no questions and repetition tasks was presented in full to 24 subjects on each of two consecutive days. During the first session, half of the subjects in each group were tested over the telephone, while the others were seen face-to-face. On the next day, the identical stimulus items were used; however, the presentation modes and the subgroups were interchanged so that each subject received a full evaluation under both experimental conditions. The two scores achieved by each subject were then compared to determine whether TEL-C and traditional evaluation procedures yielded comparable results.

CHAPTER III

RESULTS AND DISCUSSION

The purpose of this study was to compare TEL-C procedures and traditional evaluation procedures used in aphasia auditory comprehension evaluation. The hypothesis statements were:

1. Non-aphasic subjects will achieve TEL-C auditory comprehension evaluation scores that are not significantly different from their traditional evaluation scores.
2. Aphasic subjects will achieve TEL-C auditory comprehension evaluation scores that are significantly different from their traditional evaluation scores.
3. Aphasic subjects will achieve TEL-C and traditional auditory comprehension evaluation scores that are significantly different from non-aphasic subjects.
4. Aphasic subjects will exhibit no significant learning effect from one test presentation to the next.

To determine the acceptability of the preceding research hypotheses, three independent variables were systematically manipulated and statistically examined through the use of analysis of variance. Analyses were done separately for each task. Results are shown in Table 1.

The three variables have been given the labels "group," "mode," and "order." The term "group" was used in reference to the classification of subjects as either aphasics or controls. The "mode" label was used to describe the means of stimulus delivery; either face-to-face

TABLE 1

Mean Scores ($\overline{X}$) and Standard Deviations (SD) for Both Groups of Subjects Under Each Experimental Condition

		Aphasics		Controls	
Yes/No Questions		TEL-C	FACE	TEL-C	FACE
TEL-C delivery preceding Face-to-Face	$\overline{x}$	13.70	12.70	14.50	14.70
	SD	1.03	1.21	0.55	0.52
Face-to-Face delivery preceding TEL-C	$\overline{x}$	11.50	12.00	14.20	14.30
	SD	2.59	2.00	1.17	1.21
Word and Sentence Repetition					
TEL-C delivery preceding Face-to-Face	$\overline{x}$	75.50	82.70	92.00	95.00
	SD	19.85	14.17	7.01	3.22
Face-to-Face delivery preceding TEL-C	$\overline{x}$	79.00	82.80	95.30	94.80
	SD	11.78	10.09	3.27	4.83
Digit Repetition					
TEL-C delivery preceding Face-to-Face	$\overline{x}$	3.50	3.30	5.30	4.30
	SD	1.38	1.51	0.82	1.03
Face-to-Face delivery preceding TEL-C	$\overline{x}$	3.00	3.20	5.80	4.70
	SD	1.67	1.60	0.41	1.21
Paragraph Comprehension Questions					
TEL-C delivery preceding Face-to-Face	$\overline{x}$	3.30	3.30	3.30	3.70
	SD	0.82	1.03	1.03	0.52
Face-to-Face delivery preceding TEL-C	$\overline{x}$	2.20	3.00	4.00	3.70
	SD	1.72	1.27	0.00	0.52

or using TEL-C. While the concept "order" related to the sequence in which the presentation modes were used; TEL-C was either preceded or followed by traditional delivery.

Group (Hypothesis 3)

As a group, the aphasics scored significantly lower than the control subjects on each of the four auditory comprehension tasks. The difference was significant at the .05 level for yes/no questions and repetition tasks, and at the .10 level for paragraph comprehension questions. The fact that the groups could be distinguished on the basis of their evaluation scores lended support for the construct validity of the test protocol.

Order (Hypothesis 4)

The order in which the two presentation modes were used to introduce the test stimuli had no significant influence on the responses made by either group of subjects on any of the subtests. Therefore, it may be assumed that neither of the groups exhibited a significant learning effect as a consequence of multiple stimulus presentations. This was consistent with Green and Boller's (1974) findings that severely impaired aphasics displayed no significant learning effect after four presentations of a single auditory comprehension evaluation.

Mode (Hypotheses 1 and 2)

In most cases, the two evaluation scores that were recorded for each subject could not be distinguished on the basis of the presentation mode which had been used. In other words, on two of the subtests—yes/no questions, and paragraph comprehension questions—the scores achieved by the subjects during traditional evaluation were not significantly different than those attained using TEL-C delivery. The same held true for the control subjects on the word and sentence repetition task and for the aphasic subjects on the digit repetition subtest. Under the two remaining experimental conditions, the presentation mode did have a significant influence on the subjects' achievement. Specifically, the control subjects scored significantly poorer (.05 level of confidence) on the face-to-face digit repetition task compared to their TEL-C rating on the same subtest. In contrast, the aphasics' scores on the face-to-face word and sentence repetition task were superior (.10 significance level) to those achieved during TEL-C evaluation.

Demographic Information

Each subject was asked to provide the following information so that the potential influence on the experimental results could be determined. Because of the nature of their language deficits, the aphasics' responses were verified by review of their medical records or speech pathology files. Only one of the demographic characteristics (type of aphasia) appeared to have a noticeable influence on the subjects' performance.

Age. The mean age of the aphasic subjects was 63 years (range 51-79) while the subjects in the control group ranged in age from 42 to 77 (mean age 60).

Educational level. Of the 12 non-aphasic subjects, two reported having attended college while five had fulfilled the reouirements for a high school diploma. This could be compared to the three high school and five college graduates who were among the 12 subjects in the aphasic group. Overall, the highest level of education that had been completed by the subjects in Group 1 ranged from eighth grade to a Ph.D., while Group 2 subjects' educational range was from fourth grade to three years of college.

Hearing acuity. Six of the 12 aphasic subjects reported having normal hearing, three wore hearing aids, and three had mild to moderate hearing losses without hearing aids. The majority of the control subjects (58%) reported having noticed a decrease in their hearing acuity, two wore hearing aids, and three had essentially normal hearing. The information that was provided by the aphasic subjects was verified by review of their audiological reports from medical and/or speech pathology files. Because audiometric results were not available for all 12 of the non-aphasic patients, their data were based entirely upon subjective report. The potential inaccuracy of self-reported information should be considered when attempting to draw implications concerning the non-aphasics' hearing acuity.

Primary language. English was the primary language spoken by all of the subjects in each of the groups.

Etiology. The primary cause of aphasia (92%) for the subjects in Group 1 was a cerebral vascular accident (CVA). One patient reported having suffered aphasia as a result of vascilitus.

Type of aphasia. Anomia was the primary diagnosis for seven (58%) of the aphasic subjects. Three subjects had expressive as well as receptive deficits. One exhibited characteristics of Broca's aphasia while another had deficits primarily in the area of auditory comprehension.

Post onset. The span of time which had elapsed since the aphasics' most recent (or only) cerebral insult ranged from 6 months to 89 months. The majority (75%) of the aphasic subjects were between 1 and 5 years post onset.

Handedness. Eleven of the 12 (92%) aphasic subjects reported being right handed pre-morbidly while one was ambidexterous.

Source of subjects. Eight of the subjects in Group 1 were patients of a V.A. hospital, three were referred from a private rehabilitation center, and one had come from a university speech and hearing clinic. All 12 subjects in Group 2 were V.A. patients.

Discussion

The two significant differences that were revealed from the statistical analysis of the "mode" variable warrant further discussion. It had been determined that aphasic subjects achieved significantly higher scores on word and sentence repetition tasks that were presented face-to-face than they did when the stimuli were delivered by TEL-C. In an attempt to explain this discrepancy, the two repetition scores that had been recorded for each subject were considered in relation to each other and in terms of the subjects' demographic information. Of the 12 aphasic subjects, it was determined that nine had achieved their higher scores during traditional testing and two had excelled during TEL-C evaluation. One aphasic received identical scores under each condition. The numerical difference between the aphasics' TEL-C and traditional evaluation scores ranged from 1-23 points for the nine subjects whose traditional score had been higher and from 10-13 points for those whose TEL-C score had been superior.

The subjects' demographic characteristics were then considered and a relationship was revealed between the aphasics' primary symptoms and the difference in their evaluation scores. The comparison is depicted in Table 2. It was readily apparent that the aphasics who had auditory comprehension and/or repetition deficits (#3, 5, 6, 10) were those who achieved traditional evaluation scores that were far superior to their TEL-C rating. The only possible exception was Subject 4 whose scores differed only slightly from one another. Although this subject's comprehension was impaired to a degree, his speech clinician reported that his most debilitating characteristic was a deficit in verbal expression which was compounded by the presence of apraxia. Therefore, it may be assumed that Subject 4 exhibited higher level auditory comprehension skills than those displayed by the other patients (#3, 5, 6, 10). Consequently, the discrepancy between his evaluation scores was less widespread.

Also presented in Table 2 are the two evaluation scores which were achieved by each of the subjects who had been classified as anomics (#1, 2, 7, 8, 9, 11, 12). Because it is generally maintained that anomics' repetition and comprehension skills are relatively intact, it may be assumed that their two evaluation scores would be quite similar. This assumption was supported to some extent by all but one of the anomics' test results. The most obvious were the three subjects (#1, 7, 12) who obtained nearly identical scores under each experimental condition. In contrast, two anomics (#2, 11) achieved scores that were superior when tested using TEL-C. The fact that each of these subjects had received TEL-C training prior to

TABLE 2

A Comparison of the Difference Between Group 1's TEL-C and Face-to-Face Word and Sentence Repetition Scores in Relation to Their Primary Aphasia Symptoms

Primary Symptom	Anomia/ Aud. Comp.	Express/ Receptive	Auditory Comp.	Broca	Express/ Receptive
Subject	3	4	5	6	10
Face-to-Face Score	88	75	88	97	76
TEL-C Score	75	74	65	82	63
Difference	13F	1F *	23F	15F	13F

Primary Symptom	Anomia	Anomia	Anomia	Anomia	Anomia	Anomia	Anomia
Subject	1	2	7	8	9	11	12
Face-to-Face Score	78	70	87	98	58	90	98
Tel-C Score	73	83	86	85	43	100	98
Difference	5F	13T *	1F	13F *	15F *	10T *	=

participating in the study may serve to justify this discrepancy. The other two anomic subjects (#8, 9) acquired face-to-face evaluation scores that surpassed their TEL-C ratings. Because Subject 9 had been labeled as anomic by his most recent speech clinician, his test results were analyzed in conjunction with those of the other similarly impaired aphasics. On the basis of his test scores, however, it was apparent that he exhibited deficits in auditory comprehension and/or repetition as well. Therefore, it would not be uncommon for his traditional evaluation score to surpass his TEL-C rating.

The only subject whose test performance did not appear to relate to his primary aphasic symptom was Subject 8. Because his test scores were relatively high, it appeared that this subject had adequate auditory comprehension and repetition skills. However, his traditional evaluation score exceeded his TEL-C rating by 13 points. This discrepancy could not be attributed to the effects of a hearing loss because the subject displayed normal hearing bilaterally. The fact that Subject 8 exhibited co-existing dysarthria may or may not have influenced his test results. Data concerning the influence of motor impairments was not collected on a regular basis because that was not the purpose of this study. However, when the scores of the three individuals who were known to have motor deficits (#4, 8, 10) were compared, no observable trend emerged. Therefore, it may be concluded that a relationship existed between the aphasics' primary symptoms and the difference in their evaluation scores for the majority (92%) of the subjects in Group 1.

None of the other demographic information appeared to correlate with the experimental findings. Based on these limited results, it could be assumed that TEL-C delivery would be appropriate for use in evaluating the word and sentence repetition abilities of aphasics whose auditory comprehension skills were relatively intact. The use of TEL-C procedures to test aphasics with auditory comprehension deficits may result in their word and sentence repetition skills being underestimated.

The other significant difference that was revealed from the statistical analysis of the "mode" variable was that the control subjects' scores on the TEL-C digit repetition task were significantly higher than those achieved during traditional evaluation. Because the digit repetition subtest had been taken directly from the Minnesota Test for Differential Diagnosis of Aphasia, the current evaluation results were compared to those reported by Schuell (1974). As part of the initial standardization procedures, the Minnesota Test was presented to 75 aphasic subjects and 50 non-aphasic control subjects. Schuell compared the two groups on the basis of the number of subjects who had been able to repeat all seven digits, the number who could repeat at least five digits, and the number of correct responses which had been made overall. A similar analysis was performed on the results of the current study with the results as shown in Table 3.

It was apparent that the non-aphasic subjects in Schuell's study received scores that were higher overall than the mean ratings that were achieved by the control subjects in the TEL-C study. This

TABLE 3

A Comparison of the Performance of the Subjects in Schuell's (1974) Study with that of the Subjects in the Current Study on a Digit Repetition Task

		Control Subjects	Aphasic Subjects
Subjects Able to Repeat all 7 Digits	Schuell	62%	5%
	TEL-C	67%	8%
	FACE	25%	17%
	MEAN	46%	12.5%
Subjects Able to Repeat 5 or More Digits	Schuell	100%	29%
	TEL-C	100%	34%
	FACE	83%	25%
	MEAN	92%	29.5%
Mean Number of Correct Items	Schuell	6.50 digits	3.06 digits
	TEL-C	5.55 "	3.25 "
	FACE	4.50 "	3.25 "
	MEAN	5.03 digits	3.25 digits

discrepancy may imply that the non-aphasics in the current study exhibited a reduction in digit repetition span. Schuell attributed the errors made by the subjects in her control group to "transient inattention or distraction." This rationale could also be used to explain the non-aphasics' inferior performance under similar testing conditions (i.e., face-to-face) in the present study. However, it could not be used to justify the fact that the subjects' possible retention deficits were less apparent during TEL-C evaluation. Instead, it could be hypothesized that the use of a telephone served to focus the subjects' attention on the experimental task, much as the headphones had done for the aphasics in Gordon's (1968) study. As one subject stated, "The telephone forced me to pay attention, it was all I had to rely on to get the correct answer..."

CHAPTER IV

SUMMARY

The present study was designed to investigate the efficacy of using TEL-C delivery to supplement aphasia auditory comprehension evaluation. A total of 24 male subjects were tested; 12 subjects had been diagnosed as aphasic for a minimum of 6 months and 12 non-aphasic subjects acted as controls. An auditory comprehension examination which consisted of yes/no questions, paragraph comprehension questions, and repetition tasks was presented in full to each subject on two consecutive days. Half of the subjects in each group were first tested using TEL-C delivery while the others received traditional evaluations (i.e., face-to-face). On the second day of testing, the presentation modes and the subgroups were interchanged. The two test scores achieved by each subject were then statistically analyzed in relation to the variables "group," "order," and "mode" (previously defined). As a "group," the aphasics scored significantly lower than the control subjects on each of the four auditory comprehension subtests. The specific "order" in which the presentation modes were used to introduce the experimental stimuli had no significant influence on the responses made by either group of subjects on any of the tasks. In general, the particular "mode" that was used to present the test stimuli was not significantly related to the experimental results. However, on the word and sentence repetition task, the aphasic subjects achieved a significantly higher score under the traditional evaluation condition. In contrast, the non-aphasic subjects obtained a significantly higher score on the TEL-C digit repetition subtest. It was speculated that the telephone served to direct the subjects' attention to the task at hand which resulted in them receiving a superior rating under the TEL-C condition.

Based upon the limited results of the present study, it appears that TEL-C may be a useful procedure for evaluating the auditory comprehension abilities of adults with aphasia; especially those whose auditory comprehension is relatively intact.

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APPENDIX A

Pre-Test

I. Conversational and Expository Speech

a. Response to greeting. (Q: "How are you today"?)

b. Response with "yes" or "no." (Q: "Have you ever been in this hospital before"? or "Have I tested you before"?)

c. Response with "I think so," or equivalent. (Q: "Do you think coming to the hospital/clinic has helped you"?)

d. What is your full name?

e. Tell me the state/date you were born.

II. Auditory Decoding

f. Point to the window.

g. Where is the light?

h. Point to an article of furniture.

i. Where is the entrance to this room?

j. Where is the exit?

APPENDIX B

Auditory Comprehension Evaluation Form

I. YES/NO QUESTIONS

I am going to ask you some questions. I want you to listen carefully and tell me if the answer is yes or no. Are you ready?

1. Do apples grow on trees?
2. Are towns larger than cities?
3. Does milk come from cows?
4. Should children disobey their parents?
5. Is winter warmer than summer?
6. Are there seven days in a week?
7. Does everyone put money in the bank?
8. Are there many cities in the United States?
9. Does the sun rise in the west?
10. Do you wear shoes on your feet?
11. Were the Indians in this country before the white men came?
12. Can anyone get a license to fly an airplane?
13. Is it a policeman's duty to enforce the law?
14. Was Abraham Lincoln the first president of the United States?
15. Is it possible for a good swimmer to be drowned?

Score_______________

APPENDIX B (cont'd)

II. REPETITION TASKS

A. I am going to read some words and sentences. Listen carefully, then repeat exactly what I say. Are you ready?

1. Bed
2. Nose
3. Pipe
4. Window
5. Banana
6. Snowball
7. Forty-five
8. Ninety-five percent
9. Sixty-two and a half
10. The telephone is ringing.
11. He is not coming back.
12. The pastry cook was elated.
13. First British Field Artillery.
14. No ifs, ands, or buts.
15. Pack my box with five dozen jugs of liquid veneer.

B. Now I am going to read some numbers. Wait until I finish, then say them after me.

5 3
4 9

8 2 4
6 2 7

9 1 6 2
3 1 8 5

2 7 4 8 1
6 3 5 9 4

9 2 6 7 3 8
8 6 3 4 1 6

7 9 6 2 5 4 1
5 4 2 7 1 8 3

Score A_______________
B_______________

APPENDIX B (cont'd)

III. PARAGRAPH COMPREHENSION QUESTIONS

I am going to read you a short story and then I will ask you some questions about it. Are you ready?

Mr. Jones had to go to New York. He decided to take a train. His wife drove him to the station but on the way, they had a flat tire. However, they arrived at the station just in time for him to catch the train.

1. Did Mr. Jones miss his train?

   Did he get to the station on time?

2. Was Mr. Jones going to New York?

   Was he on his way home from New York?

I am going to read another paragraph.

A soldier tried to cash a check in a bank near his camp. The teller, firm but sympathetic, said, "You will have to have identification from some of your friends from the camp." The discouraged soldier answered, "But I don't have any friends in camp - I'm the bugler."

1. Was the soldier's check cashed at once?

   Did the teller object to cashing the check?

2. Did the soldier have a friend with him?

   Did the soldier have trouble finding friends?

Score______________

APPENDIX C

V.A. Patient Consent Form

Information about Telecommunicology (TEL-C) and its use in evaluating the auditory comprehension abilities of adults with aphasia.

The following information will be presented to each subject:

The Department of Audiology and Speech Pathology supports the practice of protection for human subjects participating in research. The following information is provided so that you can decide whether you wish to participate in the present study. You should be aware that even if you agree to participate, you are free to withdraw at any time without loss of benefits provided by the V.A. The study is concerned with determining the usefulness of testing the understanding of speech when talking over the telephone. You will be given part of an evaluation while seated face-to-face with a speech pathologist and the other portion while talking to the clinician over the telephone. The results of the presentations will be compared to determine which, if either, is a more accurate representation of your abilities to understand speech. In the unlikely event you are injured as a result of participation in this study, the Topeka Veterans Administration Medical Center will furnish medical care, as provided by federal statute. Compensation for such injury may be available to you under the provision of title 38, United States Code, Section 351, and/or the Federal Tort Claims Act. For further information, you can contact the V.A. District Legal Council at 1-913-272-3111. Do you have any questions concerning what I have told you? If you would like to talk to someone about this project, you can see Mr. William George in the Speech Pathology Department, or we can give you the name of someone appropriate who is not directly connected with the project. Your participation is solicited, but strictly voluntary. Do not hestiate to ask questions about the study. Be assured your name will not be associated in any way with the research findings. We appreciate your cooperation very much.

Sincerely,

____
Janet Dare

(SUBJECT) I, ________________________ certify that the above written summary was discussed and explained fully to me by________________________ on this date.

________________________ ________________________
Date Signature

________________________ ________________________
Date Witness