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ABSTRACT

As part of the compressed speech project, a research institute and laboratory were established. Research was completed concerning aural tests and the use, methods, and variables of compressed speech. Research in progress involved the same areas. In addition, a new speech compressor was utilized, and reports of a conference and various other activities were presented. (JD)

THE DEVELOPMENT OF ACCELERATED SPEECH AS A USEFUL COMMUNICATION TOOL IN THE EDUCATION OF BLIND AND OTHER HANDICAPPED CHILDREN

By

Emerson Foulke and Jacques Robinson

Progress Report
Project No. 7-1254
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PROGRESS REPORT

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U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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Introduction

There were two developments during this reporting period that will provide significantly increased support for the compressed speech project. A new graduate research institute was established at the University of Louisville, with the principal investigator as its director, and the activities of the institute are carried out in a new laboratory.

Last year, the principal investigator prepared a proposal for the establishment of a graduate research institute, and submitted it for consideration by appropriate bodies within the University of Louisville. On June 25, 1969, the Board of Trustees of the University of Louisville authorized the establishment of a graduate research institute to be known as the Perceptual Alternatives Laboratory. The mission of this laboratory is to investigate the perceptual alternatives available to individuals when, for whatever reason, the stimulus energy on which a given perceptual process depends, is not available. For instance, the perception of speech normally depends upon an individual's ability to sense acoustical energy. If hearing is impaired, it cannot be sensed. However, the transduction of acoustical stimulation to visual or tactile stimulation may provide a perceptual alternative. If, because of a malfunction of the central nervous system, the dyslexic child cannot process written language, the specification of words with acoustical stimulation, instead of visual stimulation, may provide him with a perceptual alternative. The blind pedestrian cannot obtain visual knowledge of the disposition of objects in his environment. However, if an organization specifying important characteristics of the environment can be imposed on ultrasonic energy, and if that organized energy can be transposed to the audible spectrum, the blind pedestrian may have a perceptual alternative. These are examples of the alternatives with which the laboratory is concerned. The investigation of alternative ways of informing about aspects of the environment raises the question of how the equivalent information contained in alternative forms of stimulation should be displayed. Consequently, the study of sensory displays constitutes another major interest of the laboratory. To illustrate, suppose that language, normally displayed on the printed page, is to be displayed aurally for the blind child or

dyslexic child. What kind of aural display would be most suitable? At what rate should the words in this display occur? What kind of steps might be taken to give the person who reads by listening the same kind of control over his display that is enjoyed by the visual reader?

Over the past several years, the principal investigator has developed several related lines of research. With the establishment of the Perceptual Alternatives Laboratory, these research activities are drawn together under a single, unifying concept.

The laboratory's research program now includes: a) the investigation of the process of reading by listening, with special reference to the role played by rate controlled recorded speech in this process; b) the study of haptic perception, with special reference to the observer's ability to obtain language information from displays consisting of patterns of dots, and his ability to obtain information about spatial relations from various kinds of tactographic displays; c) the investigation of the perceptual basis for mobility, and the development or improvement of tools by means of which a blind pedestrian might obtain the information needed to guide the mobility process; and, d) the human ability to obtain information from acoustical energy that has been transduced to mechanical energy and displayed tactually. All of these research activities are related, and all have to do with perceptual processes which might, under appropriate circumstances, replace other perceptual processes.

The willingness of the University of Louisville to grant institute status to this collection of related research activities suggests an interest on its part in promoting the continuity of the research program. This interest has found tangible expression in the form of new laboratory space in the recently completed Life Sciences Building. At present, the Perceptual Alternatives Laboratory occupies a suite of nine rooms. There are four offices, a reception and work area, an electronics shop, a recording studio, a speech rate laboratory, and a print shop. The recording studio, where master tapes containing monitored, recorded oral reading are prepared, is equipped with a soundproof booth that is considerably larger than the one previously available in the past for use on the compressed speech project. Furthermore, the recording studio, itself, provides considerably more acoustic isolation than was possible in the former laboratory space. With a better recording studio, and a larger soundproof booth, and with the equipment now in use, it is

possible to make speech recordings that meet high professional standards. The electronics shop and the speech rate laboratory are provided with complete electromagnetic shielding. For the first time, it it possible to perform electronic measurements, operate solid state logic configurations, and prepare rate controlled recordings without the risk of interference produced by a local radio station, and other nearby sources. The print shop contains the duplicating, folding, addressing, and stapling machinery needed to prepare the CRCR Newsletter, distributed monthly, and to prepare reports such as this one.

Four rooms in another building on campus, occupied by the laboratory before the present space became available, are still available for use. According to present plans, two of these rooms will be equipped with listening carrels. There will, at last, be a suitable place for the conduct of listening experiments. The remaining two rooms will be used for the conduct of other laboratory experiments.

Several benefits are provided by the new laboratory quarters. There is more and better equipped space in which to work. All of the laboratory staff members are now located in a single suite of rooms, and most of the laboratory activities are conducted in these rooms. Before the laboratory space became available, the laboratory's staff and activities were distributed among three separate locations on the campus. A single place of work has resulted in greatly improved communication among staff members, and more adequate supervision of laboratory projects is possible.

The new quarters occupied by the Perceptual Alternatives Laboratory, and its new status as a graduate research institute, should result in increased productivity. There may be increased visibility for the class of research activities carried on in the laboratory, attracting increased interest on the part of both researchers and those who support research.

The Project Staff

In addition to the principal investigator, the project employs as co-investigator, Dr. Jacques Robinson, an assistant professor in the School of Education at the University of Louisville. It is the responsibility of the co-investigator to assist the principal investigator in the design, conduct, analysis, and report of experiments.

Mrs. Beth Challman, research associate, Mr. Robert Heise, graduate research assistant, and Mr. Dean Tuttle, research assistant, complete the investigative staff. In addition, the staff includes Mrs. Pauline Duke, office manager, Mrs. Lela Johns, publications secretary, Miss Sally Kendrick, general secretary, Mr. William Wirth, the technician in charge of the recording studio and speech rate laboratory, Mr. Fred Higbie, the electronics technician, and Mr. Charles Cotter, technical assistant in the recording studio and speech rate laboratory.

Completed Research

The Use of Time-Compressed Speech as a Review Technique

An experiment was performed to evaluate the use of compressed speech as a review technique for use by students who read by listening. The subjects were the students in the ninth, tenth, eleventh, and twelfth grades at the Kentucky School for the Blind and the Indiana School for the Blind. All students listened to a short, moderately interesting biographical sketch about Franklin Pierce. The subjects were then divided into three groups, with grades and schools proportionally represented in each group. One week later, subjects were recalled for a second session. One group reviewed by listening to the same tape they had heard the previous week. The second group reviewed by hearing the selection in 50% of the original recording time. No review was provided for the third group. All three groups were given a multiple-choice test of comprehension, covering the facts and implications of the listening selection. In order to insure full cooperation, $5.00 prizes were given to the individuals receiving the highest scores in each of the three groups in both schools. As expected, those students who reviewed did significantly better on the test of comprehension than those students who did not. The performance of those who reviewed by listening to the compressed rendition of the listening selection was not significantly different from the performance of those who reviewed by listening again to the original selection. The results point to a very practical application of compressed speech as a review technique for students who read by listening. These students are generally unable to engage in the kind of rapid reviewing that is routine for those who read visually. It is likely that even higher compressions may be utilized for reviewing, effecting an even greater savings in listening time for the busy student.

Aural Versus Braille Test Taking

An experiment was performed to determine the influence of test-taking procedure on test performance for braille and large print readers. In one condition, subjects obtained test information by reading braille or large print. In the other condition, they obtained test information by aural reading. Braille and large print readers are generally slow, quite variable, and often deficient in reading ability. They may be more competent and less variable in their listening ability. Consequently, aural test reading may provide an increased opportunity for many braille or large print readers to obtain test information, and the consequence may be better measurement of the ability assessed by the test.

The subjects in this experiment were the students enrolled in the seventh, eighth, and ninth grades at the Kentucky School for the Blind. For counterbalancing purposes, the subjects were divided into four groups, matched for school grade and IQ. Each group received one form of the Paragraph Meaning Sub-Test and the Social Studies Content Sub-Test of the Stanford Achievement Test in braille or large print, and the equivalent form of the same Sub-Tests aurally.

It was expected that students with higher mental ages would score higher on these tests, regardless of the mode of presentation, and this expectation was born out statistically. The mode of presentation made no difference for good braille or large print readers, but poor braille or large print readers did better on the tests they read aurally. This result suggests that when poor braille or large print readers are examined with tests written in braille or large print, the measurement performed by the test is contaminated by poor reading ability.

A Comparison of the Sampling Method with the Method of Harmonic Compression

The purpose of this experiment was to compare speech compressed by reproducing consecutive samples of a recorded speech signal with speech compressed by the method of harmonic compression. This method is an outgrowth of research at Bell Laboratories, and is employed in the compressor built at the American Foundation for the Blind. The signal quality of speech compressed by the method of harmonic compression is quite high, but speech can only be compressed to one-half of the original recording time. Compression by Fairbanks'

sampling method results in a slight, but audible degradation in signal quality. However, speech can be reproduced in any desired fraction of original recording time. In order to gauge the significance of these conflicting factors, it was judged important to discover whether or not the slight difference in signal quality between the two methods is a difference that makes a difference.

Accordingly, an experiment was performed in which three groups of listeners were tested for comprehension of a listening selection. For one group, the selection was compressed to 50% of its original recording time on the harmonic compressor. For the second group, the listening selection was compressed to 50% of original recording time on the Graham compressor, which makes use of the Fairbanks method. The third group listened to a selection that was not compressed in time. The listening selection was the biographical sketch about Franklin Pierce, mentioned earlier, and listening comprehension was assessed by a multiple-choice test written for this selection. One hundred five college students at the University of Louisville were randomly assigned to the three treatment groups. All subjects heard the selection on earphones, and were tested immediately for comprehension.

The comprehension scores for the subjects who heard the uncompressed selection were significantly higher than the scores for either of the other two groups. However, there were no significant differences between the scores of those whose selection was compressed on the Graham compressor, and the scores of those whose selection was compressed on the harmonic compressor. This result suggests that, although the product of the harmonic compressor is somewhat more pleasing to hear, the product of the Graham compressor may be more generally useful.

Processing Time as a Variable in the Comprehension of Time-Compressed Speech

In earlier progress reports, the research conducted by Miss Ruth Ann Overmann, in partial fulfillment of the requirements for a Master's degree, has been described. Her thesis, entitled "Processing Time as a Variable in the Comprehension of Time-Compressed Speech", has been accepted by the Graduate School, and may be borrowed from the library of the University of Louisville. An account of this research will also be prepared as an Interim Progress Report to the Office of Education. This account will appear in the conference Proceedings, to be published shortly. A summary of the research follows.

An experiment was performed to test the hypothesis that listening comprehension declines more rapidly than word intelligibility as a function of compression in time, because comprehension depends upon processing operations that require time. If too much time is eliminated by compression, the remaining time will not be sufficient to permit the required processing, and comprehension will suffer. The hypothesis was tested by comparing the comprehension of compressed listening selections with the comprehension of listening selections which were different only in that the time eliminated by compression was restored at phrase and sentence boundaries. The improvement in comprehension following time restoration was statistically significant for two of the three compressions at which comparisons were made. Although restoration of time at the highest compression represented in the experiment improved comprehension, it was still significantly poorer than the comprehension demonstrated by a control group that listened to uncompressed speech, suggesting that the loss of processing time is not the only factor responsible for the poor comprehension of highly compressed speech.

Effects of Stimulus and Interstimulus Duration on the Immediate Recall of Time-Compressed Sequences of Different Orders of Approximation to English

The research performed by Mr. James Wilson has been discussed in earlier progress reports. This research is also reported in his Master's thesis, entitled "Effects of Stimulus and Interstimulus Duration on the Immediate Recall of Time-Compressed Sequences of Different Orders of Approximation to English", which may be borrowed from the library of the University of Louisville. An account of this research will be prepared as an Interim Progress Report to the Office of Education. A summary of the research follows.

> An experiment was designed to examine the effects of sequential redundancy and of stimulus and interstimulus duration at different total rates of presentation on the immediate recall of twelve twenty-word sequences. The sequences were presented auditorily and S was instructed to recall orally as many of the words in any order that he could after each sequence had been presented.

George Miller's "chunk" served as the basic concept behind this experiment although no measure of the chunk was made. We hypothesized that if more redundant sequences could be organized into fewer chunks than less redundant sequences, the average number of words recalled from the former would be greater than the average number of words recalled from the latter. On the basis of this and the findings of Miller and Selfridge (1950), we hypothesized that the average number of twelfth and fourth order words recalled would be greater than the average number of second order words recalled. The experiment confirmed the hypothesis that recall of fourth order words was greater on the average than recall of second order words, but while the average number of twelfth order words recalled was greater than the average number of second order words recalled, it was less than the average number of fourth order words recalled. This latter finding was discussed and was considered to result possibly from the fact that the second and fourth order sequences were constructed by Ss from one population and the twelfth order sequences were constructed by Ss from a different population.

We considered the argument that as rate is increased, the rate of information input could be kept below channel capacity if more information could be organized into each chunk. If more information could be organized into each chunk from the higher order than from the less redundant lower order sequences, we would expect increasing the rate of presentation to result in less of a decline in the number of words recalled from higher order sequences than from lower order sequences. This hypothesis was not confirmed by the present experiment.

We considered Aaronson and Markowitz's (1967) suggestion that:

> ...for maximum recall and comprehension, for a fixed amount of compression, it may be optimal to delete more from the words than from the intervals between words. English is so redundant that much of the word can be eliminated

without decreasing intelligibility, but the inter-word intervals are needed for perceptual processing.

In light of this, in the present experiment, at each rate of presentation there were two cases. In one case only the words were compressed by means of the Fairbanks apparatus and the time savings was added to the durations between the words. In the second case, only the durations between words were compressed. The hypothesis that interstimulus duration was relatively more critical than stimulus duration for information processing and recall (particularly at a high rate and for processing less redundant sequences) was not confirmed by the present experiment.

Possible reasons for the negative results were discussed. One possibility was that the highest rate used in the experiment was not high enough so that channel capacity for processing information was not exceeded. At the highest rate, each S might have had all of the time he needed for processing as much of the lower order sequences as he could process at lower rates. Since the highest total rate would not exceed channel capacity, adding the time savings between words would not result in better recall than that obtained when the sequences were shortened by decreasing only the interstimulus durations. A second possible explanation for the negative results was that interstimulus duration simply might not be more critical than stimulus duration as far as the accuracy of recall of words from passages differing in amount of sequential redundancy was concerned.

To conclude, the results of the experiment suggest that sequential redundancy was the only controlled factor in the experiment affecting the average number of words per passage that were recalled. It was not possible to conclude whether the remaining negative results were simply a result of our rate conditions being too slow or were a result of our assumptions not being applicable to sequences differing in the amount of sequential redundancy.

Research in Progress

An Aural Intelligence Test

In the last progress report, the rationale for a group aural intelligence test was given, and preliminary work on the development of such a test was reported. After examination of many tests that might be suitable for aural administration, the Lorge-Thorndike Test was chosen. Equivalent forms of this test have now been prepared, both in braille and in recorded form. Blind children, for whom WISC verbal scores have been obtained, will receive both the braille and the recorded form of the Lorge-Thorndike Intelligence Test. The resulting scores will be analyzed in order to gauge the suitability of the Lorge-Thorndike Test as an aural test of intelligence. If it is at all satisfactory, it can be further refined by the usual procedures for test construction.

The Intelligibility of Words Removed, Intact, from Fluent Speech

In the last progress report, the research conducted by Mr. Robert Heise, on the relationship between word intelligibility and listening comprehension was discussed. A detailed report of this work is being prepared, and will be submitted to the Office of Education as an Interim Progress Report. A somewhat abbreviated account of his work was presented by Mr. Heise at the Second Louisville Conference on Rate and/or Frequency Controlled Speech. This account will appear in the conference Proceedings, to be published shortly.

One of Heise's findings was that the intelligibility of time-compressed words is influenced by a wide variety of factors, and that the apparent relationship between word intelligibility and listening comprehension depends substantially upon the conditions under which word intelligibility is determined. Words spoken in isolation are usually articulated with greater care than when they occur in fluent speech, and their beginnings and endings are not modified in order to permit smooth transitions from word to word. Accordingly, words spoken in isolation are, in general, more intelligible than words spoken in the context of fluent speech. At the time Heise carried out this research, the apparatus needed to reproduce selectively single words in a stream of fluent speech was not available. An effort was made to prepare stimulus materials in such a way that the pronunciation

of the single words used in the test for intelligibility would closely approximate their pronunciation in the context of fluent speech. However, this effort was not entirely successful. Apparatus has now been constructed that will permit the selective reproduction of single phrases, words, or even syllables in a recorded stream of fluent speech. This apparatus will be described more fully in a later section of this report. Its availability will permit the conduct of experiments in which the intelligibility of time-compressed words, pronounced as they are when they occur in the context of fluent speech, can be determined. The data of these experiments will permit a more cogent analysis of the relationship between the intelligibility and the comprehension of time-compressed speech.

The Comprehension of Time-Compressed Fluent Speech as a Function of the Locations of Unfilled Intervals

In Overmann's research, it was shown that the restoration, at phrase and sentence boundaries, of the time lost by compression, improved comprehension. Apparently listeners can use the time made available by restoring the time lost by compression to perform the processing operations on which comprehension depends. The next step in this research is to determine the syntactic locations at which the availability of time would contribute most to the comprehension of compressed speech. In research to be reported in his Master's thesis, Heise will determine the effect on the comprehension of compressed speech of adding unfilled intervals at various syntactic locations. If it can be shown that unfilled time is more useful at some locations than at others, it will be possible to make inferences regarding the way in which listeners process spoken language. The apparatus for the selective reproduction of segments of recorded fluent speech will be used in preparing the listening materials for this experiment.

Listener Control of the Duration of Unfilled Intervals in Time-Compressed Speech

One way to get directly at the listener's requirement for time in which to process what he hears would be to allow him to determine the duration of the unfilled intervals in fluent speech. With the apparatus for selectively reproducing segments of recorded, fluent speech, this can now be done. Therefore, an experiment is planned in which subjects

will listen to, and be tested for their comprehension of recorded fluent speech that has been segmented. At the end of each segment, the tape recorder on which this speech is reproduced will be automatically turned off. In order to hear the next segment, it will be necessary for the subject to press a button in order to start the tape recorder again. The relay that turns the tape recorder on and off will also operate the pen on a single-channel chart recorder. When the tape recorder is running and, consequently, when speech is occurring, the pen will write at one of its two levels. When the tape recorder is off and there is no speech signal, the pen will write at the other level. From this chart it will be possible to determine the amount of "off" time allowed by a subject between each segment of the listening selection. Listening selections will be divided into such segments as words, phrases, clauses, and sentences, and these segments will be presented at various levels of compression. Presumably, a subject will require more time to process some segments than others, and this fact should be reflected by variations in the off times between segments. This information, together with measures of the comprehension of segmented and unsegmented listening selections, may permit some useful inferences about the way in which spoken language is processed by a listener, and may provide clues about how to improve the aural display of language.

Reading by Listening as an Alternative for Poor Readers in Public Schools

As Dr. Roy Butz* points out, the educational experience provided by the standard public school program is built on the supposition that those who receive the experience know how to read. Success in the program depends upon the ability to read and, to the extent that a child has a reading problem, he has a reduced opportunity to learn what he would need to know in order to succeed in the program. Unfortunately, when a child reads poorly, this lack of ability is often interpreted as but one manifestation of a general lack of learning aptitude.

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*Dr. Roy J. Butz, Director, Reading & Language Center, Oakland County Service Center, Campus Drive, Pontiac, Michigan 48053.

However, there are reasons for believing that many of those who read poorly can listen effectively. If these children had been allowed to read by listening, they might have prospered in the educational program. The poor performance of these children may simply be a consequence of the inflexibility of an educational establishment which insists that they continue to try to use a channel of communication which, for them, is ineffective, and refuses to help them make use of a channel that would work. The dyslexic child affords an obvious example. There are dyslexic children who, though they cannot read by visual inspection of the printed page, have shown superior educational achievement when an adequate mobilization of resources has made aural reading a realistic alternative. There are large numbers of children in our public schools who, though they do not present a sufficiently definitive constellation of symptoms to permit a diagnosis of dyslexia, do have real trouble in reading. They can read after a fashion, but reading is, for them, an unpleasant experience, and when released from the coercion of the school system, will know well enough how to eliminate this unpleasant experience. These are the children who, as adults, will not read in any meaningful sense of the word. They will obtain the information specified by written letters from signs, billboards, and labels, but they will receive most of their information about the world that lies beyond their personal experience from pictures in magazines and newspapers, and from television. These are the children who might be well served by the provision of an alternative reading system -- the system of aural reading. The extent of this problem is not well defined yet, but it is undoubtedly serious. The following experiment is planned as an initial step in coming to grips with it.

A large number of high school children in the Louisville Public School System will be tested for reading comprehension. They will then be tested for listening comprehension, and from the two sets of measures, an effort will be made to isolate a group of students who are poor readers but good listeners. If the differences observed are impressive, an effort will be made to involve the Louisville Public School System in a collaborative project in which children meeting this description will be identified and given the opportunity to depend upon aural reading in order to meet the requirements of educational tasks.

A Demonstration of the Educational Efficacy of Reading by Listening to Time-Compressed Recorded Speech

In the last progress report, a project was described in which blind children, enrolled in the California School for the Blind, are to be given extensive experience in reading by listening to time-compressed speech. They will read, both for recreational purposes, and in order to obtain the information they need for success in a school course. Mr. Tuttle submitted the following account of progress on this project to the principal investigator on January 9, 1970.

> This is a brief progress report of the compressed speech project at the California School for the Blind involving the eighth grade history book Land of the Free and some recreational reading.
>
> The most critical task has been to orient several of the staff members of the California School for the Blind to the value and importance of this project. Without an initial acceptance by the staff, this project would be doomed from the start. I have gained the cooperation of the eighth grade history teacher (with some reservations), the ninth grade English teacher, and the Director of Advanced Studies for the high school youth. I have found the administration accepting and cooperative after reassuring them that the school would not be called upon to bear any extra work loads.
>
> The following number of students are involved in the aspect of the project specified:
>
> 9 High school students (grades 10-12) for Recreational Reading
> 8 Ninth graders for Recreational Reading
> 9 Eighth graders for history: Land of the Free
> Unknown number, as yet, in the Berkeley Public Schools
>
> With respect to materials, my first task was to prepare braille answer sheets for both the Nelson-Denny (a five choice test) and the STEP Test of Listening Comprehension (a four choice test). I also made up some sample

answer sheets for practice purposes as this type of answer sheet was new to most children at the California School for the Blind. I then duplicated these answer sheets in sufficient quantities for me to be able to administer an uncompressed and compressed listening pretest and post-test.

For testing purposes I have received from the University of Louisville the following test tapes: Nelson-Denny, Form A and B (uncompressed), STEP Form 2A and B (uncompressed), STEP Form 3A and B (uncompressed), STEP Form 2B Paragraphs only (compressed).

The following pretests have been administered.

For the high school students:

Nelson-Denny, Form A, uncompressed, evening study hall, one sitting; STEP, Form 2B, compressed, evening study hall, one sitting.

For the ninth graders:

STEP, Form 3A, uncompressed, morning, first period, two sittings on two successive days; STEP, Form 2B, uncompressed, morning, first period, two sittings on two successive days.

For eighth grade:

STEP, Form 3A, uncompressed, morning, first period, one sitting; STEP, Form 2B, compressed, morning, first period, one sitting.

To date, I have received four tapes of Land of the Free, which completes the book. I am in the process of adding tone signals for page numbers and chapter breaks to facilitate their use by the students.

To date, I have also received the following titles of recreational reading:

The Hottest Fourth of July in the History of Hangtree County (2 other copies completed)
From the Earth to the Moon (2 other copies completed)
20,000 Leagues Under the Sea (2 reels)
Men of Thunder

This next week I begin distributing copies of the tapes available. I plan to attend the history class when the tapes are to be used so that I can assist this particular teacher who seems to have some reservations. In addition, I have set up a listening library which I shall conduct and supervise every evening Monday through Thursday. This will give me an opportunity to work with the students, help them with the use of tape recorders, give them tips on studying with tapes, but mainly to supervise the use of the equipment as the school staff was unwilling to do this.

As yet, I have not been able to administer any braille reading tests as proposed since I have not been able to locate any tests and none have come from the University of Louisville. I am currently in the process of making out some questions for the attitude questionnaire for both student and teacher.

This project is regarded as of particular importance at the present stage of development of time-compressed speech as an educational medium. A large number of short-term experiments, involving subjects who are naive with respect to time-compressed speech, have now been performed. Useful information has been obtained by means of these experiments, but they have serious limitations, and the point of diminishing returns has been reached. In order to make a meaningful judgment about the actual educational utility of time-compressed speech, it will be necessary to gather information that can only be obtained from readers who have listened to time-compressed speech in large quantities, over a long period of time, and for a variety of reading purposes, including serious educational purposes. The objective of this project is to realize such conditions, and then to assess the effectiveness of reading by listening.

The Role of Expressive Variables in the Comprehension of Fluent Speech

Messages are, of course, specified by the words with which they are constituted, and by the order in which these words are arranged. When these messages are spoken, some additional specification is provided by expressive variables, such as changes in vocal pitch and intensity, the amount and distribution of unfilled time in the spoken message, and speech rate. By interpreting these variables, the listener probably obtains processing instructions.

It is a fact obvious to those who read by listening that oral readers differ widely in skill. Of course, the oral reader must have articulatory facility, and experience with the language, in order to pronounce words correctly. However, beyond this, his skill is largely defined in terms of the way in which he manages expressive variables.

This analysis suggests two lines of investigation. First, the examination of the productions of skilled oral readers may provide useful clues regarding how spoken language is processed. Preliminary to this examination, there should be a demonstration that the productions of skilled oral readers are, in fact, more comprehensible than the productions of unskilled oral readers. In an earlier experiment (Foulke, 1967), it was shown that, even in the ranks of professional readers, there are differences in renditions that result in differences in comprehension. Plans are now underway to collaborate with Dr. Norman Lass* in the conduct of an experiment in which the productions of skilled oral readers, and of unskilled oral readers, will be compared in terms of comprehensibility. An effort will be made to analyze skilled and unskilled productions, in order to determine those factors most responsible for the observed differences. With this information in hand, it may be possible to examine the productions of skilled oral readers, with a view to determining those features of their oral productions that make them compatible with the needs of listeners, engaged in the task of processing spoken language.

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The other approach is to gain control over the expressive variables, and to vary them independently, and systematically. This, however, is not easy to accomplish. An oral reader, instructed to hold one expressive variable constant, changes the way in which other expressive variables are represented in his production, so that independent variation is not achieved. The solution is probably to be found in electronic processing of recorded fluent speech. In fact, time-compression, by the sampling method or by the method of harmonic compression, affords an excellent example of the manipulation of speech rate without affecting other expressive variables. An effort is now underway to find a means of controlling and manipulating the other expressive variables. If this can be done, it will be possible to specify more exactly the characteristics of the properly structured oral display.

The Acceptability of Time-Compressed Recorded Books by Blind and Physically Handicapped Readers

If blind and physically handicapped readers are to make judgments about time-compressed recorded books, they must have time-compressed recorded books to read. Accordingly, arrangements have been made for the distribution of two time-compressed recorded books, by the Library of Congress through its system of regional libraries, to the blind and physically handicapped readers served by it. The titles were chosen through consultation with Mrs. Freddie Peaco, a staff member of the Division for the Blind and Physically Handicapped, Library of Congress, who gave advice concerning the titles most frequently requested by college students and other adult readers. The titles are Patterns of Culture by Ruth Benedict, published by the Houghton Mifflin Company, and Modern Short Stories edited by M. X. Lesser and John N. Morris, published by the McGraw-Hill Book Company, Inc. The recorded books have been compressed to 70% of original recording time, and have been put on cassettes. Fifty copies of each book have been prepared. In addition, fifty copies of a selection entitled "Reading by Listening to Time-Compressed Speech", written by the principal investigator, have been prepared in cassette form for distribution through the same regional libraries. When these materials have been in circulation for some time, an effort will be made to determine the reactions of those who listened to them.

Apparatus

The new speech compressor, mentioned in the last progress report, is now in operation, and performing satisfactorily. This compressor, manufactured by Wayne Graham, Discerned Sound, 4459 Kraft Avenue, North Hollywood, California 91602, is a compressor of the Fairbanks type. The signal to be compressed is first recorded on a storage loop, and it is this loop that is scanned by the sampling wheel. The use of a storage loop makes it possible to vary the duration of discarded samples, and this is an important capability for many research purposes. The signal from the playback heads on the sampling wheel is amplified, by preamplifiers mounted on the sampling wheel shaft, before it is passed through the brush and ring assembly by means of which it is removed from this shaft. Since the brush and ring assembly is a serious source of noise, this amplification affords a needed improvement in the signal-to-noise ratio. The compressor also includes circuitry for muting the signal at sample boundaries, in order to achieve a smoother speech record. With the great flexibility and high signal quality afforded by this instrument, the laboratory is capable of producing time-compressed and expanded speech for a wide variety of applied and basic research purposes.

The speech compressor in use before the new one was obtained has been described in an earlier progress report. It has been taken out of service for overhauling and modification. It will be equipped with an improved sampling wheel, a storage loop and related record and erase heads and associated electronics, and the brush and ring assembly will be replaced by a rotary transformer. If these modifications are successful, the laboratory will be equipped with another speech compressor of high quality, and great flexibility.

As mentioned earlier, apparatus has been assembled by means of which it is possible selectively to reproduce segments of fluent speech. This is accomplished in the following manner. Fluent speech is recorded on one track of a stereo tape. A brief tone is then recorded on the other track of the tape, with its onset occurring from one-half to one second before the onset of the segment of interest. The actual amount of time is not critical. One channel of the tape recorder on which this tape is reproduced, the channel in which the speech signal appears, is connected through an electronic switch to the input of another tape recorder. The output of the other channel of the first tape recorder is amplified, rectified, and applied to the coil of a relay. The closure of this relay

is the initiating event for a configuration of solid state logic modules. When the tone recorded on track two of the tape is reproduced, the relay closes, initiating a delay period, the duration of which can be adjusted over a range of 2.046 seconds in steps of two milliseconds. At the end of the delay period, a relay, connected in the external control circuitry of the electronic switch, closes. This closure operates the electronic switch and turns on the speech signal recorded on track one. As the relay closes, another timed period, called the record period, is also initiated. The duration of this period is adjustable, in steps of two milliseconds through a range of 8.190 seconds. When it is finished, the relay opens again, turning off the electronic switch and the speech signal. The durations of the delay period and the record period are adjusted, by successive approximations, until the electronic switch is turned on only during the occurrence of the segment of interest. This segment is then copied on the tape recorder to which the output of the electronic switch is fed. Although the operation of this apparatus is tedious, it performs quite satisfactorily, and its availability will enable a variety of experiments in which segments of the speech record are to be reproduced selectively, or in which unfilled intervals in the speech record are to be manipulated.

The Second Louisville Conference on Rate and/or Frequency Controlled Speech

The first Louisville Conference on Time-Compressed Speech was held at the University of Louisville on October 19, 20, and 21, 1966. The conference Proceedings, a volume of 168 pages, containing research reports and an extensive list of references, was distributed widely and has proved to be a valuable source of information in the field. All regions of the United States, and several provinces of Canada were represented at the conference, and the interest it generated has undoubtedly been responsible, in large degree, for the rapid growth of basic and applied research activity concerning rate controlled recorded speech. Those attending the conference recommended the establishment of a center from which rate controlled recorded speech could be obtained, and the preparation and distribution of a monthly newsletter reporting matters of interest to experimenters, educators, and others concerned with rate controlled recorded speech. Both of these recommendations have been carried out. The Center for Rate Controlled Recordings was established at the University of Louisville, and is now a unit of the Perceptual Alternatives Laboratory. Its affairs are guided by a national

board of advisors (for names and addresses of board members, see Appendix A). A monthly newsletter has been prepared for 34 months, and its circulation has grown steadily. At present, over 900 copies are distributed each month.

Because the objectives of the first Louisville Conference were substantially realized, there has been a steady stream of requests for a second conference. Accordingly, the Board of Advisors of the Center for Rate Controlled Recordings planned a Second Louisville Conference on Rate and/or Frequency Controlled Speech, which was held at the University of Louisville on October 22, 23, and 24, 1969. The conference was a collaborative effort, involving the Advisory Board to the Center for Rate Controlled Recordings, the University of Louisville, the Division of Research, Bureau of Education for the Handicapped, Office of Education, and the Division for the Blind and Physically Handicapped, Library of Congress. The Advisory Board planned and conducted the conference program. The University of Louisville provided the conference meeting room and supporting services. Some conference expenses were covered by money provided by the Office of Education for support of Project No. 7-1254. A grant of $2,500 was received from the American Foundation for the Blind. The Library of Congress provided additional support by purchasing compressed speech materials and conference proceedings. A contribution of genuine importance was made by the staff of the Perceptual Alternatives Laboratory, who managed conference logistics with skill, energy, and good humor. Those participating in the conference program were reimbursed for travel and per diem expenses. Approximately 125 individuals came to the conference from all regions of the United States, from Canada, and England. The conference program is shown in Appendix B.

One recommendation made by those attending the conference was for the conduct of a workshop on rate controlled recorded speech. This workshop would be presented for a restricted audience of those who wish to acquire research competence in the area of rate controlled recorded speech. Instruction would be given in terminology, computations related to rate controlled recorded speech, methods for the time-compression and expansion of recorded speech, and the use of ancillary equipment involved in the production of rate controlled recorded speech, such as filters, program equalizers, tape recorders, and production of monitored recorded oral reading. An effort will be made to offer such a workshop at the University of Louisville this summer.

A volume of conference proceedings is now being prepared. This volume will contain the research reports delivered at the conference, and a list of over 400 references. This volume should be an even more valuable source of information about research on rate controlled recorded speech than the volume of proceedings of the first Louisville Conference. It will be distributed without charge to those who participated in the conference program, and sold to other requesters. This charge is for the purpose of recovering some of the costs incurred in its production. No monetary profit will be realized.

Judging by the many unsolicited commendations received by staff members, both during the conference and afterward by mail, the Second Louisville Conference on Rate and/or Frequency Controlled Speech was a success. Stimulation provided by the conference has resulted in the initiation of several research projects, many letters have been received from individuals who attended the conference requesting research reports and other information about rate controlled recorded speech, the distribution list for our monthly newsletter has grown considerably, and a large number of requests for the conference proceedings have been received, including many requests from people who did not attend the conference.

Other Project Related Activities

Demonstration Tapes

Four demonstration tapes have been prepared for distribution by the Center. The first tape, entitled "Controlling the Rate of Recorded Speech by the Sampling Method" ($2.00) presents an explanation of how speech is compressed by reproducing consecutive, temporally contiguous samples of a recorded speech signal. The tape contains examples of speech that has been compressed and expanded by several amounts, and with several durations of discarded samples. Also included are examples in which vocal pitch has been varied, with and without a change in word rate. The second tape, entitled "Reading by Listening to Time-Compressed Recorded Speech" ($3.00) tells how recorded speech is compressed or expanded, and indicates sources for rate controlled recorded speech and for speech compression equipment. In addition, the findings of research regarding the comprehension of time-compressed speech are discussed, and the use of time-compressed recorded speech by aural readers is considered. This selection is

presented on the first track of a cassette, at a normal word rate. The same selection is presented on the second track in 65% of the original recording time. The third tape, entitled "The Use of a Computer for the Compression of Speech by the Sampling Method" ($2.00) presents examples of compressed speech in which the function performed by a compressor of the Fairbanks type is simulated by the computer, and examples of dichotic speech in which the samples retained by the Fairbanks method are presented to one ear and the samples discarded by the Fairbanks method are presented to the other ear. The fourth tape, entitled "The Time-Compressed Babble of Many Tongues" ($2.00) contains examples of the time-compressed speech of native speakers of many foreign languages.

The CRCR Newsletter

The monthly newsletter, prepared and distributed by the Center for Rate Controlled Recordings, continues to show a rapid growth in circulation. At present, approximately 900 copies are distributed each month. The principal investigator serves as editor. The assistant editor is Mrs. Beth Challman, who collects material for publication in the newsletter, and supervises its printing and distribution.

Other Communications

In addition to the information disseminated through the newsletter, the laboratory has filled a large number of requests for reprints and progress reports, and maintains an active and extensive correspondence with experimenters and educators, supplying information about speech compression equipment and giving advice about the preparation of rate controlled recorded speech. A very large number of requests for rate controlled recorded speech has been filled. In some cases, recorded tapes are sent by requestors for processing at the Center. In other cases, the speech to be compressed or expanded is also recorded at the Center.

Visitors

There has been a steady stream of visitors to the laboratory -- singly and in groups. Dr. Randall Harley, in the Department of Special

Education at George Peabody College, has brought two groups of graduate students in Special Education to the laboratory, where they were acquainted with laboratory processes and activities, and given a demonstration of the time-compression and expansion of speech by the sampling method. Dr. Joan Chase, in the Department of Special Education at Hunter College, has also brought two groups of graduate students in Special Education to the laboratory. Dr. Harvey Rawson, in the Department of Psychology at Hanover College, brought a group of undergraduate psychology majors to the laboratory on February 9. A group of students from Central High School in Louisville toured the laboratory on January 26.

Consulting

The principal investigator has served as a consultant to several projects in which time-compressed speech is to be applied in educational settings. Consulting visits have been made to: Mr. Fred Sinclair, Consultant in Education of the Visually Handicapped, Department of Education, State of California, 721 Capitol Mall, Sacramento, California 95814; Dr. James W. Smith, Experimental Education, San Juan Unified School District in Suburban Sacramento, 3738 Walnut Avenue, Carmichael, California 95608; and, Mr. Charles R. Russell, Director, Media Project, Texas School for the Blind, 1100 West 45th Street, Austin, Texas 78756.

The principal investigator has presented several papers and addresses at conferences and conventions, and has published several reports, as shown in the following list.

Addresses and Papers:

The Exploration of Perceptual Alternatives. Colloquium address, Department of Psychology, Vanderbilt University, October 9, 1969.

Research Objectives in Non-Visual Perception. Colloquium address, Department of Special Education, George Peabody College, October 9, 1969.

An Explanation of Speech Compression by the Sampling Method. Presented at the Workshop, Second Louisville Conference on Rate and/or Frequency Controlled Speech, October 22, held at the University of Louisville on October 22, 23, and 24, 1969.

A Comparison of "Dichotic" Speech and Speech Compressed by the Electromechanical Sampling Method. Written by Emerson Foulke and Elizabeth M. Wirth and presented by the senior author on October 23, to the Second Louisville Conference on Rate and/or Frequency Controlled Speech held at the University of Louisville on October 22, 23, and 24, 1969.

The Consideration of Perceptual Alternatives for Visually Handicapped Children. Colloquium address, Department of Special Education, Hunter College, October 30, 1969.

Development of Efficient Communication Skills. Address to the First Western Regional Conference of the American Educators of the Visually Handicapped, Los Angeles, California, November 8, 1969.

A Comparison of Alternative Methods for the Time-Compression of Recorded Speech Without Pitch Distortion. Presented at the Annual Convention of the American Speech and Hearing Association in the session Time and Frequency Altered Speech -- Theoretical and Applied, Chicago, Illinois, November 14, 1969.

The Influence of Age, Grade, and Intelligence on the Comprehension of Time-Compressed Speech. Accepted for presentation at the 1970 American Educational Research Association Annual Meeting to be held in Minneapolis, Minnesota, March 2-6, 1970.

Papers:

Foulke, E. Non-Visual Communication -- IV: Reading by Listening. Education of the Visually Handicapped, 1969, 1, #3.

Foulke, E. Non-Visual Communication -- V: Reading by Listening. Education of the Visually Handicapped, 1969, 1, #4.

Foulke, E. Non-Visual Communication -- VI: Reading by Listening. Education of the Visually Handicapped, in press.

Foulke, E. Non-Visual Communication -- VII: Reading by Listening. Education of the Visually Handicapped, in press.

Foulke, E. Reading by Listening. Proceedings of the Institute of the Tennessee State Department of Education, April 22, 1969, Louisville, Kentucky, in press.

Foulke, E. and Wirth, E. M. A Comparison of "Dichotic" Speech and Speech Compressed by the Electromechanical Sampling Method. Proceedings of the Second Louisville Conference on Rate and/or Frequency Controlled Speech, October 22, 23, and 24, 1969, University of Louisville, in press.

Foulke, E. Methods for Controlling the Word Rate of Recorded Speech. Journal of Communication, submitted for publication.

Publicity

The Second Louisville Conference on Rate and/or Frequency Controlled Speech was covered by both television and the press. The principal investigator was interviewed by Phyllis Knight, a member of the staff of the News Department of WHAS-TV, and this interview was broadcast on the evening news, October 23, 1969. The conference was also announced in The Louisville Times, on October 21, 22, and 23, 1969. The principal investigator was interviewed by Ryan Halloran and Julie Shaw on the Morning Show, a television program produced by WAVE-TV, on November 6, 1969. During the interview, the activities of the Perceptual Alternatives Laboratory were discussed, including the research on rate controlled recorded speech.

Appendix A

Members of the Advisory Board for the Center for Rate Controlled Recordings

Dr. Emerson Foulke, Chairman

Mr. Robert S. Bray, Chief
Division for the Blind and Physically Handicapped
Library of Congress
1291 Taylor Street
Washington, D. C. 20540

Dr. H. Leslie Cramer
156 Line Street
Cambridge, Massachusetts 02139

Dr. Sam Duker
Office of Testing and Research
Brooklyn College
Brooklyn, New York 11210

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Dr. Thomas G. Sticht
Human Resources Research Office
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P. O. Box 5787
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Dr. Richard Woodcock
American Guidance Service, Inc.
Publishers' Building
Circle Pines, Minnesota 55014

Dr. Willard Zemlin
Speech Research Laboratory
and Hearing Clinic
University of Illinois
Urbana, Illinois 61820

Appendix B

PROGRAM OF THE SECOND LOUISVILLE CONFERENCE ON RATE AND/OR FREQUENCY CONTROLLED SPEECH

Workshop: Concepts and Terminology Pertaining to Rate Controlled Speech

Dr. Willard R. Zemlin
Speech and Hearing Research Laboratory
University of Illinois
Champaign, Illincis 61801

Dr. Emerson Foulke, Director
Perceptual Alternatives Laboratory
University of Louisville
Louisville, Kentucky 40208

Dr. Robert J. Scott
8604 Bunnell Drive
Potomac, Maryland 20854

An Introduction to Speech Compression Techniques

Dr. H. Leslie Cramer
Senior Research Analyst
Peace Corps
806 Connecticut Avenue, N. W.
Washington, D. C. 20525

The Effect of Rate of Compression and Mode of Presentation on the Comprehension of a Recorded Communication to Junior College Students of Varying Aptitudes

Mr. C. Cordell Parker
Department of Speech and Drama
Tarrant County Junior College
Northeast Campus
Fort Worth, Texas

Perturbations of Sex Judgments with Time and Frequency Altered Speech

Dr. Daniel Beasley
Audiology and Speech Sciences
Michigan State University
East Lansing, Michigan 48823

Dr. Willard R. Zemlin
Speech and Hearing Research Laboratory
University of Illinois
Champaign, Illinois 61801

Dichotic Speech-Time Compression

Dr. Sanford Gerber
Department of Speech
University of California
Santa Barbara, California 93106

Dr. Robert J. Scott
8604 Bunnell Drive
Potomac, Maryland 20854

A Comparison of "Dichotic" Speech and Speech Compressed by the Electromechanical Sampling Method

Dr. Emerson Foulke, Director
Perceptual Alternatives Laboratory
University of Louisville
Louisville, Kentucky 40208

Mrs. Elizabeth M. Wirth
Perceptual Alternatives Laboratory
University of Louisville
Louisville, Kentucky 40208

The Intelligibility of Compressed Words

Mr. Robert Heise
Perceptual Alternatives Laboratory
University of Louisville
Louisville, Kentucky 40208

Studies on the Efficiency of Learning by Listening to Time-Compressed Speech

Dr. Thomas G. Sticht
Human Resources Research Office
The George Washington University
P. O. Box 5787
Presidio of Monterey
Monterey, California 93940

Application of Rate Controlled Recordings in the Classroom: IMRID

Dr. Richard W. Woodcock
American Guidance Service, Inc.
Publishers' Building
Circle Pines, Minnesota 55014

Automation and Speech

Dr. A. Hood Roberts
Acting Director
Center for Applied Linguistics
1717 Massachusetts Avenue, N. W.
Washington, D. C. 20036

Processing Time as a Variable in the Comprehension of Time-Compressed Speech

Miss Ruth Ann Overmann
5532A Sandpiper
St. Louis, Missouri 63136

Speech Pause Duration as a Function of Syntactic Junctures

Dr. Kenneth F. Ruder
Bureau of Child Research
University of Kansas
Lawrence, Kansas 66044

Dr. Paul J. Jensen
Communication Science Laboratory
University of Florida
Gainesville, Florida 32601

The Significance of Intra- and Inter-Sentence Pause Times in Perceptual Judgments of Oral Reading Rate

Dr. Norman J. Lass
Speech and Hearing Sciences Laboratory
Division of Otolaryngology
School of Medicine
West Virginia University
Morgantown, West Virginia 26506

Temporal Spacing and the Comprehension of Time-Compressed Speech

Dr. Raymond L. Johnson
Communications Skills Research Program
American Institutes for Research
8555 Sixteenth Street
Silver Spring, Maryland 20910

Dr. Herbert L. Friedman
American Institutes for Research
8555 Sixteenth Street
Silver Spring, Maryland 20910

The Automation 2002, Information Rate Changer

Mr. Stephen Temmer, President
Infotronic Systems, Inc.
2 West 46th Street
New York, New York 10036

Response Parameters in Rate Incremented Aural Coding

Dr. Murray S. Miron
Department of Psychology-Psycholinguistics
150 Marshall Street
Syracuse University
Syracuse, New York 13210

Mr. Eric Brown
Research Assistant
Psychology Department
Syracuse University
504 Huntington Hall
Syracuse, New York 13210

The Effects of Variation in Source Language Presentation Rate on the Performance of Simultaneous Conference Interpreters

Mr. David Gerver
University of Durham
Department of Psychology
7 Kepier Terrace
Gilesgate, Durham ENGLAND

The Harmonic Compressor

Mr. John W. Breuel
American Foundation for the Blind
15 West 16th Street
New York, New York 10011

Mr. Leo M. Levens
American Foundation for the Blind
15 West 16th Street
New York, New York 10011

The Graham Compressor, A Technical Development of the Fairbanks Method

Mr. Wayne Graham
Discerned Sound
4459 Kraft Avenue
North Hollywood, California 91602

Time Compression of Speech on a Small Computer

Mr. Shahid U. Qureshi
Department of Electrical Engineering
The University of Alberta
Edmonton 7, Alberta CANADA

Dr. Y. J. Kingma
Department of Electrical Engineering
The University of Alberta
Edmonton 7, Alberta CANADA

The Braided Speech Method of Time-Compressing Speech

Dr. H. Leslie Cramer
Senior Research Analyst
Peace Corps
806 Connecticut Avenue, N. W.
Washington, D. C. 20525

Mr. Robert P. Talambiras
Adage, Inc.
1079 Commonwealth Avenue
Boston, Massachusetts 02215

The Measurement of Listening Comprehension

Dr. David B. Orr, President
Scientific Educational Systems, Inc.
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910 17th Street, N. W.
Washington, D. C. 20006

Effects of Motivation and Word Rate On Aural Comprehension

Dr. Carson Y. Nolan
American Printing House for the Blind, Inc.
P. O. Box 6085
Louisville, Kentucky 40206

Miss June E. Morris
Research Associate
Department of Educational Research
American Printing House for the Blind, Inc.
Louisville, Kentucky 40206

Comprehension of Narrative Passages by Fourth Grade Children as a Function of Listening Rate and Eleven Predictor Variables

Dr. Robert L. Gropper
Assistant Professor of Education
University of Miami
Coral Gables, Florida 33124

A Comparison of Two Techniques for Increasing the Reading Rate of Sixth Grade Gifted Pupils: TCS Self-Improvement

Mr. Charles R. Walker
Assistant Superintendent
Centennial Schools
Warminster, Pennsylvania 18974

Compressed Speech Research at the AIR University

Capt. Meredith W. Watts, Jr., USAF
Department of Instructional Technology
Academic Instructor and Allied Officer School
Maxwell Air Force Base, Alabama 36112

Economic Analysis of Time-Compressed Speech for Instructional Broadcast Satellites: The Case of Brazil

Dean Jamison
Assistant Professor
Department of Economics
Stanford University
Stanford, California 94305

An Investigation Into Extended Use of Time-Compressed Speech with Intermediate-Grade Subjects

Mrs. Grace D. Napier
Department of Education
Temple University, Graduate School
Philadelphia, Pennsylvania 19122

Listening Training Employing Compressed Speech

Mrs. Rachel Rawls
Consulting Psychologist
North Carolina State Commission
for the Blind
P. O. Box 2658
Raleigh, North Carolina 27603

Comprehension for Immediate Recall of Time-Compressed Speech as a Function of Sex and Level of Activation

Dr. Sally McCracken
Department of Speech and Dramatic Arts
Eastern Michigan University
Ypsilanti, Michigan 48197

Comprehension of Rate Controlled Speech by Second Grade Children with Functional Misarticulations

Dr. Robert Vernon Stroud, Director
Clinical Services
Barney Medical Center
1735 Chapel Street
Dayton, Ohio 45404

Rate Controlled Speech and Second Language Learning

Dr. Herbert L. Friedman
American Institutes for Research
8555 Sixteenth Street
Silver Spring, Maryland 20910

Dr. Raymond L. Johnson
Communications Skills Research Program
American Institutes for Research
8555 Sixteenth Street
Silver Spring, Maryland 20910

Compressed Speech in Medical Education

Mrs. Gloria Boyle
Research Assistant
School of Medicine
University of Missouri - Columbia
228 Medical Science Building
Columbia, Missouri 65201

The Relationship of Listening Skills to the Utilization of Compressed Speech

Dr. Rolland Callaway
Department of Curriculum and Instruction
School of Education
University of Wisconsin
Milwaukee, Wisconsin 53201

Dr. Gerald Gleason
Department of Educational Psychology
University of Wisconsin
Milwaukee, Wisconsin 53201

Barbara Klaeser
Milwaukee School of Engineering
1025 N. Milwaukee
Milwaukee, Wisconsin 53201

Deaf Children's Audition of Distinctive Features Within Frequency Sampled Speech

Dr. Daniel Ling
School of Human Communication Disorders
McGill University
3465 Cote des Neiges Road
Montreal, Quebec CANADA

Effects of Training on the Intelligibility and Comprehension of Frequency-Shifted Time-Compressed Speech by the Blind

Dr. Paul Resta
Group Head
Instructional Management Systems
Southwest Regional Laboratory for Educational
Research and Development
11300 La Cienega Boulevard
Inglewood, California 90304

References

Aaronson, D. and Markowitz, N. Immediate recall of normal and compressed auditory sequences. Paper presented at the Eastern Psychological Association, Boston, Mass., April, 1967.

Foulke, E. The influence of the reader's voice and style of reading on the comprehension of time-compressed speech. The New Outlook for the Blind, 1967, 61, #3, 65-68.

Miller, G. A. and Selfridge, J. A. Verbal context and the recall of meaningful material. American Journal of Psychology, 1950, 63, 176-185.