COMPARISON OF THE EFFECTIVENESS OF THREE METHODS FOR INCREASING READING RATE

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This is to certify that the

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John Howard Stamper

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James L. Page
Major professor

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ABSTRACT

COMPARISON OF THE EFFECTIVENESS OF THREE METHODS FOR INCREASING READING RATE

John Howard Stamper

Past research concerning time-compressed speech has typically examined the effects upon intelligibility, comprehension, and learning by various stimulus and listener variables. Relatively few research studies have examined the effects of reading improvement techniques upon reading rate and comprehension. (Orr et al, 1965; Reidford, 1965; Orr, 1966; Reiland, 1970; Stamper, 1970; and Walker, 1971). Results of past research have been mixed as to the effectiveness of practice in compressed listening (i.e., listening to time-compressed speech at increasingly faster compression rates) and compressed audio-pacing (i.e., listening to a time-compressed narration while following in an accompanying visual text). Orr et al (1965) found compressed listening to have a favorable effect upon visual reading rate. Subsequently, Orr et al, (1965) hypothesized compressed audio-pacing training may produce a stronger effect upon subjects' reading rate. Reidford (1965), Orr (1966), Reiland (1970), Stamper (1970) and Walker (1971) examined the effects of various training conditions and subject characteristics upon reading rate and comprehension. None of the researchers found any effect upon reading comprehension attributable to practice in compressed audio-pacing. However, Orr (1966) and Stamper (1970) found compressed audio-pacing training to have a favorable effect upon reading rate. Reidford (1965) and Reiland (1970) found no such effect.

The previous research studies reviewed have failed to adequately compare traditional reading improvement methods (i.e., visual-pacing through which the presentation time of the visual text is controlled) to methods utilizing time-compressed speech. Likewise, no previous research was reviewed which examined the treatment method of combining the time-compressed audio narration with a moving, synchronous text. It would appear from a review of the research literature that the question remains: What relative effect

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will training in compressed listening, visual-pacing, compressed audio-pacing, and non-paced reading have upon subjects' visual reading abilities?

The independent variables of the present experiment are the four separate training conditions: (l) compressed-listening practice (i.e., the audio treatment); (2) visual-pacing practice (i.e., the visual treatment); (3) compressed audio-pacing practice (i.e., the audio/visual treatment); and, (4) non-paced reading practice (i.e., the control treatment). The dependent variables are subjects' reading rate and reading comprehension during non-paced reading.

The major hypotheses are of the null hypothesis type of no differences among treatment groups for both reading rate and reading comprehension gain scores. Alternate major hypotheses involve the groups' improved relative performance in respect to the control group. The minor hypotheses are of the null hypotheses type, of no differences between treatment groups for reading rate and comprehension. Alternate minor hypotheses involve the relative performance between individual treatment groups. It is hypothesized that the audio/visual treatment scores will be greater than those of the audio and visual treatments respectively.

Several assumptions are made in the present experiment. One assumption is that the Nelson-Denny Reading Test adequately measures subjects' reading rates and comprehension. A second assumption is that the use of compressed audio-pacing of a synchronous visual text will have a favorable effect upon subjects' reading rate. A third assumption is that the treatment intervals for the present experiment are of adequate length to have effect upon reading abilities.

Several limitations of the study should be noted. One limitation is the limited generalizability of its findings which is possible. Secondly, limited treatment time was available during the experiment. A third limitation is that several subjects reported to have fatigue after the audio and audio/visual

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treatments. This may have affected post-testing. A fourth limitation is the inherent limitation of traditional reading abilities testing.

Survive the Savage Sea (Robertson, 1973) was chosen as the visual text in the experiment. A professionally recorded narration of the book was time-compressed from 160 to 600 words per minute in 20 word per minute incriments. A videotaped "crawl" of the visual text was produced, and synchronized to the compression rate of the time-compressed narration. The "pacing point", at which this text and narration were synchronous was near the vertical mid-point of the television screen.

Forms "A" and "B" of the Nelson-Denny Reading Test (Nelson-Denny, 1960) were used as pre and post instruments for measurement of reading rate and comprehension. The test itself is a widely-used test of reading abilities. Psychometric characteristics of the test concerning its standardization were adjudged favorable.

Treatment sessions were individually scheduled, lasting a total of 70 to 80 minutes in length. Pre- and post-tests totaled 40 minutes, each consisting of a timed one minute rate test and a 19 minute comprehension test. Subjects in audio and audio/visual treatments were permitted to adjust the television monitors volume and brightness. Control group subjects could adjust ambient room light.

The experimental design was a pre-test/post-test control group design (Campbell and Stanley, 1963). Subjects were randomly assigned both pre-tests and treatments. Post-tests were assigned as the alternate test form from that given as the pre-test.

An analysis of variance was preformed upon the treatment groups' mean gain scores to test the hypothesis H_o: $\mu_1 = \mu_2 = \mu_3 = \mu_4$ for the dependent variables of reading rate and reading comprehension. The F ratios obtained were 1.5476 (for rate) and 1.3639 (for comprehension). There were 2 degrees of freedom among sample means and 29 degrees of freedom within samples.

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The tabled F ($P < .05$) was 2.934. Since neither of the obtained F ratio values exceeded the tabled F value, neither of the null hypotheses of no significant difference among groups for reading rate or comprehension gains could be rejected. Since no significant differences among treatments were revealed for measures of reading rate and comprehension, post-hoc procedures to determine the relative strengths of treatment effects (as were hypothesized in Chapter One) were not appropriate.

The results of the present experiment raises several implications for future research. The use of time-compressed speech in methods for improvement of reading abilities could not be demonstrated in the present experiment to be significantly better than practice in non-paced reading or a traditional visual-pacing technique. It is anticipated, however, that time-compressed audio-pacing practice may prove superior to existing reading improvement techniques under the conditions of extended training session length with a larger sample population.

COMPARISON OF THE EFFECTIVENESS OF THREE METHODS FOR INCREASING READING RATE

By

John Howard Stamper

A DISSERTATION

Submitted to

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Chapter One

Problem

The present experiment seeks to extend and supplement past research concerning time-compressed speech used in reading improvement techniques. Time-compressed speech refers to the reproduction of recorded speech sounds at a faster than normal rate. Speech reproduced in such a manner has also been described by a plethora of other technical terms, often describing the technique which was used to accomplish the phenomenon. Some examples are: rate-altered speech, speeded speech, time-shortened speech, rapid-speech and others. The term time-compressed speech will be used throughout this and subsequent chapters.

This chapter will examine six subject areas: (1) an overview of trends in time-compressed speech research and how the present experiment will contribute to the research which has been conducted in the past; (2) examination of the purposes for which the experiment was conducted; (3) statement of the hypotheses to be tested in the present experiment; (4) description of possibly unfamiliar terms which will be used in this and subsequent chapters; (5) discussion of the assumptions made in constructing the present experiment; and (6) discussion of the limitations of the present experiment which should be noted by the reader.

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PROBLEM OVERVIEW

The mid-1950's marked the beginning of most of the research which has been conducted in the United States regarding the educational uses of various techniques for producing time-compressed speech. Since that time, research concerning time-compressed speech has largely centered upon questions dealing with the limits and characteristics of an individual's ability to discern audio messages which have been "time-compressed". These questions dealt with the measurement of immediate recall, comprehension, and retention of simple to complex messages.

Interest in the potential uses of time-compressed speech for educational purposes heightened during the mid-1950's, due apparently to success in developing devices which could produce time-compressed recordings readily (Fairbanks, Everitt and Jaeger, 1954). Table 1.1 presents several randomly selected research areas which have dealt with the use of time-compressed speech.

TABLE 1.1

RANDOM STUDIES SELECTED FROM THE TIME-COMPRESSED RESEARCH LITERATURE

AREA	TYPE	EXAMPLE
Educational uses of time "saved"	What educational 'strategies' should be used for the time made available through the use of time compressed speech in instruction?	Fairbanks 1954
Learner abilities and trainability	What are the limits of comprehension of time-compression and is the ability trainable?	Orr & Friedman 1968
Optimum presentation rates to learners	Is there an optimum time-compressed presentation rate for which instructional materials should be recorded?	Jester 1966
Audio-paced visual reading for improving rate	What effect does time-compressed audio-pacing of visual texts have upon learner reading rates?	Stamper 1970
Preference of presentation rates by learners	What is the most preferred time-compressed presentation rate by learners?	Foulke & Sticht 1966

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The present study was an extension of past educational research which has sought to apply techniques involving time-compressed speech toward beneficial instructional uses. The use of time-compressed speech for the improvement of reading abilities has been only infrequently reported in the research literature. For the few studies which do exist dealing with time-compressed speech used in reading improvement, little variation in the techniques examined has been evident (Reidford, 1965; Orr, 1966; Stamper, 1970; Reiland, 1970, and Walker, 1971). For example, one of the methods used in the present experiment was a pacing technique with a synchronous time-compressed speech narration accompanying the same visual text. No prior research studies were found in the literature which employed this technique for improvement of reading abilities. Similarly, a videotape recording was used as a presentation medium for visual and audio stimuli in the present study. No prior research studies were found which used this presentation medium in techniques for improvement of reading abilities.

The present experiment seeks to determine the relative usefulness of four training techniques for reading skills improvement. Two of the techniques, called in the experiment the audio and audio/visual treatments, used time-compressed speech to pace subjects' listening and/or visual reading rates. The two other techniques examined in the present experiment are a traditional visual-pacing method using manipulation of the rate of a moving text, and non-paced reading practice which was used as a control treatment.

It is hoped that the present experiment will extend and enrich the framework of research concerning the use of time-compressed speech techniques for improvement of reading abilities by comparison of the effectiveness of various previously reported reading improvement techniques. Likewise, it is hoped the experiment will provide additional reading improvement technique for use in further research. In order to describe the objectives of the present experiment more fully, a review of the purposes of the present experiment follows.

PURPOSE OF THE EXPERIMENT

The purpose of the present experiment was to investigate the relative utility of four separate conditions of practice upon reading rate and reading comprehension. These conditions were: (1) practice listening to a time-compressed audio recording of a text; (2) practice watching a visual text presented at an increasingly faster rate; (3) practice both listening and watching a text presented at an increasingly faster rate; and (4) practice visually reading a text at a self-chosen rate. Had any of the conditions using time-compressed speech proven successful in improving subjects' reading abilities, some present day teaching in reading improvement, such as merely providing motivation to read faster, may have been altered.

Table 1.2 lists the independent variables of the present experiment. The dependent variables are reading rate and comprehension. The symbols which will be used in symbolic representation of the experimental hypotheses are also presented.

TABLE 1.2
INDEPENDENT VARIABLES OF THE PRESENT STUDY

DESCRIPTION	SYMBOL	VARIABLE
Practice listening to time-compressed speech	A	Audio-Only
Practice watching a paced presentation	V	Visual-Only
Practice listening and watching a paced presentation	A/V	Audio/Visual
Practice in non-paced, visual reading	C	Control

HYPOTHESES

The major hypotheses of the present experiment are presented in written form in Table 1.3. Symbolic representations are presented in Table 1.4.

TABLE 1.3

MAJOR HYPOTHESES - WRITTEN

NUMBER	WRITTEN HYPOTHESES
Rate H_0	THERE IS NO DIFFERENCE AMONG READING RATE GAINS FOR THE AUDIO, VISUAL, AUDIO/VISUAL AND CONTROL GROUPS WHEN READING RATE IS MEASURED BY THE NELSON-DENNY READING TEST.
Rate H_1 H_2 H_3	THERE ARE RESPECTIVELY HIGHER READING RATE GAINS FOR THE AUDIO, VISUAL AND AUDIO/VISUAL GROUPS THAN FOR THE CONTROL GROUP WHEN READING RATE IS MEASURED BY THE NELSON-DENNY READING TEST.
Comprehension H_0	THERE IS NO DIFFERENCE AMONG READING COMPREHENSION GAINS FOR THE AUDIO, VISUAL, AUDIO/VISUAL AND CONTROL GROUPS WHEN READING COMPREHENSION IS MEASURED BY THE NELSON-DENNY READING TEST.
Comprehension H_1 H_2 H_3	THERE ARE RESPECTIVELY HIGHER READING RATE GAINS FOR AUDIO, VISUAL AND AUDIO/VISUAL GROUPS THAN FOR THE CONTROL GROUP WHEN READING COMPREHENSION IS MEASURED BY THE NELSON-DENNY READING TEST.

TABLE 1.4

MAJOR HYPOTHESES - SYMBOLIC

NUMBER	For the dependent variable reading rate:	NUMBER	For the dependent variable reading comprehesion:
H_0	$A = V = A/V = C$	H_0	$A = V = A/V = C$
H_1	$A > C$	H_1	$A > C$
H_2	$V > C$	H_2	$V > C$
H_3	$A/V > C$	H_3	$A/V > C$

The minor hypotheses of the present experiment are presented in written form in Table I.5. Symbolic representations are presented in Table I.6.

TABLE I.5

TABLE HYPOTHESES - WRITTEN

NUMBER	WRITTEN HYPOTHESES
Rate H_0	THERE IS NO DIFFERENCE BETWEEN MEAN READING RATE GAINS FOR THE AUDIO/VISUAL, AUDIO, OR VISUAL GROUPS WHEN READING RATE IS MEASURED BY THE NELSON-DENNY READING TEST.
Rate $H_1 H_2$	THE MEAN READING RATE GAIN FOR THE AUDIO/VISUAL GROUP IS HIGHER THAN THE MEAN READING RATE GAIN FOR THE AUDIO OR VISUAL GROUP RESPECTIVELY WHEN READING RATE IS MEASURED BY THE NELSON-DENNY READING TEST.
Comprehension H_0	THERE IS NO DIFFERENCE BETWEEN MEAN COMPREHENSION GAINS FOR THE AUDIO/VISUAL, AUDIO, OR VISUAL GROUPS WHEN READING COMPREHENSION IS MEASURED BY THE NELSON-DENNY READING TEST.
Comprehension $H_1 H_2$	THE MEAN COMPREHENSION GAIN FOR THE AUDIO/VISUAL GROUP IS HIGHER THAN THE MEAN COMPREHENSION GAIN FOR THE AUDIO OR VISUAL GROUP RESPECTIVELY WHEN READING COMPREHENSION IS MEASURED BY THE NELSON-DENNY READING TEST.

TABLE I.6

MINOR HYPOTHESES - SYMBOLIC

NUMBER	For the dependent variable reading rate:	NUMBER	For the dependent variable reading comprehension:
H_0	A/V = A=V	H_0	A/V = A = V
H_1	A/V > A	H_1	A/V > A
H_2	A/V > V	H_2	A/V > V

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DEFINITION OF TERMS

Definitions of terms used in describing the present experiment which are possibly unfamiliar to the reader are presented below. Please note that these definitions refer only to the present experiment.

AUDIO-PACING

Visual scanning of a printed text that is controlled in rate by a simultaneously-presented audio presentation of the same text.

AUDITORY

Pertaining to the hearing sense. In the present experiment, the auditory stimulus refers to the sound which is reproduced through the television monitor from the audio track of a videotape recording.

AUDITORY STIMULI

Sounds presented to subjects, including speech sounds. In the present experiment, the auditory stimuli were time-compressed.

BOOK/COMPRESSED-AUDIOTAPE

The use of a time-compressed narration of a book in conjunction with a book. Several previous research studies used such combinations (Reidford, 1965; Orr, 1966; Stamper, 1970; Reiland, 1970 and Walker, 1971).

COMPREHENSION

Extracting meaning from written or spoken language stimuli. In the present experiment, the Nelson-Denny Reading Test was used as a measure of reading comprehension.

COMPRESSED-AUDIO ONLY

A treatment condition in the present experiment in which a time-compressed speech stimulus was presented to subjects unaccompanied by any visual text.

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COMPRESSED AUDIO–PACING

Visual scanning of a visual text that is controlled in rate by presentation of a simultaneous time-compressed auditory narration.

COMPRESSED AUDIO/VISUAL

As "compressed audio-pacing". In the present experiment, the term designates a treatment condition in which the visual text accompanying the time-compressed speech was also paced.

COMPRESSED-LISTENING

The act of listening to time-compressed speech as opposed to normal rates of speech. In the present experiment, the audio and audio/visual groups participated in compressed-listening training where the rate of compression was gradually increased.

COMPRESSION METHOD

A technique used in production of speech having a time-compressed effect. In the present experiment, the Lexicon speech-compression device, a type of electronic speech-compressor, was used in production of audio materials for treatments.

COMPRESSED SPEECH

An abbreviation of the phrase, time-compressed speech. Compressed speech is the phenomenon which results from the altering of normal-speed recordings of speech sounds to recordings presenting the same speech at a faster than original rate.

CONNECTED DISCOURSE

Written or spoken language expressing several thoughts. In the present experiment, pre- and post-testing involved subjects answering questions about several paragraphs of reading.

CRAWL

A studio device for production of a moving text effect on a television screen; or the televised effect itself. In the present experiment, a videotaped crawl was used in the visual and audio/visual treatments.

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DEGREE OF SPEECH COMPRESSION

The amount a time-compressed speech recording is speeded. In past research, the degree of speech compression is often expressed as a percentage of the time required for the original recording. In the present experiment, the degree of speech compression is expressed as a measure of words per minute.

DUBBING

Re-recording an audio recording. Audio fidelity is progressively lost as recordings are dubbed several times.

ELECTROMECHANICAL SPEECH COMPRESSION

A method of time-compression of audiotape recordings. Electromechanical speech compression often involves rotating playback heads and an adjustable capstan drive arrangement.

ELECTROMECHANICAL SAMPLING

The basis of production for electromechanical speech compression. Electromechanical sampling involves systematically selecting and discarding tiny bits of a recorded audio signal in production of a time-compressed speech recording.

ELECTRONIC SPEECH COMPRESSION

A method of time-compression of audiotape recordings. In the present experiment, electronic speech compression involved the use of the Lexicon Compressor, employing a small digital-to-analog computer.

ELECTRONIC SAMPLING

The basis of production for electronic speech compression. In the present experiment, electronic sampling involves systematically changing a recorded audio signal to corresponding electronic patterns, and sampling these patterns in its reconversion to a time-compressed speech signal.

FIXED-LEVEL CRITERION

Holding a learning achievement constant and allowing learning time to vary. Stamper (1970) used successively higher degrees of time-compression as fixed-level criteria in compressed audio-pacing training. The Stamper (1970) experiment was, in many respects, a pilot study to the present experiment.

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FREE READING

Non-paced visual reading. In the present experiment, free reading was a control condition.

LISTENER VARIABLES

Subject attributes. Several previous studies in the research literature have examined the effects of such listener variables as subject age, intelligence or sex upon listening comprehension of time-compressed speech.

INTELLIGIBILITY

Ability to comprehend isolated speech sounds, words or short phrases. In past time-compressed speech research, intelligibility has most often involved presentations of these isolated speech stimuli. Comprehension has most often involved presentations of connected discourse.

LEXICON COMPRESSOR

The electronic speech compressor used in the present experiment.

NON-PACED VISUAL READING

Reading in a text as a self-chosen rate. In the present experiment, pre- and post-tests and the control treatment involved non-paced visual reading.

PACING RATE

The degree to which visual reading is speeded. In the present experiment, the pacing rate during compressed audio-pacing was the compression rate of the accompanying time-compressed narration.

PACING POINT

The junction at which the time-compressed narration accompanies the visual text. In the present experiment, the pacing point in the audio/visual treatment materials was approximately near the vertical midpoint of the television monitor screen.

RATE OF COMPRESSION

The relative speed of a modified audiotape recording to the original recording. This relationship is often expressed as the percentage of reduction in the time required for playback of the modified audiotape as compared to the original audiotape. In the present experiment, rate of compression refers to a measure of words per minute.

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RATE OF CRAWL

The speed of a moving text. In the present experiment, the rate of crawl for the text appearing on a television monitor was expressed as a measure of its words per minute rate.

READING ABILITY

The ability to comprehend written symbolic stimuli at certain rates of speed. For the present experiment, reading ability was measured through the use of the appropriate subsections of the Nelson-Denny Reading Test, Forms A and B.

READING COMPREHENSION

Measurement of the amount of information obtained in timed, non-paced visual reading of various narrative passages. For the present experiment, reading comprehension was measured through the use of the appropriate subsection of the Nelson-Denny Reading Test, Forms A and B.

READING RATE

Measurement of the words per minute speed obtained in timed, non-paced visual reading of narrative passages during the time period of one minute. For the present experiment, reading rate was measured through the use of the appropriate subsection of the Nelson-Denny Reading Test, Forms A and B.

SAMPLING

Systematic selection of tiny bits of a recorded speech signal. In the present experiment, the time-compressed speech material used in treatments was produced through electronic sampling of an original-rate recording.

SPEED-CHANGE METHOD

A method for production of time-compressed speech. Speed-changing is accomplished by increasing the playback speed of an original-rate recording.

SPEED-CHANGE SPEECH

The resultant time-compressed speech produced by the speed-change method.

SPEEDED SPEECH

Speech presented at a faster than normal rate. Often the term speeded-speech is used to refer to speed-change speech.

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STIMULUS VARIABLES

Time-compressed speech attributes. Several studies in the research literature have examined the effects of such stimulus variables as compression rate or compression method upon subjects' listening comprehension of time-compressed speech.

STIMULTANEOUS PRESENTATION

Presentation of a visual text with an accompanying time-compressed narration. In the present experiment, the audio/visual treatment involved simultaneous presentation of the visual and auditory materials.

STRUCTURED SELF-IMPROVEMENT TECHNIQUE

A commonly-used method for reading rate improvement. Walker (1971) compared the effects of traditional structured self-improvement training (Preston & Botel, 1967) to training in compressed audio-pacing. Another traditional method has been visual-pacing training, as used in the present experiment.

SYNCHRONOUS AUDIO/VISUAL PRESENTATION

The auditory narration accompanying a televised, visual text simultaneously at all rates of presentation. In the present experiment, the audio/visual treatment involved a synchronous audio/visual presentation.

SYNCHRONOUS VISUAL TEXT

A moving text accompanying a time-compressed speech narration which maintains a fixed "pacing point" relative to the narration. In the present experiment, the audio/visual treatment involved the use of a synchronous visual text. This is a unique aspect of the present experiment when compared to similiar previous research studies.

TELEVISION SCREEN MIDLINE

A point in the middle of the vertical axis of a television screen. In the present experiment, the television screen midline was the approximate "pacing point" in the audio/visual treatment.

TIME-COMPRESSED MASTER RECORDING

A "first generation" reco.ding (i.e., a recording which has not been re-recorded) which contains the original time-compressed speech signal. In the present experiment, the time-compressed master recording was re-recorded onto the audio track of the videotape recording used in treatments.

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TIME-COMPRESSED MESSAGE

An audio recording containing meaningful information which is presented at a faster than normal rate.

TIME-COMPRESSED SPEECH

Spoken language presented at a faster than normal rate. In the present experiment, time-compressed speech was presented alone (in the audio treatment) and accompanied by a visual text (in the audio/visual treatment).

TIME-COMPRESSION DEVICE

A mechanism used to produce a speech signal altered in rate. In the present experiment, the Lexicon (i.e., a type of electronic time-compression device) was used in production of time-compressed speech.

TIME-COMPRESSOR

As "speech compressor" or "time-compression device".

TRAINING MODALITIES

Practice which subjects receive in various treatment conditions. In the present experiment, effects upon reading rate and comprehension were determined for audio, visual, audio/visual, and control training modalities. In the audio training modality, subjects practiced "compressed-listening". In the visual training modality, subjects practiced "visual-pacing". In the audio/visual training modality, subjects practiced "compressed audio-pacing". In the control training modality, subjects practiced "non-paced visual reading".

VOCAL ACCELERATION METHOD

A technique used in production of speech having a "time-compressed" effect. Using the vocal acceleration method, time-compressed speech is accomplished by merely "speaking at a faster than normal rate".

VARIABLE-PACING TECHNIQUE

Compressed audio-pacing of a text at an ever-increasing compression rate; or at frequent, small increases in compression rate. In the present experiment, the compression rate used in the audio/visual treatment was increased approximately 20 words per minute during each three minute time period. The present experiment is unique as compared to similiar previous research because of its use of a variable-pacing technique in treatments.

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VISUAL-PACER

A technique or device used to control subjects' visual reading rate. In the present experiment, both "compressed audio-pacing" and "video-pacing" were used as visual-pacers of reading rate.

VISUAL READING RATE

Reading speed; or the scanning rate of a subjects' eye movements over a printed text. In the present experiment, visual reading rate was measured by the Nelson-Denny Reading Test.

VISUAL-PACING RATE

The speed at which a subject's visual reading rate is controlled through use of a "visual-pacer". In the present experiment, the visual-pacing rate was expressed by measurement of a word per minute rate.

VISUAL TEXT

The printed symbols on a page of type. In the present experiment, the visual text used in treatments was Survive the Savage Sea by Dougal Robertson (Robertson , 1973).

ZERO COMPRESSION RATE

An original speed speech presentation. In the present experiment, the zero compression rate of the recording used in treatments was approximately 160 words per minute.

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ASSUMPTIONS OF THE PRESENT EXPERIMENT

The assumptions under which the present experiment was conducted are presented in Table 1.7. The assumptions involve two areas of the experiment. The first area involves testing of reading abilities. The second area deals with treatment conditions.

Assumptions in the area of measurement center upon the Nelson-Denny Reading Test. The two major assumptions in this area are that the Nelson-Denny Test is capable of adequately measuring subjects' reading rate and comprehension. An assumption in the area of treatment methods is that the reading improvement method used in the present experiment (i.e., compressed audio-pacing of a synchronous visual text) will have a favorable effect upon subjects' reading rate. Likewise, it is also assumed that, based upon the Stamper (197 0) study, the length of training in treatments for the present experiment is of sufficient length to favorably alter subjects' reading rates.

TABLE 1.7

ASSUMPTIONS OF THE PRESENT EXPERIMENT

AREA	ASSUMPTION
TESTING	Use of a traditional, commonly-used reading comprehension test, such as is used in the Nelson-Denny Reading Test, has the capability of measuring subjects' ability to extract meaning from a printed text. Use of a short interval, timed reading rate test (such as is used in the Nelson-Denny Reading Test) has the capability to measure subjects' abilities to read from a printed text at various rates of speed.
TRAINING	Use of a synchronous visual reading stimulus and audio narration will enhance subjects' abilities to be paced at increasing presentation rates. A time period of approximately thirty minutes for exposure to treatment and control conditions is of adequate length to assure measument of any possible changes due to training.

LIMITATIONS OF THE PRESENT EXPERIMENT

Several limitations of the present experiment should be noted. As shown in Table 1.8, the areas in which limitations have been noted are in the experiment concern the inability to widely generalize its findings, the limited time available for treatments, subject fatigue due to treatment procedure, and the imprecision of depend-end variable measurement. Perhaps the greatest limitation was the limited time available for treatments. Stamper (1970) found a positive influence upon reading rate for compressed audio-pacing using time limitations similiar to the present experiment. However, Stamper (1970) used a criterion-referenced teaching technique during treatment conditions.

TABLE 1.8

LIMITATIONS OF THE PRESENT EXPERIMENT

AREA	LIMITATION
Generalizability	Because subjects volunteered to participate in the experiment, generalization beyond the study population is restricted.
Time	The total amount of time to which the majority of participating subjects would agree to spend was 70 minutes (during one session only).
Procedure	The televised display of the visual text was individually adjusted for contrast and brightness by each subject. Many commented on eye fatigue at the end of training sessions.
Measurement	Measuring the amount of text covered in a set time-interval is a widely accepted definition of reading rate. Many standardized reading tests (as the Nelson-Denny) use this technique. However, generalization beyond testing conditions may not be appropriate. That is, average reading conditions are not timed, test-structured conditions involving texts not selected by the reader. Accuracy in measuring both reading rate and comprehension may be affect by the 'test anxiety' of individual subjects.

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SUMMARY OF THE PROBLEM

This chapter has sought to examine the present experiment and its contribution to similiar past research. This chapter is important for interpretation of subsequent chapters in several ways. Chapter Two will further expand upon aspects of past research and how it affects the present experiment. Chapter Three will further specify details as to how the present experiment was carried out. Chapters Four and Five will present the findings and interpretations regarding the research questions raised by the present experiment, which were presented in this chapter.

This chapter has examined six topics: (l) an overview of the importance of the present experiment and how it may supplement previous research; (2) the purpose of the present experiment; (3) the hypotheses of the present experiment; (4) terms pertaining to the present experiment which may need need definition for the reader; (5) assumptions underlying the conduct of the present experiment; and, (6) ways in which the present experiment is limited.

Past research concerning time-compressed speech has typically concerned the effects of stimulus and listener variables upon intelligibility, comprehension, and/or learning levels of subjects. Relatively few research studies have sought to apply techniques involving time-compressed speech toward improvement of subjects' reading abilities. The present experiment seeks to determine the relative usefulness of four training techniques for reading skills improvement.

The independent variables of the present experiment are the four separate training conditions: (l) compressed-listening practice (i.e., the audio treatment); (2) visual-pacing practice (i.e, the visual treatment); (3) compressed audio-pacing practice (i.e., the audio/visual treatment); and, (4) non-paced reading practice (i.e., the control treatment). The dependent variables are subjects' reading rate and reading comprehension during non-paced reading.

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The major hypotheses are of the null hypothesis type of no differences among treatment groups for both reading rate and comprehension gain scores. Alternate major hypotheses involve the groups' improved relative performance in respect to the control group. The minor hypotheses are of the null hypotheses type, of no differences between treatment groups for reading rate and comprehension. Alternate minor hypotheses involve the relative performance between individual treatment groups. It is hypothesized that the audio/visual treatment scores will be greater than those of the audio and visual treatments respectively.

Several assumptions are made in the present experiment. One assumption is that the Nelson-Denny Reading Test adequately measures subjects' reading rates and comprehension. A second assumption is that the use of compressed audio-pacing of a synchronous visual text will have a favorable effect upon subjects' reading rate. A third assumption is that the treatment intervals for the present experiment are of adequate length to have effect upon reading abilities.

Several limitations of the study should be noted. One limitation is the limited generalizibility of its findings which is possible. Secondly, limited treatment time was available during the experiment. A third limitation is that several subjects reported to have fatigue after the audio and audio/visual treatments. This may have affected post-testing results. A fourth limitation is the inherent limitation of traditional reading abilities testing.

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CHAPTER TWO

Literature

Chapter Two will focus primarily upon a review of pertinent research concerning examination of the effects upon subjects' visual reading abilities after exposure to training techniques utilizing "compressed audio-pacing" (i.e., following visually in a written text a reading rate paced by the narration rate of an accompanying time-compressed audio recording). This chapter will also present related research dealing with general aspects of time-compressed speech research.

This chapter is divided into three sections. The first section presents an overview of time-compressed speech research. The second section examines techniques for accomplishing the time-compressed speech effect. The third section presents past research related to "compressed audio-pacing". The order of presentation for the sections stated above is arranged so as to progressively narrow the focus of the examination of the related research literature concerning time-compressed speech toward those specific research studies most directly related to the variables and characteristics of the present experiment.

OVERVIEW OF TIME-COMPRESSED SPEECH RESEARCH

Chapter One presented an introduction of the broad aspects of educational research involving time-compressed speech. The general areas of research which have been conducted since the mid-1950's are presented Table 2.1. Ostensibly, research concerning time-compressed speech since the mid-1950's has dealt with two general areas. The first area concerns presentation of time-compressed speech with no accompanying stimuli. The second area concerns stimultaneous presentation of visual stimuli (most often a visual text) accompanied by a time-compressed speech stimulus.

This section will examine briefly both of the above areas in order to show the nature of both of the broad areas of research which has been reflected in the research literature concerning time-compressed speech. This section is not intended to fully examine the results of the past research involving time-compressed speech, but to exemplify the research questions and topics which have been examined in past research.

TABLE 2.1

GENERAL AREAS OF RESEARCH
INVOLVING TIME-COMPRESSED SPEECH

Area	Focus of Research
Presentation effects of time-compressed speech stimuli	Intelligibility comprehension and learning effects for stimulus variables
	Intelligibility comprehension and learning effects for listener variables
Presentation effects of time-compressed speech plus visual stimuli	Comprehension and learning enhancement for training method variables
	Reading Skills enhancement for training method variables

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Research Involving Time-Compressed Speech with No Accompanying Visual Stimuli

Research into the use of time-compressed speech presented without accompanying visual stimuli has dealt with intelligibility, comprehension, and learning effects attributable to variables linked to the listener and/or the time-compressed message itself. These two broad research groups are represented in Table 2.1.

STIMULUS VARIABLES

The first group of research studies presented in Table 2.1 has addressed research questions involving the effects of manipulation of various characteristics of the time-compressed speech stimulus upon subjects' comprehension of (or learning gained from) the time-compressed message. The trend of this group of research studies has been toward discovery of variables of the time-compressed speech stimulus which optimize listener comprehension of the time-compressed message. This research toward optimization of the effects of the time-compressed speech message has lead to studies which examined the effects of combining visual and auditory stimuli.

The following studies are typical of this group. Several studies have examined speech intelligibility for various compression rate variables. (Hanson, 1950; Garvey, 1953; Calearo & Lazzaroni, 1957; Fairbanks & Kodman, 1957; Foulke, 1968). Fairbanks et al (1957) examined the effect upon comprehension of a time-compressed, connected discourse for the variables of compression rate and verbal redundancy characteristics. The comparative effects upon comprehension for the time-compressed speech method used to accomplish the speech-compression has been examined by several researchers McLain, 1962; Golden, 1966; Foulke 1966; Foulke, 1967; Gerber, 1968; Gerber, 1969; Gerber & Scott, 1970). Foulke (1967) examined effects upon comprehension by the narrator's voice characteristics and manner. Several studies have examined the effects upon subjects' learning and retention as influenced by message compression rate (Goldstein, 1940; Goodman & Malmuth, 1957; Barabasz, 1966; Goldhaber & Weaver, 1968).

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LISTENER VARIABLES

The second major group of studies (i.e., presented in Table 2.1 concerning time-compressed speech unaccompanied by visual stimuli) examines the effects of manipulation of various subject attributes upon comprehension of (or resultant learning achieved from) the time-compressed speech message. The trend of this group of research studies has been toward the measurement of variables related to subjects having an effect upon the comprehension of a time-compressed message. The research toward examination of listener attributes has led to studies which examine the relationship between listening and reading skills.

The following studies are typical of this group. Hartlege (1963), Bellamy (1966), Lown (1967) and Foulke (1969) examined the relationship between sight disability and comprehension of time-compressed speech. Goldhaver and Weaver (1968) examined the effects of the sex of the listener upon comprehension of time-compressed speech. Wood (1965) and Lutterman (1966) examined the effects of subject age and the comprehension of time-compressed speech. Henneman (1949), Black (1950), Garvey (1950) and Miron and Brown (1968) examined the upward limits of comprehension of speeded-speech for normal adults. Kimura (1961) studied the effects upon perception of time-compressed speech by subjects' cerebral dominance. Orr et al (1965), Voor and Miller (1965), and Orr and Friedman (1968) examined the effects of training upon comprehension of time-compressed speech.

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Research Involving Time-Compressed Audio/Visual Stimuli

There has been a relative paucity of research dealing with effects upon subjects by combined presentation of time-compressed auditory and visual stimuli. The trend in this research area has been toward discovery of variables favorably influencing comprehension and reading skills.

COMPREHENSION ENHANCEMENT

Jester and Travers (1966) examined the effects upon learning efficiency by presentation modality (i.e., non-paced reading, compressed listening, and compressed audio-pacing). Jester and Travers (1966) concluded that compressed audio-pacing was superior to the other presentation nodes at high rates of compression. Parker (1971) examined the effects upon comprehension of a reading passage by presentation modality (i.e., compressed-audio listening; and, compressed audio-pacing of the visual text and compression rate. Parker (1971) concluded that, except for low-aptitude groups, compressed audio-paced messages may be compressed up to one-half their original presentation time with no significant loss in comprehension.

READING SKILLS ENHANCEMENT

Orr et al (1965) examined the effects upon reading rate and comprehension by training involving a compressed audio presentation. Orr et al (1965) concluded compressed-listening practice had a favorable effect upon visual reading rate. Reidford (1965) examined the effects upon visual reading rate and comprehension by training modalities (i.e., non-paced reading; compressed-audio listening practice; and compressed audio-pacing of a visual text). Reidford (1965) has found no effects on reading abilities by any training method. Stamper (1970) examined the effects upon visual reading rate by training

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modalities (i.e., non-paced visual reading and compressed audio-pacing) for elementary school-age subjects. Stamper (1970) found compressed audio pacing practice to favorably affect reading rate but not comprehension.

Reiland (1970) examined the effects upon reading rate, reading comprehension and listening ability by training modalities (i.e., non-paced visual reading, compressed audio listening practice and compressed audio-pacing) for elementary school-age subjects. Reiland (1970) found no effects upon reading or listening abilities by any treatment. Walker (1971) examined the effects upon reading rate and comprehension by training modalities (i.e., motivational practice for reading, and compressed audio-pacing of a visual text) for "gifted" elementary school-age subjects. He found no treatment effects.

Overview Discussion

The use of time-compressed speech in training for enhancement of subjects' reading skills has been relatively neglected in the research literature. Research examining time-compressed speech unaccompanied by a visual stimulus has been more fully examined. No previous studies were found which compared all the training methods used in previous research. No studies were found which used a gradually increasing time-compression rate throughout the duration of the training period. No studies were found which used a televised presentation medium for presentation of visual and/or compressed auditory stimuli. No studies were found which used a massed-practice training technique of short duration.

It appears that previous research has not adequately examined the effects of compressed-audio listening, visual-pacing of a text, compressed audio-pacing of a synchronous visual text, or non-paced reading upon listners' reading rate and comprehension?

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METHODS OF SPEECH COMPRESSION

No prior studies have compared the effects of speech compression methods upon subjects' abilities to follow a compressed, audio-paced narration in a visual text. However, McLain (1962) determined comprehension of time-compressed speech is affected by the production method used to obtain the resultant time-compressed speech. This section will compare the characteristics of the most widely used methods of speech compression, in order to provide a historical perspective of speech-compression techniques. This section will also discuss the various speech-compression techniques used in previous research involving compressed audio-pacing of subjects' visual reading rate.

Historical Development of Compression Methods

A variety of techniques have been reported in the literature for accomplishing a time-compressed speech effect. As early as 1924, French and Zinn (1928) had patented a speech-sampling device. Since that time, many other devices have appeared for producing time-compressed speech. Table 2.2 presents a chronological listing of devices which have appeared in the literature concerning time-compressed speech. The table is based on an article by Cramer, 1967.

The bulk of the research which has been reported concerning time-compressed speech has been conducted using the electromechanical speech-compression method. At the time of this writing, electronic methods of accomplishing time-compressed speech are beginning to displace the electromechanical method. For example, integrated circuitry chips for electronically sampling an audio recording are presently being incorporated into the components of moderately-priced audio-tape recorders (CRCR Newsletter, 1973). Large electronic computers are being used to achieve a time-compressed speech effect as well as to actually synthesize speech sounds.

TABLE 2.2

SELECTED METHODS USED FOR ACCOMPLISHING TIME-COMPRESSED SPEECH EFFECT

PATENT DATE	PATENT HOLDER(S) or INVENTOR(S)	TIME COMPRESSION TECHNIQUE
1924	French and Zinn (1928)	Speech "scanning" by a rotating microphone of a sound tube
1930	Freund (1935)	Rotating slotted disc sampling of a motion picture optical sound track
1935	Dudley (1935)	Sampling of speech pitch periods during radio transmission
1936	Miller (1939)	Frequency division for speech bandwidth reduction
1936	Gabrilovitch (1939)	Scanning a wire recording by rotating playback heads
1938	Schuller (1942)	Sampling a magnetic tape recording by rotating playback heads
1944	Gabor (1949)	Rotating disc with microscope lenses sampling a film optical sound track
1950	Vilbig (1950, 1952, 1967)	String filter for frequency division of connected discourse
1952	Fairbanks (1959)	Rotating playback heads sampling a magnetic tape
1956	Springer (1961 a, b; 1962 a, b, c; 1963)	Rotating playback heads sampling a magnetic tape (improved feed and drive)
1961	Ball (1951)	First computer processing program for time-compressed speech
1963	Schimmel and Clay (1963)	Rotating playback heads sampling a magnetic tape (air suspension of tape)
1965	Scott (1965)	Computer program for time-compressed speech (improved)
1970	Cramer and Talambiras (1970)	Computer program for time-compressed speech (improved)
1970	Qureshi and Kingma (1970)	Computer program for time-compressed speech (improved)
1971*	VO-COM Corporation	Variable pause time deletion device
1972*	Cambridge Research and Development Group	Integrated circuit chip for electronic sampling of speech signal
1973*	VO-COM Corporation	Compact digital-to-analog computer device for electronic sampling

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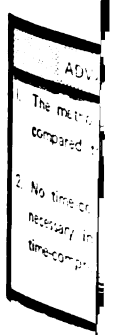

Voice Acceleration Method

No previous studies were reviewed which concerned the use of merely "speaking faster" to accomplish audio-pacing of a visual text. Some researchers have considered this technique linguistically and physiologically unsophisticated as compared to other compression methods which have been used (Garvey, 1953; Doulke, 1962), particularly the electromechanical methods (Fairbanks, Everitt & Jaeger, 1954; Fergen, 1955; Fairbanks, 1956).

Vocal acceleration has not the "method of choice" for use in previous research largely due to the method's lack of precision and sophistication in controlling speech rate, and the limited range of compression which is capable by using the method. Several studies, however, dealt with the relationship between rates of rapid-speech, produced by merely speaking at a faster rate, and comprehension of this speech as measured by immediate recall of specific facts. Studies by Nelson (1948), Harwood (1955), Fergen (1955), Calearo and Lazzaroni (1957), and Enc and Strolurow (1960) suggest that comprehension declines rapidly as speaking rates are increased.

Table 2.3 presents various advantages and disadvantages of vocal acceleration have been reported in previous research studies.

TABLE 2.3

ADVANTAGES/DISADVANTAGES OF THE VOCAL ACCELERATION METHOD

ADVANTAGES	DISADVANTAGES
1. The method is relatively inexpensive compared to other methods.	1. The rate of compression which is possible is relatively low as compared to other methods.
2. No time-compression device is necessary in production of the time-compressed speech.	2. Intelligibility and comprehension levels drop quickly as rates are increased.
	3. Few narrators care capable of rapid vocalization rates.

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Speed Change-Method

No previous studies were reviewed which involved the use of "Speed-Changing" to accomplish the audio-pacing of subjects in an accompanying visual text.

Speed-changing refers to a technique in which a speech recording is played back at a higher rate than the original recorded rate. The resultant time-compressed speech effect differs in its pitch and other prosodic characteristics from its original recorded form. As playback speed doubles, the pitch of the reproduced speech sound is doubled as well, and has a "Donald Duck" quality.

Garvey (1953), McLain (1962), Foulke et al (1966), and Barabasz (1968) suggest that the accompanying increase in pitch limits intelligibility of the time-compressed speech. Table 2.4 presents various advantages and disadvantages of this method which has been reported in previous research. Calearo and Lazzaroni, 1957; Foulke, 1962; Golden, 1966; Foulke, 1967; Gerber, 1968; Gerber, 1969; Gerber and Scott, 1970).

TABLE 2.4

ADVANTAGES/DISADVANTAGES OF THE SPEED-CHANGING METHOD

Advantages	Disadvantages
1. Relatively inexpensive compared to sampling methods	1. Limits of compression rates attainable for comprehension is limited compared to sampling methods
2. No re-recording necessary	2. Intelligibility and comprehension drop quickly after approximately double the original rate
3. No elaborate compression equipment is required	

Electromechanical Method

All previous research reviewed which involved compressed audio-pacing of a visual text used the electromechanical method for production of time-compressed speech, (Fairbanks et al 1959; Orr, 1964; Travers, 1964; Reidford, 1965; Orr, 1966; Stamper, 1970; Reiland, 1970; Parker, 1971, and Walker, 1971).

The electromechanical method of speech-compression is accomplished through sampling tiny bits of recorded audio signals (typically from between 18 to 40 milliseconds per sample) from the total recorded signal fed into the electromechanical speech-compression device. The sampled bits are processed so that the sampled signals are electroncially "spliced" together. This time-compressed signal is re-recorded on another audio tape. Concommitantly, all other non-sampled portions of the original signal are, in effect, disregarded. The speed at which the original audiotape passes through the device (plus "sample length" and the "spacing interval" between the sampled portions of the recording) determines the degree to which the resultant re-recording will be time-compressed. A diagram of the first widely acknowledged electromechanical speech compression device is presented in Figure 2.1. Table 2.5 presents various advantages and disadvantages of this method which has been reported in previous research.

TABLE 2.5

ADVANTAGES/DISADVANTAGES OF THE ELECTROMECHANICAL METHOD

ADVANTAGES	DISADVANTAGES
1. The rate of compression which is possible is relatively high as compared to speed-changing or vocal acceleration.	1. The method is relatively expensive as compared to speed-changing or vocal acceleration.
2. High levels of intelligibility and comprehension are possible at more than double the original recorded rate.	2. Mechanical noise originating from components of the compression device is often a problem.
	3. Re-recording of the time compressed signal is necessary in production of the compressed master.

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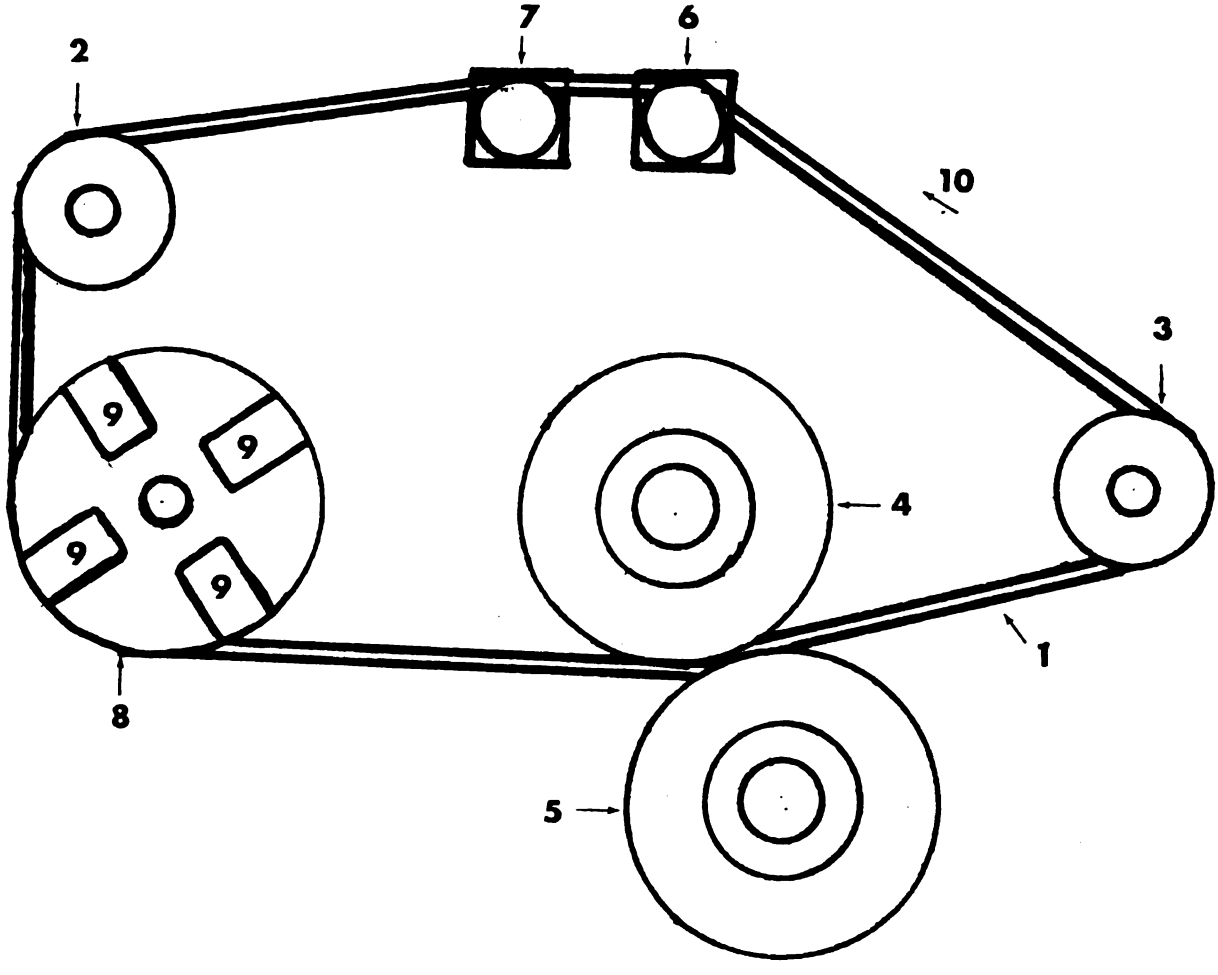
FIGURE 2.1

THE FAIRBANKS ELECTROMECHANICAL SPEECH-COMPRESSION DEVICE *



1. Magnetic audiotape
2. Idler wheel
3. Tension adjustment
4. Capstan
5. Pressure roller
6. Erase head
7. Record head
8. Rotating head assembly
9. Playback heads
10. Direction of tape travel

*Fairbanks, Everett and Jaeger (1959).

Electronic Method

No previous studies were reviewed which involved the use of electronically-processed, time-compressed speech to accomplish compressed audio-pacing of subjects in an accompanying visual text.

As for the electromechanical method, producing time-compressed speech by the electronic method is accomplished by "sampling" tiny bits of recorded audio signals. A Lexicon compressor (ie., a type of electronic speech-compression device) was used in production of the time-compressed master for the present experiment. Using the Lexicon device, time-compression of speech is accomplished by (1) conversion of the original signal into digital electronic patterns (i.e., through a small digital-to-analog computer); (2) sampling of the converted electronic patterns; and, (3) reconversion to a time-altered signal pattern (reconstructed through assemblage of the sampled digital patterns).

Table 2.6 presents various advantages and disadvantages of the electronic speech-compression method.

TABLE 2.6

ADVANTAGES/DISADVANTAGES OF THE ELECTRONIC METHOD

ADVANTAGES	DISADVANTAGES
1. The rate of compression which is possible is relatively high as compared to other methods.	1. Relatively few electronic compression devices exist as compared to other methods.
2. High levels of intelligibility and comprehension are possible at more than double the original recorded rate.	2. The method is relatively expensive as compared to other methods.

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COMPRESSED AUDIO-PACING

Overview

This section will present a review of the literature concerning the most closely-related research studies to the present experiment. The purpose of this section is to describe various time-compressed speech research which has examined the effects of combining time-compressed speech with an accompanying visual text.

This section will examine the following subjects: (1) a discussion of past research concerning the effects of compressed audio-paced stimuli upon subjects who receive little or no prior training or exposure to time-compressed speech; and, (2) an examination of past research concerning the effects upon subjects who have received training in following a compressed audio-paced narration in a visual text.

For untrained subjects, compressed audio-pacing research has typically sought to determine to what degree the addition of compressed audio-pacing to a visual text will enhance subjects' comprehension of the visual text. Wood (1965), Loper (1966), Jester (1966), Henry (1966), Foulke and Sticht (1966) and Foulke (1968) concluded that a negative relationship exists between comprehension of time-compressed aural material by untrained subjects and its rate of time-compression. Based partly on these studies, Jester and Travers (1968), and Parker (1971) sought to determine if comprehension would be enhanced through compressed audio-pacing of the visual text.

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untrained subjects revealed that the training during treatment has typically totaled six hours or more (Orr et al, 1965; Reidford, 1965; Orr, 1966; Stamper, 1970; Reiland, 1970 and Walker, 1971). The question remains if training periods of shorter duration will be effective.

For trained subjects, compressed audio-pacing research has typically involved the determination of effects of such training upon reading abilities (Orr et al, 1965; Reidford, 1965; Orr, 1966; Stamper, 1970; Reiland, 1970 and Walker, 1971). Orr et al, (1965); Reidford (1965) and Orr (1966) studied college-age subjects. Stamper, (1970), Reiland, (1970) and Walker (1971) examined the effects of training using elementary-age subjects.

This section will more closely examine those studies which contain the variables and characteristics of the present experiment. Comparison of aspects of those studies to the present experiment will be made frequently in the following chapters.

Studies Using Untrained Subjects

Two studies were reviewed in the literature, (Jester and Travers 1966, Parker 1971) which deal with the use of a time-compressed, audio stimulus for compressed audio-pacing of the visual reading rate for untrained subjects. In both of these experiments, the subjects received little or no prior experience in listening to time-compressed speech presented along or with an accompanying visual stimulus. For both studies, the rate of the narration was expected to "pace" subjects' visual reading rate.

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JESTER AND TRAVERS (1966) STUDY

Jester and Travers (1966) compared comprehension levels for 220 college students in three presentation modes: (1) time-compressed audio-only; (2) a visual presentation; and (3) time-compressed audio/visual.

The auditory materials were made up of eight narrative passages taken from the Davis Reading Test (1957). The audio narrations were originally recorded at 175 words per minute and subsequently time-compressed at stable compression rates ranging from 200 to 350 words per minute. The accompanying visual text was projected from microfilm transparencies bound in 2 x 2 slide mounts.

Subjects' comprehension scores for the three presentation modes were converted to efficiency scores following procedures outlined in the Davis Reading Test Examiners Manual (1957). These efficiency scores represented the comprehension level per unit of presentation time.

Comparison of treatment groups scores at the four presentation rates revealed comprehension of the visual-only mode to be higher than the audio-only mode at the highest compression rate of presentation. The audio/visual mode was found to be superior to both the audio-only and visual-only modes at the three highest compression rates.

Based on the Jester and Travers (1966) study, it was anticipated that subject scores for compressed audio-pacing treatments would show greater improvement of reading abilities than for treatments using separate audio or visual modes of presentation. Similar findings have been demonstrated in other studies using non-compressed materials. Webb and Wallon (1956) and Smith (1968) found audio-pacing subjects resulted in significantly greater comprehension levels than either an auditory presentation or a non-paced visual presentation.

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PARKER (1971) STUDY

Parker (1971) compared 429 junior college freshmen in comprehension of three time-compression rates for two presentation modes: (1) time-compressed audio-only; and, (2) time-compressed audio/visual.

Six experimental groups of 75 students each were randomly assigned to the audio-only and audio/visual treatments. Subjects were partitioned for analysis into high and low aptitude levels within each of the six treatment groups according to verbal comprehension scores on the Guild-Zimmerman Aptitude Survey. Audio-only groups listened to time-compressed narrations of six reading passages of the Nelson-Denny Reading Test. Audio/visual groups (called audio-ocular by Parker) were provided a printed text to follow visually while listening to the narration. The time-compression rates used were defined as: (1) zero compression- or normal speaking rate; (2) one-third compression - or two-thirds of the original presentation time; and, (3) one-half compression - or one-half of the original presentation time.

Three 3 x 2 data classifications were created, representing the three compression rates and two presentation modes. The three data classifications represented the all-level aptitude group, high-level aptitude group and low-level aptitude group. No significant losses in comprehension were found for the audio/visual mode except for low-aptitude groups. A significant loss in comprehension was found for the audio-only mode across aptitude levels.

The Parker (1971) experiment is similar to both Jester and Travis (1966) experiment in its' relatively short amount of treatment interval as compared to studies which have examined the effects of training using compressed audio-pacing.

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Studies Using Trained Subjects

Six studies were reviewed in the literature which have investigated the effects of systematic training in visually following a time-compressed auditory narration in an accompanying printed text (Orr et al, 1965; Reidford, 1965; Orr, 1966: Stamper, 1970; Reiland, 1970 and Walker, 1971).

In each of the above studies, the subjects participated in a series of practice sessions involving compressed audio-pacing techniques of varying lengths of time ranging from several hours (e.g., Orr et al, 1965; and Reidford, 1965) to several months (e.g., Stamper, 1970; and Reiland, 1970).

It should be noted that Stamper (1970), Reiland (1970) and Walker (1971) "paced" visual reading rate in static, printed texts. For example, Stamper (1970) used children's literature texts. Orr et al, (1965) Reiland (1970) and Walker (1971) each used texts taken from standardized reading tests. No study was reviewed in which a moving, visual text was presented during compressed audio-pacing treatment. Using such a moving text mechanism, one could manipulate the rate of presentation for both the visual text and its time-compressed narration to be synchronous. This addition of a dynamic, visual text would permit direct comparison of time-compressed pacing techniques to pacing using only the moving, visual text.

Visual-only pacing has been traditionally used for reading skills improvement, often tatistiscopic pacing devices. The following is a detailed description of the six studies cited above.

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ORR ET ALL (1965) STUDY

Orr et al (1965) studied compressed-listening effects. The Orr et al (1965) study centered mainly upon the "trainability" of listening comprehension skills through practice in listening to increasingly faster presentation rates of time-compressed audio recordings. Reading skill measures were included along with listening comprehension measures for pre- and post-testing.

Orr et al (1965) also hypothesized that fast readers would be able to comprehend a time-compressed message better than slow readers. A significant positive correlation between visual reading rate and the ability to comprehend time-compressed speech was demonstrated in the findings of the study. In addition, Orr et al (1965) concluded that training in listening to time-compressed speech had a beneficial effect upon visual reading rates.

This study was used as a basis by Stamper (1970) for the design of language arts curricular materials for reading improvement for the Hawaii English project. The Hawaii English project was first introduced into the Hawaii state school system during 1970-71, school-year. Stamper (1970) had hypothesized that training and listening abilities for K-3 level elementary school pupils would improve their reading abilities. As developmental work on the materials themselves progressed, the strategy of compressed audio-pacing was substituted for compressed listening practice only. Nevertheless, the Orr et al (1965) study was largely the impetus for the Hawaii English Project materials.

The degree of compression for compressed-speech materials in the Orr et al (1965) study was higher than the other studies reviewed. Orr et al (1965) used time-compressed recordings ranging from 325 to above 400 words per minute. Orr et al (1965) used relatively large incremental increases in compression rate during the experiment of about 100 words per minute. No study reviewed used a continuously increasing compression rate, but Stamper (1970) used relatively small incremental increases of 20 words per minute.

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Reidford (1965) conducted a follow-up study to the Orr et al study, which attempted to more rigidly control some of the extraneous conditions Reidford identified as present in the Orr et al (1965) study Reidford identified contaminating factors in the Orr experiment as motivational set, expectations of improvement, and inadequate experimental design.

In the Reidford (1965) study, 84 college undergraduates participated in the study on a volunteer basis. Experimental groups in the study simultaneously listened to time-compressed speech narrations and visually followed along in accompanying printed texts. In the experimental treatment, the listening materials were narrations of the printed texts which were compressed at rates ranging from 40% to 60% above the original recording rate. Control groups in the study listened only to compressed audiotape narrations without visually following a text. In the control treatment, audiotape narrations ranged from 0% to 50% compression rates.

All subjects were pre-tested using a Perceptiscope. The Perceptiscope is a visual pacing device in which pacing is accomplished by controlling the amount of presentation time for the visual stimulus through the use of a motion picture mode. Visual textual materials at four different, visual-reading rates were presented via the device. The rates ranged from 185 to 480 words per minute. Following the presentation, a multiple-choice comprehension test was administered. The test consisted of 10 comprehension questions, each item the correct answer being one of four choices.

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An analysis of covariance was performed on the pooled post-test scores (i.e., the sum of comprehension scores at the three reading rates presented on the Perceptiscope). No F value for main effects proved to be significant. Reading gains (i.e., post-test minus pre-test scores), however, were significant at each presentation rate except at 480 words per minute. Reidford (1965) attributed these gains to inadequate controls upon subject motivation and set. He concluded that this study raised doubts as to the beneficial effects of training using time-compressed speech techniques, upon reading comprehension rates.

It should be noted that a type of visual-pacing device was used during the Reidford (1965) experiment. A Perceptiscope was used by Reidford (1965) to measure subjects' comprehension levels during pre-test and post-test sessions. He presented a visual text on the motion picture device visually-paced at four different word per minute rates and subsequently measured comprehension levels for each rate. This use of a projected visual text marked the first study reviewed in the literature which used a visual text presented via mediated presentation. No study was reviewed in which visual text was presented via television during compressed audio-pacing practice. It should also be noted that Reidford (1965) used this visual "pacing" in pre- and post-testing. All other related studies used non-paced visual reading conditions during reading rate and comprehension testing. No study was reviewed in which a mediated presentation of the visual text was used during treatments.

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ORR (1966) STUDY

Orr (1966) conducted a follow-up study to his 1964 study, which had suggested a possible positive relationship between various kinds of training involving the use of time-compressed speech and reading abilities. In the 1966 study, Orr compared the reading test scores for an experimental group (receiving practice in compressed audio-pacing exercises at progressively faster presentation rates) with a control group (receiving no training or practice).

The experimental and control groups consisted of college-level students who had volunteered to take part in the study. Training ranged over a three week period. Training was accomplished over four separate practice sessions. During the sessions, the experimental group subjects received practice in simultaneously listening and visually following from ten different passages of text. Each passage was between one and two thousand words in length.

Ten time-compressed speech audiotapes (each presented at a particular compression rate) accompanied the visual passages. Taken as a whole, the audio-tapes were compressed to six different compression levels, progressing sequentially to the highest compression level. The range of compression rates for the six compressed audiotapes was 225 words per minute (at the lowest compression rate) to 475 words per minute (at the highest compression rate). Each compressed audiotape was presented at one particular compression rate within that range.

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Alternate forms of the Nelson-Denny Reading Test (1963) were given to subjects as pre- and post-assessments of reading rate and comprehension. Subjects in the control treatments received only these pre- and post-tests. In effect, the control condition was essentially and intervening time period.

Orr (1966) found that reading rates for the experimental group subjects (who received training using compressed audio-pacing exercises at progressively faster presentation rates) improved significantly. He found no significant loss or gain in comprehension levels. The mean reading rate gain for the experimental group was 90 words per minute. The mean gain for the control was 10 words per minute.

It should be noted that Orr (1966) found the compressed audio–pacing treatment to have no effect upon reading comprehension. This would also agree with the findings of Reidford (1965), Stamper (1970), Reiland (1970), and Walker (1971). These findings would tend to support the viewpoint that reading rate may be substantially a habitual rate of eye fixations while scanning a page of print. This hypothesis was cited by Stamper (1970) as the rationale for design of separate instructional materials for improvement of reading comprehension.

Orr (1966) paced experimental subjects at reading rates (in ten historical passages from one to two thousand words in length) ranging from 225 to 475 words per minute. This training covered four treatment sessions over a total period of three weeks.

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STAMPER (1970) STUDY

Stamper (1970) conducted an exploratory study based upon the Orr et al (1965) and Orr, (1966) studies which suggested a positive relationship between training involving the use of time-compressed speech and reading abilities.

The study was conducted as part of the evaluation of language arts curricular materials produced by the Hawaii English Project, a statewide developmental project. The Hawaii English Project developmental effort was implemented into the Hawaii state school system curriculum, and various other state curricula in the United States, Micronesia, the Phillipines and New Zealand.

The materials module under test was titled the "Speeded Reading Program". Its objective was to improve visual reading rate without detrimental effect upon reading comprehension.

Forty-six second and third grade students took part in the study, all of whom had completed the difficulty level 20 in an instructional library of graded-difficulty books.

The experimental group received their training over the winter and spring semesters of the academic school year, and was accomplished in various numbers of practice sessions and lengths of training time per session. The student achievement criterion levels were held constant and instructional time was allowed to vary.

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During each of the training sessions, the experimental group subjects received practice in simultaneously listening and visually following in a particular book from the instructional library. The criterion level for each book was the ability to follow the compressed narration visually in the text without losing his or her place for ten consecutive pages. This criterion ability for each book was verified by a checker (who had previously finished the Speeded Reading Program) or by the teacher.

For the experimental group, 13 time-compressed audiotapes accompanied the 13 visual texts choses for the Speeded Reading Program. Taken as a whole, these compressed audiotapes ranged from approximately 140 words per minute to approximately 550 words per minute. Each compressed audiotape was presented at one particular compression rate within that range. Each subsequent book/compressed-audiotape combination was paced at approximately 20 words per minute faster than the previous book/compressed-audiotape combination. The total amount of compressed audiotape recordings in the Speeded Reading Program was approximately two and one-half hours in length.

Control group subjects did not choose to enter the Speeded Reading Program, but maintained progress through all other reading-related modules in the Hawaii English Project program. It should be noted that the classroom activities in which both control and experimental groups centered upon the children working "on their own", under teacher supervision and guidance, in the various other learning modules in the Hawaii English Project bank of materials.

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Near the end of the school year, all members of the target classes having reached level 20 or above in the instructional library were tested on reading rate and comprehension.

A significant difference in favor of the experimental group was found to exist between experimental and control groups for reading rate, but not for comprehension. The author concluded that the technique of compressed audio-pacing of a visual text was of possible utility to increasing reading rate for lower-elementary subjects.

Stamper (1970) raised several questions concerning the technique of compressed audio-pacing. For example, the Speeded Reading Program utilized a compressed-pacing technique in which the compression rate was at a fixed level. Consequently, compressed-pacing rates for the compressed audiotape accompanying each new text was 20 words per minute faster than each previous compressed-audiotape/text combination. From analysis of student records, it was determined that the time spent on each compression level, on an average, was less than half of the length of the book/tape materials available. Therefore, it was speculated that a gradually increased pacing rate (i.e., a variable-pacing technique rather than successive fixed-level rates) might prove successful in improving reading rate.

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REILAND (1970) STUDY

Reiland (1970) was interested in determining the effects of training involving time-compressed speech upon elementary school-level subjects. In the Reiland (1970) study, 428 pupils in seven elementary school classrooms took part in the experiment. Reiland (1970) sought to determine the effect of various kinds of training involving time-compressed speech upon measures of reading achievement and listening comprehension.

Three treatment conditions were compared in the study. These involved: (1) compressed audio-pacing of visual reading in books; (2) compressed-listening of time-compressed audiotapes with no visual reading; and, (3) a control which did not involve time-compressed speech. The control condition for the Reiland (1970) study was defined as subject's non-paced visual-reading the same 18 stories as were audio-taped in various time-compressed rates for the first two conditions cited above.

For the experimental treatments, 18 "narrative style" stores were recorded on audiotape, and time-compressed via an electromechanical compression method. Six different compression rates were used, ranging from about 175 words per minute to 300 words per minute. Each of the six compression rates was "faster" than the previous compression rate in the series. Three time-compressed audiotapes (each of a different story) were produced at each of the six compression levels.

No significant differences for the dependent variables of reading speed, reading comprehension, or listening comprehension were found. The use of

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WALKER (1971) STUDY

Walker (1971) investigated the effectiveness of training methods using a compressed audio-pacing technique for improving reading rate, as compared to a self-improvement technique. Dependent variables were reading speed and reading comprehension.

The experimental treatment consisted of following along in a printed text while listening to a compressed audiotape narration or a technique in which an individual engaged in a series of self-motivating exercises in reading. Control groups engaged in no such training. Daily training spanned a six-week period. The individual comprehension levels for all subjects were determined by a pre-test.

In the Stamper (1970), Reiland (1970) and Walker (1971) studies, subjects were of elementary school-level age. It should be noted that all subjects in the Walker (1971) study obtained a score of 130 or more on the Weschler Intelligence Scale for Children or an equivalent test. The subjects were 71 sixth-grade students.

Assignment to treatment groups involved having all seventy-one pupils read silently in a randomly-selected book (from a series of 105 books of approximately sixth-grade reading difficulty). Students were then assigned to treatments on the basis of relative performance by comparison of reading rate scores through a stratisfied randomization process.

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An analysis of variance was used in statistical analysis of the results. The three factors used for each analysis of variance were methods, sex and pre-experimental reading rate. At the .05 level, significance was found to exist among methods. Using Scheffe's technique, experimental group scores were found to be significantly higher than those of the control group. However, the self-improvement group scores (i.e., as described by Preston and Botel, 1967) were found to be significantly higher than the compressed audio-pacing groups scores. Walker (1971) concluded that the use of time-compressed speech as a technique to help children increase their reading rate was of great potential benefit.

Walker (1971) sought to compare a traditional method of rate improvement with compressed audio-pacing. However, Walker (1971) used a structured self-improvement technique (Preston and Botel, 1967). This technique involves attempting to get the reader to: (1) select easy materials; (2) preview the materials; (3) force him or herself to read more rapidly; and (4) keep a progress record. No previous study was reviewed in the literature which compared the widely-used technique of visually-pacing subjects' reading rate to compressed audio-pacing.

The Walker (1971) study used time-compressed speech in treatments which had been matched to subjects' present reading rate. As previously discussed in the Reiland (1970) study, the degree to which subjects are paced beyond their normal visual reading rate may influence compressed audio-pacing treatment effects.

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SUMMARY OF LITERATURE REVIEW

This chapter has sought to extend the information presented in the overview of time-compressed speech research, which was presented in Chapter One, by examining closely-related research which has previously been reported in the research literature. Chapter Three will further clarify and expand upon various aspects of the research studies presented in this chapter through examination of design aspects of the present experiment, such as in the description and comparison of specific procedures used in conducting the present experiment.

This Chapter has examined three topics: (1) a general overview of the time-compressed speech research literature; (2) a discussion of various speech-compression methods which have been used in past research; and (3) a detailed examination of previous research which has concerned compressed audio-pacing of visual reading.

The most frequently reported methods which have been used for accomplishing a time-compressed speech effect are vocal acceleration, speech-changing, electromechanical-sampling, and electronic sampling. Each method has its own particular advantages and limitations. The compression methods used have had an influence upon the nature of the research which has been conducted.

Research concerning time-compressed speech can be divided into two general research areas. One area, representing the largest group of studies, has sought to examine various effects surrounding presentation of a time-compressed auditory stimulus without any accompanying visual stimulus. However, the present experiment most closely resembles the second research area, which has concerned presentation of a time-compressed speech narration with an accompanying visual text in attempting to positively affect subjects' visual reading abilities.

Compressed-listening training (i.e., listening to time-compressed speech without

an accompanying visual text) was found to have a favorable effect upon subjects' visual reading rate by Orr et al (1965). Orr et al (1965) hypothesized that combining the time-compressed audio narration with a visual text may produce a stronger effect upon subjects' reading rate after training. Subsequently, Reidford (1965), Orr (1966), Reiland (1970), Stamper (1970) and Walker (1971) examined the effects of various training conditions (and subject ability levels) for training techniques utilizing compressed audio-pacing. None of the researchers found an effect upon reading comprehension attributable to practice in compressed audio-pacing. However, Orr (1966), Stamper (1970) and Walker (1971) found a favorable effect by such training upon reading rate. Reidford (1965) and Reiland (1970) found no effect upon reading rate by this training.

A Summary of the findings for the most pertinent research studies is presented in Table 2.7. A comparison of these studies is presented in Table 2.8.

TABLE 2.7

SUMMARY OF PREVIOUS RESEARCH USING COMPRESSED AUDIO-PACING FOR IMPROVING READING RATE

Date	Author	Finding Related to the Present Experiment
1964	Orr	Compressed-listening training favorably affects visual reading rate.
1965	Reidford	Compressed audio-pacing training has no affect upon visual reading rate or comprehension.
1965	Orr et al	Compressed audio-pacing training favorably affects visual reading rate with no affect upon comprehension.
1970	Stamper	Compressed audio-pacing training favorably affects visual reading rate with no affect upon comprehension.
1970	Reiland	Compressed audio-pacing training has no affect upon visual reading rate or comprehension.
1971	Walker	Compressed audio-pacing training favorably affects visual reading rate with no affect upon comprehension.

TABLE 2.8

SUMMARY OF PREVIOUS RESEARCH USING AUDIO–PACING FOR IMPROVING READING RATE

Training Method	Dependent Variable	Negative Effect Found	No Effect Found	Positive Effect Found
Compressed Listening	Reading Rate		Reidford (1965) Reiland (1970)	Orr (1965)
	Reading Comprehension		Orr (1965) Reidford (1965) Reiland (1970)	
Compressed Audio-Pacing	Reading Rate		Reidford (1965) Reiland (1970)	Orr (1966) Stamper (1970) Walker (1971)
	Reading Comprehension		Reidford (1965) Orr (1966) Stamper (1970) Reiland (1970) Walker (1971)	

The review conducted of the related research literature reveals the present experiment to be unique in a number of ways. The purpose of the present experiment is to compare the effectiveness of training techniques upon visual reading rate and comprehension.

Previous research studies concerning training involving the use of time compressed speech intended to improve visual reading abilities have largely failed to compare traditional visual-pacing methods to compressed audio-pacing techniques. Likewise, no previous research study has examined the effects upon reading abilities of combining the time-compressed audio narration with a moving, synchronous visual text.

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It would appear from a review of the research literature concerning compressed audio-pacing, that the research questions posed in the present experiment have not been fully answered. The question remains: What relative effect will training using presentations of (1) a time-compressed audio narration, (2) a paced visual text, (3) a combined audio/visual presentation, and (4) non-paced reading practice have upon subjects' visual reading abilities?

Chapter Three
Design

Chapter Two presented a survey of the literature concerning speech production techniques and the use of time-compressed speech to visually pace reading rate for both untrained and trained subjects. The purpose of this chapter is to describe the design of the present study so as to operationally define the nature of the research question carried out in the present experiment. The methodology and materials used in the present experiment will also be examined so that a comparison of the related research is possible.

Chapter Three is divided into four sections regarding the design considerations for the experiment. The first section describes the subjects who participated in the experiment. The second section described the audio, visual, and test materials used in treatments. The third section discusses the procedures followed in obtaining data from subjects. The fourth section presents the general research design used in obtaining the data.

SUBJECTS

This section will present design considerations concerning the participants of the experiment. The purpose of this section is to describe how individuals were selected for the experiment, as well as, characteristics of the subjects themselves.

To achieve the above purposes, this section will examine considerations involving the sample selection for the experiment. Secondly, this section will present an examination of the effects of "volunteerism" of subjects and experimental mortality. Thirdly, a description of various characteristics of the particiapting subjects will also be presented.

Sample Selection

The students in a large, undergraduate, teacher education course at Michigan State University were selected as the population for the experiment. Approximately two hundred students were enrolled in the course, thereby enhancing the possibility of volunteers to participate in the experiment. Also, because the course was required in teacher preparation programs of the college, the course population was relatively stable and diverse.

Experimental Mortality

Forty-five students volunteered to participate in the experiment. A telephone survey of a class study section was conducted. Also, two announcements to the assembled class during two separate class sessions were made concerning the experiment. During the survey and announcements the potential volunteers were not informed of specifics concerning the nature of the experiment, nor techniques, which were to be employed during the experiment. Potential volunteers were told that the experiment was to involve the area of reading and that participation was to be for a small, monetary incentive.

Data was obtained in the experiment for thirty-three subjects. Of the original forty-five volunteers: (1) five subjects did not arrive for their appointments; (2) five subjects were unable to schedule a treatment session; (3) one subject did not finish completing the post-test; and (4) one subject was administered an incorrect pre-test. A summary of the data regarding experimental mortality for the experiment is presented in Table 3.1

TABLE 3.1

EXPERIMENTAL MORTALITY CONSIDERATIONS

Reason for Disgarding Data	Number
Unable to Keep Appointment	5 Subjects
No Show	5 Subjects
Treatment Not Completed	1 Subject
Treatment Incorrectly Completed/Not Rescheduled	1 Subject

Subject Characersitics

Information cards were obtained from all thirty-three subjects who participated in the experiment. Appendix L presents a summary of subject information as arranged by treatment groups. Appendix M presents a summary of data concerning the number of male and female subjects assigned to each treatment condition. Table 3.2 presents a summary of the academic characteristics of subjects in the experiment. As can be seen in Table 3.2, the subjects represented a diverse variety of academic preparation.

TABLE 3.2

SUMMARY OF SUBJECT CHARACTERISTICS

Sex	College	Academic Major	Academic Minor
Male N=7	Education N=20	Fine Arts N=6	Social Sciences N=6
			Special Education N=3
		Social Studies N=5	Childhood Development N=3
	Arts & Sciences N=3	Data Management N=2	English N=3
			Language Arts N=3
	Arts & Letters N=1	Language Arts N=2	Art N=2
		Math N=2	Elementary Education N=2
Female N=26	Business N=1	Theater N=1	Music Education N=1
			Natural Resources N=1
		Human Ecology N=1	Business Education N=1
	Unreported N=8		Communications N=1
		Unreported N=14	Unreported N=7

MATERIALS

This section will present design considerations concerning the materials used in the experiment. The purpose of this section is to describe how the visual text was selected and prepared for the experiment; how the audio recording was obtained and the time-compressed audiotape prepared; and how the testing instruments were selected.

Visual Materials

The book Survive the Savage Sea (Robertson, 1973) was used as the source of the visual textual materials which were used in the Visual, Audio/Visual, and Control treatments.

The narrative style of Survive the Savage Sea was an advantage in using the text as a visual stimulus for the experiment. The text was largely a narrative description of events in the story rather than a series of conversational interactions among the characters of the story. This narrative style enabled the professional announcer (who read orally the text in producing the origina, master audiotape) to vocalize the passages at a fairly uniform rate. Large variations in rate and pause time often occur during oral reading of quotations. These frequent variations become undesirable as an experimenter wishes to control the rate at which the audio narration paces a subject's visual reading rate. Since Survive the Savage Sea was largely narrative in writing style, variations due to character quotations were minimal.

The format of the printed text in Survive the Savage Sea permitted the use of pages taken directly from the text in production of the visual "crawl". The book's margin size in relation to the text, line length, character size and, total size of the pages aided in the production of the "crawl". This "crawl" was produced by piecing together individual pages of text to form a long roll. The format of the printed text greatly aided in the simplicity and accuracy of production of the videotaped materials used in the experiment.

The videotaped "crawl" was used in conjunction with two treatment conditions, the video treatment and the audio visual treatment. During the video treatment, the text moved upward on the television monitor at a set rate of movement (i.e., crawl rate). This technique "visually paced" a subject's reading rate (i.e., by the presentation and withdrawl of the visual stimulus). During the audio/visual treatment the audio narration was presented through the earphones at a set rate of accelerated vocal production (i.e., degree of speech-compression). Simultaneously, the visually-paced text appeared on the television monitor screen. This combination of techniques provided a method for "visual and auditory pacing" of the subject's reading rate.

Both the visual and audio/visual treatments were presented through the use of a television monitor. The primary procedural difference between these two treatments during the experiment was the presence or absence of the audio narration. During the audio/visual treatment, the audio narration accompanied the videotape visual text in a synchronous fashion with the visual's "crawl rate". During the visual treatment no audio narration was present. During treatments this difference was accomplished by adjustment of the sound volume control on the television monitor for the presence or absence of the accompanying auditory narration.

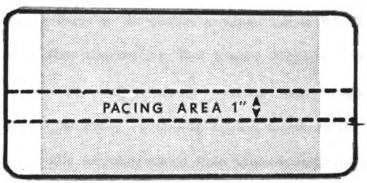
The audio treatment was presented through the use of the sound system in the television monitor, without accompanying visual text. The audio treatment provided practice in listening to increasingly faster rates of presentation of the audio narration. During the audio treatment, the picture brightness control was adjusted so that the television monitor screen was completely black (i.e., devoid of any televised image).

The videotaped materials were produced under professional studio conditions at the College of Osteopathic Medicine on the Michigan State University campus. A Sony "Videomatic" videocassette recorder/playback device was used for production of the master videotape. In producing this videotape, the time-compressed audio narration was re-recorded on the videocassette's audio track, while the visual text was simultaneously recorded on the videocassette's video track. During this recording of the videocassette, the "rate of crawl" for the visual text was adjusted manually in the studio to be synchronous to the line of text appearing at the vertical midpoint (i.e., horizonal axis) of the television monitor screen.

The "rate of crawl" for the visual text ranged from approximately one inch/second during the first portion of the videotape to approximately 5.5 inches/second at the end of the videotape. The number of "words per minute" of the visual text paced visually by the videotaped "crawl" was synomous to the "rate of speech compression" for the accompanying, synchronous audio track. Thus, the "visual-pacing rate" for visual "crawl" ranged from approximately 150 words/minute during the first portion of the videotape to approximately 630 words/minute at the end of the videotape.

FIGURE 3.1

AREA OF SIMULTANEOUS AUDIO/VISUAL PACING



As shown in Figure 3.1, the line of text at (or near) the television screen midline (i.e., vertical axis) was paced at a synchronous rate to the spoken narration. Since the spoken narration varried slightly in presentation rate, the effective area of pacing encompassed approximately one inch to either side of the vertical axis of the television screen. This was due to limitation for producing fine distrinctions of rate variations by the visual "crawl" device.

Neither the audio nor video tracks of the videocassette were presented to control group subjects, although the control conditions involved visual materials. The original paper "crawl" which was used in production of the videotape was manipulated by control group subjects during "self-paced" reading. The presentation rate for the visual materials used with the control group subjects was dependent upon the rate set by the subject in this "self paced" condition. No audio narration of the text accompanied the hand manipulated visual materials used in the control groups treatment.

Audio Materials

The original audio recording used in production of the time-compressed recording was a narration of the book Survive the Savage Sea. This original rate recording was produced in the studios of ration station WKAR on the campus of Michigan State University in East Lansing, Michigan. This recording had originally been produced as one in a series of radio programs involving the stations' continuing educational services to the blind. The narration rate of the original audio recording varied from approximately 140 to 170 words per minute. The audio tape was recorded on a Sony TC 850 tape recorder at 7½ inch per second.

The original audio recording was chosen because of the expertise and familiarity the staff of WKAR with respect to producing master audiotapes for time-compression. The reasons for choice of the original rate audiotape recording are summarized in Table 3.3.

TABLE 3.3

CONSIDERATIONS OF CHOICE FOR THE ORIGINAL RATE AUDIOTAPE NARRATION

Category	Recording Characteristic
Audio Engineering	The studio and narrator were familiar with techniques for audiotaping for production of time-compressed tapes.
Narrator Characteristics	Voice quality, rate and articulation of the professional voice used for production to the audiotapes were adjuged to be excellent by pilot testing groups.

The time-compressed master audiotape was produced from the original-speed master audiotape at the Department of Audiology and Speech Sciences at Michigan State University. Departmental personnel supervised the production of the time-compressed, master audiotape at the department's Perceptual Laboratory. The Lexicon (Lee, 1972) (i.e., a speech-compression device employing a digital-to-analog computer), was used for the production of the time-compressed master audiotape.

The time-compressed master audiotape was produced at continuously variable compression rate by stages over the length of the recording. Each successive five minute time period during the compressed audiotape was increased in rate approximately 10% faster than the preceeding five minute period. The "word per minute rate" of the compressed audiotape ranged from approximately 150 words per minute at the start of the audiotape to approximately 630 words per minute at the finish. Several random checks of the audiotape were made to confirm the accuracy of the word per minute rate of each compression rate level.

The time-compressed, master audio recording was subsequently copied onto the audio track of the videotape (Sony 60 minute video-cassette) to be used in the treatment sessions. The videotape's audio and visual stimuli were sychronized during videotape production so that the video "crawl rate" matched the rate of presentation for the accompanying time-compressed audio narration. This sychronized videotape was produced during the television studio production sessions through a technique involving monitoring the time-compressed recording during the "dubbing" process. The rate at which the visual "crawl" passed the television camera was manipulated so that the visual text matched the rate of the audio narration.

Several videotaping attempts were required before satisfactory video and audio tracks on the videotape were obtained. During the initial videotaping production sessions the line of narration (which was being spoken at any given point on the audiotape) was paced precisely at the horizontal axis of the television monitor screen. This precision was accomplished by a series of small movements of the visual "crawl" through "line-by-line" increments. This "precision pacing" technique was abandoned after pilot testing of the original videotape due to its distracting effect upon subjects. A smoother pacing movement was substituted. Since the smoother pacing could not be paced precisely, this gave rise to the technique of using an approximate "area of pacing" (approximately one inch above and below the horizontal axis of the television screen) rather than a precise "pacing point" (i.e., the line of text exactly at the horizontal axis of the television screen).

Likewise, the pacing location itself was moved to various points on the television screen before satisfactory pacing results were obtained during pilot testing. One prototype videotape paced subjects reading at the top edge of the television monitor screen. It was thought that a "pacing point" at the edge of the screen would motivate subjects to maintain their reading rate due to the fact that the text would disappear off the top edge of the screen should the subject not maintain the set reading pace. This prototype was disregarded, however, since the use of different television monitors for display of the videotape often produced different image sizes on the television screen.

The audio stimulus itself also required adjustments shown by pilot testing. Through these tests, it was found that environmental room noise was said by pilot test participants to be distracting and in competition with the audio materials. This was said to be due to the high level of concentration needed by participants for comprehension of the higher speech compression rates for the audio narration. The use of audio earphones appeared to greatly enhance listening conditions during pilot testing, and were subsequently used during experimental treatments.

Testing Materials

The reading rate and comprehension sections of Forms A and B of the Nelson-Denny Reading Test (Nelson-Denny, 1958) were selected as measures for the dependent variables of visual reading rate and comprehension for several reasons. First, rate and comprehension were presented as individual test sections to be administered separately. This made it unnecessary to administer the total test, which would have included a lengthy measure of reading vocabulary. Second, rate and comprehension measures were reported as separate scores. For purposes of the present experiment, it was assumed that rate and comprehension are aggregates of total reading ability. Separate measures of the aggregate abilities were preferred over obtaining a single efficiency score (e. g., Davis Reading Test, 1964). Third, administration time for the test was relatively short; i.e., 20 minutes. Since pre- and post-testing, as well as the experimental treatment, could be administered during a single session (approximately 70 minutes), effects resulting from maturation of subjects were adequately controlled. A summary of reasons for choice of the Nelson-Denny Reading Test in the present experiment is presented in Table 3.4. Psychometric characteristics of the test are presented in Appendices O, P, Q, and R.

TABLE 3.4

LOGISTICAL CONSIDERATIONS FOR SELECTION OF THE NELSON-DENNY READING TEST

TEST CHARACTERISTICS	COMMENTS
Testing Format was by Sections: 1) Vocabulary, 2) Rate 3) Comprehension	This format permitted administration of the rate and comprehension sections as spearate units.
Sections could be interpreted as separate scores.	Separate scores were preferred over a single, embedded "total ability" score.
Test could be administered in twenty (20) minutes.	This length of administration time needed for the test permitted subjects to finish treatments and testing in a single session.

The difficulty levels of the passage used to measure reading rate in the present experiment were neither the easiest nor the most difficult reading passages present in the Nelson-Denny Reading Test. The reading difficulty level for Form A was 74.8; Form B was 74.4. The average reading difficulty for all reading passages for Forms A and B of the Nelson-Denny Reading Test is summarized in Table 3.5. The figures in Table 3.5 represent the percent of correct answers for each reading passage (for both the upper and lower 27 percent of subject scores for all 72 test items of Forms A and B). Average difficulty of reading passages was 74.8.

TABLE 3.5

AVERAGE DIFFICULTY LEVELS FOR READING PASSAGES IN THE NELSON-DENNY READING TEST

Passage	Form A	Form B
1	74.8	74.4
2	80.4	82.9
3	78.0	80.3
4	73.1	75.3
5	69.8	73.4
6	67.4	64.8
7	63.8	63.9
8	53.4	53.4

*According to the Nelson Denny Reading Test Examiner's Manual (1960)

PROCEDURES

This section will present uses employed during the experiment, including: (1) the manner in which data was collected during the experiment; and, (2) the adjustments involving the stimulus materials which subject were permitted to make during individual treatment sessions.

Data Collection

The mechanics of data collection for the present experiment were designed so that the method to be used was standardized, yet allowed for individual differences of learning. Data collection for the present experiment was conducted during the week of July 15, 1974.

A schedule of appointments for individual treatment sessions was set up prior to each treatment date. Each appointment was scheduled for approximately 70 to 80 minutes in length. Subjects were assigned to treatments through the use of table of random numbers.

As each subject arrived for his or her appointment, he or she was taken to a secluded treatment room where the pre-test was administered. Directions for the pre-test were read orally while the subject visually followed the directions in a text, (see Appendix N). Any questions concerning the pre-testing were answered at that time. Reading rate was measured over a one-minute interval during the first portion of the pre-test. When the test proctor signaled the subject that one minute had elapsed, the subject pointed to the line of text at which he or she had stopped. This line number was recorded by the text proctor. The subject then continued with the remaining portion of the pre-test, for twenty minutes, at which time the test proctor again signaled the subject to stop. Pre-test answer sheets and test booklets were collected at that time.

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After the proctor had collected all pretest materials from the subject, instructions concerning the treatment were explained: (i.e., equipment, controls, pacing-location on the television screen, and time interval). All procedural questions involving the treatment were answered by the proctor. All treatments, regardless of type, lasted a total of 30 minutes after instructions had been given and questions answered. Following the treatment portion of the session, the alternate form of the Nelson-Denny Reading Test was administered as a post-test.

Adjustments Permitted During Treatment

As noted above, subjects were shown the equipment which would be involved in the treatment which they would receive. Certain preferential adjustments of various controls on the equipment were permitted during the explanation period as well as during the treatment.

Different individuals preferred different volume adjustments during listening to auditory stimuli. This appeared to become especially important to subjects observed during pilot tests. Prior to treatments, the volume level of the audio was individually adjusted to a level preferred by the individual subject. The subject was permitted to adjust the audio volume by manipulating the volume control on the front of the television monitor. The tone setting for the auditory stimulus was pre-set at maximum treble. This adjustment was pre-set for two reasons. First, it was observed during pilot testing that comprehension of the auditory material at higher time-compression rates was enhanced by setting the tone control at its full treble setting. Second, the television monitor used in the experiment had no accessible tone control and adjustment of the Sony videotape playback device tone control was inconvenient.

For treatments involving televised visual stimuli, the visual and audio/visual treatments, the brightness level of the television monitor screen was determined by preference of individual subjects. The subject was permitted to adjust the brightness level of the television monitor screen by manipulating the brightness control on the front of the television monitor. The contrast control setting for the visual stimulus was pre-set at near-maximum contrast. This adjustment was pre-set so as to increase the figure/field definition of the text during production of the videotape "crawl", and therefore improve the "readability" of the materials during the treatments. For the control treatment, which involved non-televised visual stimuli, the original paper "crawl" used in producing the videotape materials was manually unrolled on subjects during non-paced reading. Ambient room light was adjusted to a brightness level preferred by individual subjects. As can be seen in Table 3.6, audio, visual and audio/visual treatment groups were permitted to adjust both the sound and brightness levels of the television monitor. No sound stimuli were intended to be part of the control treatment. The brightness level of the environmental light was permitted to be adjusted by subjects.

TABLE 3.6

INDIVIDUAL ADJUSTMENTS REGARDING SIMULUS MATERIALS PERMITTED DURING TREATMENT

Stimuli	Treatments Involved	Adjustment Permitted
Auditory	Audio Audio/Visual	Volume Level
Televised Visual	Visual Audio/Visual	Brightness Level
Non Televised Visual	Control	Ambient Lighting

DESIGN OVER TIME

This section will present considerations concerning the experimental design of the present experiment. The purpose of this section is to describe the nature of the manipulation of independent variables during the experiment.

A pre-test/post-test/control group design was employed in the present experiment (Campbell and Stanley, 1963). (See Figure 3.2.)

FIGURE 3.2

EXPERIMENTAL DESIGN OVER TIME

R	O_1	R	X_1	A - B	O_2
R	O_1	R	X_2	A - B	O_2
R	O_1	R	X_3	A - B	O_2
R	O_1	R	X_4	A - B	O_2

In Figure 3.2, "R" represents the random assignment of subjects. This randomization involved selection of both the form of the pre-test and the treatment conditions. Administration of Form "A" or "B" of the Nelson-Denny Reading Test for individual subjects as a pre-test was determined through the use of a table of random numbers. Assignment to treatments was also pre-determined by consulting a table of random numbers.

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"A-B" indicates the alternate assignment of subjects; i.e., the assignment of the alternate test form from that received during pre-testing). For example, should a subject be randomly assigned Form A of the Nelson-Denny Reading Test as the pre-test, Form B was assigned as the post-test.

"O_1" represents the Pre-Test (i.e., Nelson-Denny Reading Test, Form A or B). This pre-testing portion of the session was twenty minutes in length.

"O_2" represents the Post-Test (i.e., Nelson-Denny Reading Test, Form A or B). This post-testing portion of the session was twenty minutes in length.

"X_1" represents the Audio Treatment, thirty minutes in length. During the Audio Treatment, a time-compressed narration was presented to subjects via earphones. The rate of time-compression increased gradually. No visual stimulus accompanied this auditory stimulus.

"X_2" represents the Visual Treatment, thirty minutes in length. During the Visual Treatment, a visual text was presented on a television monitor. This text rolled upward on the television screen, the rate of which increased gradually. No auditory stimulus accompanied this visual stimulus.

"X_3" represents the Audio/Visual Treatment, thirty minutes in length. During the Audio/Visual Treatment, both auditory and visual stimuli for the same text were presented in a synchronous fashion (i.e., the rate of visual and audio-pacing were the same).

"X_4" represents the Control Treatment, thirty minutes in length. During the Control Treatment, visual stimuli were presented by a paper roll text to subjects. The rate at which the text was unrolled was determined solely by manipulation by the subject. No auditory stimulus accompanied this visual stimulus.

DESIGN SUMMARY

Chapter Three has presented an overview of design considerations concerning the conduct of the present experiment. The major topics presented were: (1) a discussion of the materials used in the experiment; (2) description of the procedures followed during the experiment; and, (3) examination of general aspects involving the experimental design variables.

A large, undergraduate, teacher education course at Michigan State University was selected as the source of subjects for the present experiment because of its large, stable population. Many academic courses of study were represented among the group. Forty-five students volunteered to participate in the experiment for a small, monetary incentive. Data was actually collected for thirty-three subjects.

Survive the Savage Sea (Robertson, 1973) was chosen as the visual text in the experiment. A professionally recorded narration of the book was time-compressed from 160 to 600 words per minute in 20 word per minute incriments. A videotaped "crawl" of the visual text was produced, and synchronized to the compression rate of the time-compressed narration. The "pacing point", at which this text and narration were synchronous was near the vertical mid-point of the television screen.

Forms "A" and "B" of the Nelson-Denny Reading Test (Nelson-Denny, 1958) were used as pre and post instruments for measurement of reading rate and comprehension. The test itself is a widely-used test of reading abilities. Psychometric characteristics of the test concerning its standardization were adjudged favorable.

Treatment sessions were individually scheduled, lasting a total of 70 to 80 minutes in length. Pre- and post-tests totaled 40 minutes, each consisting of a timed

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one minute rate test and a 19 minute comprehension test. Subjects in audio and audio/visual treatments were permitted to adjust the television monitors volume and brightness. Control group subjects could adjust ambient room light.

The experimental design was a pre-test/post-test control group design (Campbell and Stanley, 1963, page 183). Subjects were randomly assigned both pre-tests and treatments. Post-tests were assigned as the alternate test form from that given as the pre-test.

In summary, this chapter has described, in part, the nature of the present experiment's design. Chapter Four will further define and describe the experiment by focusing upon the resultant data obtained from pre- and post-testing and the procedures results of analysis of data.

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Chapter Four

Results

This chapter is divided into two sections. The first section describes findings related to main treatment effects upon reading rate. Section two presents findings as to main treatment effects upon reading comprehension.

MAIN TREATMENT EFFECTS

The main analysis concerned comparisons of mean gain scores between treatment groups. The dat descriptive of differences in reading rate and comprehension were measured under four independent variables: compressed listening practice, visual-pacing, compressed audio-pacing, and practice in non-paced visual reading. Statistical significance was evaluated by analyses of vairance. The .05 level was established as the acceptable level for statistical significance.

Differences in Reading Rate Gains

The null hypothesis concerning reading rate gain was: There is no difference among reading rate gains for the audio, visual, audio/visual and control groups when reading rate is measured by the Nelson-Denny Reading Test.

The individual reading rate scores are presented in Appendix A. Reading rate gains for all treatments are presented in Table 4.1.

TABLE 4.1

READING RATE GAINS FOR ALL TREATMENTS

TREATMENT	PRETEST		POSTTEST		GAIN (WPM)
	SUM OF SCORES	MEAN SCORE	SUM OF SCORES	MEAN SCORE	
Audio Only N=10	2799	279.9	3676	367.6	+ 87.7
Visual Only N=8	2465	308.6	3161	395.1	+ 86.5
Audio/Visual N=10	2489	248.9	3939	393.9	+ 145.0
Control N=5	1864	372.8	2087	417.4	+ 44.6

From an examination of Table 4.1, it maybe seen that the mean gain in reading rate was highest for the audio/visual group (145 words per minute) as compared to the audio group (87.7 words per minute), the visual group (86.5 words per minute) and the control group (44.6 words per minute). All groups showed an improvement in reading rate.

Within groups, subjects varied widely in reading rate gains. From Table 4.2, it can been seen that rate gain effects ranged from a 394 words per minute improvement for an audio/visual treatment subject to a 39 word per minute decrease for a control treatment subject.

TABLE 4.2

INDIVIDUAL READING RATE GAINS (W.P.M.)

Audio Treatment N=10	Visual Treatment N=8	Audio/Visual Treatment N=10	Control Treatment N=5
55	136	73	64
87	28	77	81
219	- 18	50	- 39
- 35	160	194	39
63	19	70	78
31	81	119	
235	24	394	
98	266	242	
105		82	
19		149	

ISOLATED READING RATE LOSSES

The factors contributing to isolated reading rate losses registered for three subjects, in the audio, visual, and control groups, respectively, could not be determined with certainty. Reading rate losses were not expected due to experimental treatments, since it was hypothesized that practice in the various treatment conditions would enhance reading abilities. The control condition was expected to have no effect upon reading rate scores. Findings revealed that a subject in the visual treatment group showed an 18 words per minute loss in reading rate. Two other subjects had 35 and 39 words per minute reading rate declines, in the audio and visual treatment groups. Pre- and post-test data concerning these three isolated subjects are presented in Table 4.3.

TABLE 4.3

SUBJECTS WITH READING RATE LOSSES

Subject Number	Treatment Group	Pre-Test Reading Rate	Post-Test Reading Rate	W.P.M. Loss
04	Audio	238	203	- 35
13	Video	425	407	- 18
33	Control	318	279	- 39

As can be seen in Table 4.3, pre-test scores for subjects showing a decline in reading rate ranged from 238 to 425 words per minute. It would appear unlikely that these losses are solely influenced by the initial reading rate of subjects before receiving treatments. It is also unlikely that subjects' fatigue due to participation in a particular treatment is the sole source of these differences, since the losses are distributed across treatment groups. Likewise, several subjects concluding the audio/visual treatment commented that such practice was particularily strenuous, both mentally and physically; yet this group's lowest score was a 73 words per minute increase in reading rate.

It was found, however, that the three subjects showing reading rate losses generally improved in reading comprehension scores during post-testing. Individual pre- and post-test scores for reading comprehension for these subjects is presented in Table 4.4.

TABLE 4.4

COMPREHENSION SCORES FOR SUBJECTS WITH RATE LOSSES

Subject Number	PRE-TEST			POST-TEST		
	Number Attempted	Number Correct	Percent Correct	Number Attempted	Number Correct	Percent Correct
04	24	17	71	25	18	72
13	27	20	74	23	21	91
33	28	22	79	35	32	91

An analysis of variance (ANOVA) was used to test the hypothesis H_0: $\mu_A = \mu_B = \mu_C = \mu_D$ (where μ_A is the population mean of the audio treatment group; μ_B is the is the population mean of the visual treatment group; μ_C is the population mean of the audio/visual treatment group; and μ_D is the population mean of the control group). The analysis of variance was chosen as the test statistic since the H_0 contained more than two groups. The formula used, as well as the intermediate steps used to obtain the F ratio, is presented in Appendix S. The tabled F value for the .05 level was found to be 2.934. The number of degrees of freedom among sample means was two (i.e., k -1 or 3-1). The number of degrees of freedom within samples was 29 (i.e., $\Sigma n_i - k_i$ or 33-4). The F value obtained was 1.548. Since the obtained F did not exceed 2.934, the hypothesis H_0 could not be rejected. A summary of the findings is presented in Table 4.5.

TABLE 4.5
ANALYSIS OF VARIANCE
READING RATE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F-RATIO
Sample Means	2	38372.34	12790.78	$F = \frac{12790.78}{8265.01} =$ 1.5476
Within	29	239685.3	8265.01	
Totals	31	10217.28		

Differences in Reading Comprehension Gains

The null hypothesis concerning reading comprehension gains presented in Chapter One was: There is no difference among reading rate gains for the audio, visual, audio/visual and control groups when reading rate is measured by the Nelson-Denny Reading Test.

Gains in the number of questions attempted during comprehension testing for all treatments are presented in Table 4.6.

TABLE 4.6

GAINS IN THE NUMBER OF QUESTIONS ATTEMPTED DURING COMPREHENSION TESTING

Treatment	Questions Attempted		Gain	Mean Gain
	Pre-Test	Post-Test		
Audio N=10	263	304	41	4.1
Visual N=8	203	203	- -	- -
Audio/Visual N=10	255	268	13	1.3
Control N=5	162	170	8	0.8

From an examination of Table 4.6, it is seen that the mean gain in the number of questions attempted was highest for the audio treatment group (a mean increase of 4.1 questions) as compared to all other treatments. Gains for the audio/visual and control treatment groups were slight. The visual treatment group showed no increase in questions attempted. Mean gains for audio/visual and control groups were respectively 1.3 and 0.8 questions. These findings are of interest because they indirectly provide a measure of reading rate. It was anticipated that gains in the number of questions attempted during comprehension testing would be proportionate to the group's reading rate gains. However, reading rate testing revealed that whereas the audio/visual treatment group's rate gains to be 145 words per minute, the mean gain in comprehension testing for the number of questions attempted was

only a 1.3 question increase. Likewise, the mean rate gain for the audio treatment group was 87.7 words per minute while the gain in number of comprehension questions attempted was 4.1. Reading rate gains for the visual and control treatment groups were 86.5 and 44.6 words per minute while gains in comprehension questions attempted were 0 and 0.8 questions respectively. The factors contributing to these differential effects upon the relative number of questions attempted during comprehension testing could not be determined with certainty. The motivational set of individual subjects during post-testing may have had an influence upon these results.

For reading comprehension, an analysis of variance (ANOVA) was used to test the hypothesis H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$ (where μ_1 is the population mean of the audio treatment group. μ_2 is the population mean of the visual treatment group, μ_3 is the population mean of the audio/visual treatment group; and μ_4 is the population mean of the control group). The formula used, as well as a presentation of the intermediate steps used to obtain the F ratio are found in Appendix N. There were 2 degrees of freedom among sample means and 29 degrees of freedom within samples. The F value obtained was 1.3639. Since the tabled F was 2.934, the hypothesis H_0 of no significant differences among sample means could not be rejected. A summary of the findings is presented in Table 4.7.

TABLE 4.7
ANALYSIS OF VARIANCE
READING COMPREHENSION

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F-RATIO
Sample Means	2	196.545	65.515	$F=\frac{65.515}{48.034}=$
Within	29	1393	48.034	1.3639
Totals	31	1589.545		

SUMMARY OF RESULTS

Chapter Four has presented the results of the present experiment. The first section in this chapter looked at differences in reading rate gains among treatment groups. An analysis of variance (ANOVA) for groups' mean reading rate gains revealed no significant differences among roups at the .05 level of confidence. The F ratio obtained was 1.5476; the tabled F value was 2.9340.

The second section in this chapter concerned possible differences in reading comprehension gains among treatment groups. An analysis of variance (ANOVA) for groups' mean comprehension levels revealed no significant differences among group means at the .05 level of confidence. The F ratio obtained was 1.3639 while the tabled F value was 2.9340.

In summary, no significant differences were found among mean reading rate or comprehension scores which could be attributed to treatments. A discussion of the results and their implications to future research will be presented in Chapter 5.

CHAPTER FIVE

Summary

Chapter Four presented the results of the statistical analyses of data gathered in the present experiment. The purpose of Chapter Five is to summarize and interpret the results of the present experiment, in light of the objectives of the experiment. Likewise, this chapter will attempt to relate the findings of the present experiment to the results of similiar past research studies. This chapter will also examine the implications for future research arising from the conclusions reached from the present experiment.

SUMMARY OF RESULTS

An analysis of variance was preformed upon the treatment groups' mean gain scores to test the hypothesis $H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$ for the dependent variables of reading rate and reading comprehension. The F ratios obtained were 1.5476 (for rate) and 1.3639 (for comprehension). There were 2 degrees of freedom among sample means and 29 degrees of freedom within samples. The tabled F ($p < .05$) was 2.934. Since neither of the obtained F ratio values exceeded the tabled F value, neither of the null hypotheses of no significant difference among groups for reading rate or comprehension could be rejected. Since no significant differences among treatments were revealed for measures of reading rate and comprehension, post-hoc procedures to determine the relative strengths of treatment effects (as were hypothesized in Chapter One) were not appropriate.

DISCUSSION OF RESULTS

Prior research concerning the use of time-compressed speech in techniques intended to enhance visual reading abilities has provided mixed results as to the effectiveness of such reading improvement methodologies. In general, the results of the present experiment tend to support the conclusions of past researchers (i.e., Reidford, 1965; Reiland, 1970) that compressed audio-pacing training has no significant effect upon reading abilities. However, extenuating circumstances regarding several specific findings concerning the present experiment tend to support the contention that further examination of this research area is needed.

Reading Rate

One objective of the present experiment was to determine the relative effectiveness of four treatment methods upon subjects' reading rate. The treatments involved practice in compressed listening, visual-pacing, compressed audio-pacing, and non-paced reading. No significantly different effects could be demonstrated as attributable to any treatment condition as compared to all groups. The null hypothesis of no significant differences in reading rate gains among treatment groups differing by training methods could not be rejected at the .05 level of confidence. Thus, analysis by subsequent tests to establish the relative effects of training between treatments was inappropriate.

This finding is similiar to that of Reidford (1965) and Reiland (1970). Orr (1966) and Stamper (1970) found compressed audio-pacing to have a significant effect upon reading rate. It should be noted that the characteristics of the

compressed audio-pacing treatment used in the present experiment and those used in past research were somewhat dissimilar. Findings related to the characteristics of the compressed audio-pacing treatment and previous research follows.

COMPRESSED AUDIO-PACING CHARACTERISTICS

The present experiment sought to compare the effects of practice in compressed-listening, visual-pacing, compressed audio-pacing, and a control of non-paced reading. Reidford (1965), Orr (1966), Stamper (1970), Reiland (1970), and Walker (1971) had previously compared the effects of compressed audio-pacing, compressed listening and non-paced reading. Orr et al (1965) and Reiland (1970) examined the effects of compressed listening practice upon reading rate and comprehension. A characteristic of each of these studies was the use of compressed audio-pacing in stationary (i.e., non-moving) texts, such as the use of printed books. Reidford (1965) did use the Perceptiscope (i.e., a motion-picture pacing device) in pre- and post-testing, but not during reatment conditions. Likewise, no time-compressed speech accompanied the Perceptiscope visual materials. For the audio/visual treatment in the present experiment, a compressed audio-paced narration accompanied a visually-paced text.

DURATION OF TREATMENTS

An assumption of the present experiment was that the use of a short period of training was sufficient to achieve measurable change in subjects' reading abilities. In a previous study, Stamper (1970) had used variable training periods in subjects' achievement of successively faster criterion rates for compressed audio-pacing (i.e., involving the ability to successfully follow visually in a text while being audio-paced). Stamper had provided subjects time-compressed audiotapes for up to two hours in total training time. The actual

practice time required by subjects for attainment of the faster criterion level (i.e., compressed audio-pacing of subject' at the rate of 430 words per minute) was substantially lower than the total two hours of available practice time. In the present experiment, the audio/visual treatment paced subjects upward in rate (during compressed audio/pacing) to 600 words per minute in a time period of thirty minutes. No criterion training was used during the present experiment.

Reading Comprehension

One objective of the present experiment was to determine the relative effectiveness of four treatment methods upon subjects' reading comprehension. The treatments involved practice in compressed listening, visual-pacing, compressed audio-pacing, and non-paced reading. No significantly different effects attributable to any one treatment could be demonstrated.

The null hypothesis of no significant differences in reading comprehension gains among treatment groups differing by training methods could not be rejected at the .05 level of confidence. Thus, analysis by subsequent tests to establish the relative effects of training among treatment pairs was inappropriate.

This finding is similar to that of Orr et al (1965), Reidford (1965), Orr (1966), Reiland (1970), Stamper (1970) and Walker (1971). The results of the present experiment would tend to support the conclusion that training using time-compressed speech (i.e., compressed-listening and compressed audio-pacing) has no effect upon subjects' reading comprehension abilities.

CONCLUSIONS

The following conclusions refer to the statistical analyses of the results of the present experiment. They are based upon the hypotheses of the experiment set forth in Chapter One.

1. No significant difference among groups for reading rate were found to exist attributable to the treatment conditions of practice in listening to time-compressed speech, in watching a paced presentation of a text, in watching and listening a paced presentation of a visual text which was accompanied by a time-compressed speech narration of the text, or in non-paced reading of a visual text. For reading rate, H_o: $\mu_1 = \mu_2 = \mu_3 = \mu_4$ (where μ_1, μ_2, μ_3 and μ_4 refer to treatment conditions) could not be rejected. Therefore, no relative difference in treatment effects for reading rate could be demonstrated.

2. No significant differences among groups for reading comprehension were found to exist attributable to the treatment conditions of practice in listening to time-compressed speech, in watching a paced presentation of a visual text, in watching a paced presentation of a text which was accompanied by a time-compressed speech narration of the text, or in non-paced visual reading. For reading comprehension, H_o: $\mu_1 = \mu_2 = \mu_3 = \mu_4$ (where μ_1, μ_2, μ_3, and μ_4 refers to treatment conditions) could not be rejected. Therefore, no relative difference in treatment effects for reading comprehension could be demonstrated.

Conclusion one tends to support previous findings regarding compressed audio-pacing and compressed-listening by Reidford (1965), Reiland (1970) and Walker (1971). Conclusion one tends to refute the finding of Orr et al (1965) concerning compressed-listening practice, and Stamper (1970) concerning compressed audio-pacing practice. Conclusion two tends to support the findings of Orr et al (1965), Reidford (1965) Stamper (1970) and Walker (1971).

IMPLICATIONS

General Implications

The results of the present experiment raises several implications for future research. The use of time-compressed speech in methods for improvement of reading abilities could not be demonstrated in the present experiment to be significantly better than practice in non-paced reading or a traditional visual-pacing technique. It may be possible for time-compressed audio-pacing practice to prove superior to existing reading improvement techniques under the conditions of extended training session length with a larger sample population. In addition, the following implications are raised through the present study.

READING GAINS AND ENTRY RATE

Large increases in reading rate were found for individual subjects in various experiment treatments (See Appendix A). Several large reading rate gains occured in the compressed audio-pacing group (i.e., 394, 242, 194 and 149 words per minute). These substantial reading rate gains, which were seen in various treatment groups, may be influenced, in part, by subjects' initial reading rates before treatments. The treatment conditions may differentially effect subjects varying by initial reading rate during pre-testing. One implication for future research concerns the question: "Does initial reading rate have an effect upon reading rate or comprehension gains resulting from reading improvement practice involving time-compressed speech?"

READING GAINS AND ENTRY RATE

Reading rate gains may be influenced by individual differences among subjects preferred imput modalities. Holmes (1966) suggests that predisposed differences exist in the manner in which individuals accept, process, and transmit various sensory

modes. Hill (1971) proposed five qualitative areas associated with these sensory inputs, and suggested that individuals vary in their capacity to process classes of sensory stimuli. One implication for future research involves the question; "Does the cognitive style or preferred sensory imput modality have an effect upon reading skills improvement resulting from visual- or audio-pacing practice?"

READING GAINS AND PACING RATES

Reading rate gains may be influenced by the degree to which individuals are paced upward in rate above their initial reading rates before treatments. Orr et al (1965) and Stamper (1970) paced subjects' visual reading above 500 words per minute. Both studies appear to have been successful in the improvement of reading rate. An implication for future research involves the question; "What effect does the rate of compressed audio-pacing practice have upon reading gains?"

READING GAINS AND TRAINING TIME

Reading rate gains may be influenced by the amount and kind of practice available to individuals during treatment. The present experiment paced subjects' reading rate at 600 words per minute for three minutes only. The question remains: "What effect does the amount of audio-pacing practice at higher rates of time-compression have upon reading abilities?"

TRAINING CHARACTERISTICS - SYNCHRONOUS TEXT

Reading abilities gains may be influenced by the characteristic or style of training involved. The present experiment utilized compressed audio-pacing with an accompanying visual text which was matched to the time-compressed speech narration in a synchronous fashion. One implication for future research involves the question: "What are the relative effects upon reading abilities by the use of compressed audio-pacing training using an accompanying, synchronous visual text as compared to such

training using a non-synchronous text?"

TRAINING CHARACTERISTICS, TELEVISED FORMAT

In the present experiment, compressed audio-pacing accompanied by a synchronous visual text was presented to subjects in the audio/visual treatment via television. An implication for future research involves the question: "What are the relative effects upon reading abilities by use of compressed audio-pacing training presented via television, as compared to such training presented via motion picture, projected still, or moving paper text media ?"

TRAINING CHARACTERISTICS, CRITERION-REFERENCED PRACTICE

In the present experiment, the training given to subjects was controlled by the rate of pacing achieved and the time available for practice. Stamper (1970) held the objectives of training constant (i.e., the ability to follow in a text at 530 words per minute), and allowed training time to vary for individual subjects. An implication for future research involves the question: "What are the relative effects upon reading abilities by the use of compressed audio-pacing training using a criterion-referenced instructional technique, as compared to training involving set lengths of didactic time?"

General Conclusions

The results of the present experiment failed to demonstrate any advantages of one treatment. Practice in compressed listening, visual-pacing, compressed audio-pacing, and non-paced reading did not produce significantly different effects upon subjects' reading rate or comprehension. However, standard deviations of gains for reading rate for treatments were large, A = 80.01, V = 88.21, A/V = 101.46, C = 44.35. This may suggest that subjects were differentially or

selectively effected by treatment conditions. Further research is needed to determine if the factors of training interval and entry reading abilities have influence in producing selective results among subjects. Subject capacity and/or preference of sensory stimuli in training may also contribute to the varing results of treatments. Gains in reading abilities after treatments may perhaps be predicted through the use of "learning style" tests, such as described by Hill (1973). Similarly, compressed audio-pacing treatment conditions should be further examined in future research to determine what effect variations in presentation medium and compression rate have upon reading gains. Furthermore, direct comparison of synchronous and non-cynchronous forms of compressed audio-pacing should be preformed.

In summary, it appears that further research is needed concerning the differential effects upon reading abilities by methods utilizing time-compressed speech.

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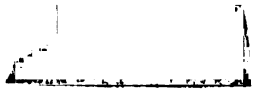

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APPENDIX A

APPENDIX A

INDIVIDUAL SCORES OF PRE- AND POST-TESTS IN READING RATE (W.P.M.) FOR ALL TREATMENTS

METHOD A

AUDIO ONLY

SUBJECT	PRE	POST
01	413	468
02	250	337
03	396	615
04	238	203
05	235	298
06	195	226
07	365	600
08	327	425
09	185	290
10	195	214

METHOD B

VIDEO ONLY

SUBJECT	PRE	POST
11	290	426
12	207	235
13	425	407
14	426	586
15	216	235
16	287	368
17	379	403
18	235	501
19	-	-
20	-	-

APPENDIX A (CONTINUED)

INDIVIDUAL SCORES OF PRE- AND POST-TESTS IN READING RATE (W.P.M.) FOR ALL TREATMENTS

METHOD C
AUDIO-VISUAL

SUBJECT	PRE	POST
21	214	287
22	250	327
23	318	368
24	177	371
25	309	379
26	298	417
27	245	639
28	226	468
29	245	327
30	207	356

METHOD D
CONTROL

SUBJECT	PRE	POST
31	327	391
32	290	371
33	318	279
34	561	600
35	368	446
36	-	-
37	-	-
38	-	-
39	-	-
40	-	-

APPENDIX B

APPENDIX B

GAINS FOR READING RATE (W.P.M.) FOR ALL TREATMENTS

TREATMENT	PRETEST		POST TEST		GAIN (WPM)
	SUM OF SCORES	MEAN SCORE	SUM OF SCORES	MEAN SCORE	
Audio Only N=10	2799	279.9	3676	367.6	+ 87.7
Visual Only N= 8	2465	308.6	3161	395.1	+ 86.5
Audio/Visual N=10	2489	248.9	3939	393.9	+145.0
Control N= 5	1864	372.8	2087	417.4	+ 44.6

APPENDIX C

APPENDIX C

STANDARD DEVIATION OF PRE- AND POST-TEST SCORES ON READING RATE (W.P.M.) FOR ALL TREATMENTS

METHOD A
AUDIO ONLY
N = 10
PRETEST

SUBJECT	SCORE (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
01	413	133.1	17715.61
02	250	- 29.9	894.01
03	396	116.1	13479.21
04	238	- 41.9	1755.61
05	235	- 44.9	2016.01
06	195	- 84.9	7208.01
07	365	85.1	7242.01
08	327	47.1	2218.41
09	185	- 94.9	9006.01
10	195	- 84.9	7208.01
TOTAL	2799	0	68742.90
MEAN ($\bar{X}$)	279.9		

$$S = \sqrt{\frac{68742.9}{10}}$$

$$S = \sqrt{6874.29}$$

$$S = 82.911$$

APPENDIX C (CONTINUED)

STANDARD DEVIATION OF PRE- AND POST-TEST SCORES ON READING RATE (W.P.M.) FOR ALL TREATMENTS

METHOD A
AUDIO ONLY
N = 10
POST TEST

SUBJECT	SCORE (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
01	468	100.4	10080.16
02	337	- 30.6	936.36
03	615	247.4	61206.76
04	203	-164.6	27093.16
05	298	- 69.6	4844.16
06	226	-141.6	20050.56
07	600	232.4	54009.76
08	425	57.4	3294.76
09	290	- 77.6	6021.76
10	214	-153.6	23592.96
TOTAL	3676	0	211130.40
MEAN ($\bar{X}$)	367.6		

$$S = \sqrt{\frac{211130.4}{10}}$$

$$S = \sqrt{21113.04}$$

$$S = 145.303$$

APPENDIX C (CONTINUED)

STANDARD DEVIATION OF PRE- AND POST- TEST SCORES ON READING RATE (W.P.M.) FOR ALL TREATMENTS

METHOD B

VIDEO ONLY

N = 8

PRETEST

SUBJECT	SCORE (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
11	290	- 18.125	328.516
12	207	-101.125	10226.265
13	425	116.875	13659.765
14	426	117.875	13894.515
15	216	- 92.125	8487.016
16	287	- 21.125	446.266
17	379	70.875	5023.266
18	235	- 73.125	5347.266
19	-	-	-
20	-	-	-
TOTAL	2465	0	57412.875
MEAN ($\bar{X}$)	308.125		

$$S = \sqrt{\frac{57412.875}{8}}$$

$$S = \sqrt{7176.610}$$

$$S = 84.714$$

APPENDIX C (CONTINUED)

STANDARD DEVIATION OF PRE- AND POST-TEST SCORES ON READING RATE (W.P.M.) FOR ALL TREATMENTS

METHOD B

VIDEO ONLY

N = 8

POST TEST

SUBJECT	SCORE (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
11	426	30.875	953.266
12	235	-160.125	25640.015
13	407	11.875	141.016
14	586	190.875	36433.265
15	235	-160.125	25640.015
16	368	- 27.125	735.766
17	403	7.875	62.016
18	501	105.875	11209.515
19	-	-	-
20	-	-	-
TOTAL	3161	0	100814.870
MEAN $(\bar{X})$	395.125		

$$S = \sqrt{\frac{100814.87}{8}}$$

$$S = \sqrt{12601.858}$$

$$S = 112.258$$

APPENDIX C (CONTINUED)

STANDARD DEVIATION OF PRE- AND POST-TEST SCORES ON READING RATE (W.P.M.) FOR ALL TREATMENTS

METHOD C

AUDIO-VISUAL

N = 10

PRETEST

SUBJECT	SCORE (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
21	214	-34.9	1218.01
22	250	1.1	1.21
23	318	69.1	4774.81
24	177	-71.9	5169.61
25	309	60.1	3612.01
26	298	49.1	2410.81
27	245	- 3.9	15.21
28	226	-22.9	524.41
29	245	- 3.9	15.21
30	207	-41.9	1755.61
TOTAL	2489	0	19496.90
MEAN ($\bar{X}$)	248.9		

$$S = \sqrt{\frac{19496.9}{10}}$$

$$S = \sqrt{1949.69}$$

$$S = 44.155$$

APPENDIX C (CONTINUED)

STANDARD DEVIATION OF PRE- AND POST-TEST SCORES ON READING RATE (W.P.M.) FOR ALL TREATMENTS

METHOD C
AUDIO-VISUAL
N = 10
POST TEST

SUBJECT	SCORE (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
21	287	-106.9	11427.61
22	327	- 66.9	4475.61
23	368	- 25.9	670.81
24	371	- 22.9	524.41
25	379	- 14.9	222.01
26	417	23.1	533.61
27	639	245.1	60074.01
28	468	74.1	5490.81
29	327	- 66.9	4475.61
30	356	- 37.9	1436.41
TOTAL	3939	0	89330.90
MEAN ($\bar{X}$)	393.9		

$$S = \sqrt{\frac{89330.9}{10}}$$

$$S = \sqrt{8933.09}$$

$$S = 94.515$$

APPENDIX C (CONTINUED)

STANDARD DEVIATION OF PRE- AND POST-TEST SCORES OF READING RATE (W.P.M.) FOR ALL TREATMENTS

METHOD D
CONTROL
N = 5
PRETEST

SUBJECT	SCORE (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
31	327	- 45.8	2097.64
32	290	- 82.8	6855.84
33	318	- 54.8	3003.04
34	561	188.2	35419.24
35	368	- 4.8	23.04
36	-	-	-
37	-	-	-
38	-	-	-
39	-	-	-
40	-	-	-
TOTAL	1864	0	47398.80
MEAN ($\bar{X}$)	372.8		

$$S = \sqrt{\frac{47398.8}{5}}$$

$$S = \sqrt{9479.76}$$

$$S = 97.364$$

APPENDIX C (CONTINUED)

STANDARD DEVIATION OF PRE- AND POST-TEST SCORES OF READING RATE (W.P.M.) FOR ALL TREATMENTS

METHOD D

CONTROL

N = 5

POST TEST

SUBJECT	SCORE (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
31	391	- 26.4	696.96
32	371	- 46.4	2152.96
33	279	-138.4	19154.56
34	600	182.6	33342.76
35	446	28.6	817.96
36	-	-	-
37	-	-	-
38	-	-	-
39	-	-	-
40	-	-	-
TOTAL	2087	0	56165.20
MEAN $(\bar{X})$	417.4		

$$S = \sqrt{\frac{56165.2}{5}}$$

$$S = \sqrt{11233.04}$$

$$S = 105.986$$

APPENDIX D

APPENDIX D

STANDARD DEVIATION OF PRE- AND POST-TEST GAIN SCORES ON READING RATE FOR ALL TREATMENTS

METHOD A

AUDIO ONLY

N = 10

SUBJECT	GAIN (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
01	55	- 32.7	1069.29
02	87	- 0.7	0.49
03	219	131.3	17239.69
04	-35	-122.7	15055.29
05	63	- 24.7	610.09
06	31	- 56.7	3214.89
07	235	147.3	21697.29
08	98	10.3	106.09
09	105	17.3	299.29
10	19	- 68.7	4719.69
TOTAL	877	0	64012.10
MEAN ($\bar{X}$)	87.7		

$$S = \sqrt{\frac{64012.1}{10}}$$

$$S = \sqrt{6401.21}$$

$$S = 80.0075$$

APPENDIX D (CONTINUED)

STANDARD DEVIATION OF PRE- AND POST-TEST GAIN SCORES ON READING RATE FOR ALL TREATMENTS

METHOD B

VIDEO ONLY

N = 8

SUBJECT	GAIN (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
11	136	49	2401
12	28	- 59	3481
13	-18	-105	11025
14	160	73	5329
15	19	- 63	3969
16	81	- 6	36
17	24	- 63	3969
18	266	179	32041
19	-	-	-
20	-	-	-
TOTAL	696	0	62251
MEAN ($\bar{X}$)	87		

$$S = \sqrt{\frac{62251}{8}}$$

$$S = \sqrt{77781.375}$$

$$S = 88.212$$

APPENDIX D (CONTINUED)

STANDARD DEVIATION OF PRE- AND POST-TEST GAIN SCORES ON READING RATE FOR ALL TREATMENTS

METHOD C

AUDIO - VISUAL

N = 10

SUBJECT	GAIN (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
21	73	- 72	5184
22	77	- 68	4624
23	50	- 95	9025
24	194	49	2401
25	70	- 75	5625
26	119	- 26	676
27	394	249	62001
28	242	97	9409
29	82	- 63	3969
30	149	4	16
TOTAL	1450	0	102930
MEAN ($\bar{X}$)	145		

$$S = \sqrt{\frac{102930}{10}}$$

$$S = \sqrt{10293}$$

$$S = 101.455$$

APPENDIX D (CONTINUED)

STANDARD DEVIATION OF PRE- AND POST-TEST GAIN SCORES ON READING RATE FOR ALL TREATMENTS

METHOD D

CONTROL

N = 5

SUBJECT	GAIN (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
31	64	19.4	376.36
32	81	36.4	1324.96
33	-39	-83.6	6988.96
34	39	- 5.6	31.36
35	78	33.4	1115.56
36	-	-	-
37	-	-	-
38	-	-	-
39	-	-	-
40	-	-	
TOTAL	223	0	9837.20
MEAN ($\bar{X}$)	44.6		

$$S = \sqrt{\frac{9837.2}{5}}$$

$$S = \sqrt{1967.44}$$

$$S = 44.35$$

APPENDIX E

APPENDIX E

INDIVIDUAL SCORES OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD A

AUDIO ONLY

SUB-JECT	PRE			POST		
	NO. ATTEMPTED	NO. RIGHT	% RIGHT	NO. ATTEMPTED	NO. RIGHT	% RIGHT
01	36	31	86	27	19	70
02	24	20	83	26	23	88
03	28	27	96	36	33	92
04	24	17	71	25	18	72
05	32	27	84	32	20	63
06	15	8	53	24	15	63
07	28	20	71	28	13	46
08	20	14	70	34	29	85
09	25	16	64	36	25	69
10	31	15	48	36	27	75

APPENDIX E (CONTINUED)

INDIVIDUAL SCORES OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD B

VISUAL ONLY

SUB-JECT	PRE			POST		
	NO. ATTEMPTED	NO. RIGHT	% RIGHT	NO. ATTEMPTED	NO. RIGHT	% RIGHT
11	32	27	84	32	27	84
12	12	12	100	12	11	92
13	27	20	74	23	21	91
14	25	20	80	28	16	57
15	28	26	93	19	16	84
16	26	23	88	36	26	72
17	35	27	77	32	26	81
18	18	16	88	21	18	86
19	0	0	0	0	0	0
20	0	0	0	0	0	0

APPENDIX E (CONTINUED)

INDIVIDUAL SCORES OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD C

AUDIO-VISUAL

SUB-JECT	PRE			POST		
	NO. ATTEMPTED	NO. RIGHT	% RIGHT	NO. ATTEMPTED	NO. RIGHT	% RIGHT
21	24	21	88	32	18	56
22	19	14	74	32	25	78
23	24	20	83	26	20	77
24	20	18	90	24	16	67
25	31	27	87	24	19	79
26	30	24	80	26	22	85
27	28	26	93	28	25	89
28	28	27	96	28	20	71
29	36	32	89	32	23	72
30	15	11	73	16	8	50

APPENDIX E (CONTINUED)

INDIVIDUAL SCORES OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD D

CONTROL

	PRE			POST		
SUB-JECT	NO. ATTEMPTED	NO. RIGHT	% RIGHT	NO. ATTEMPTED	NO. RIGHT	% RIGHT
31	35	26	74	36	29	81
32	28	22	79	36	28	78
33	28	22	79	35	32	91
34	35	30	86	35	31	89
35	36	32	89	28	24	86
36	0	0	0	0	0	0
37	0	0	0	0	0	0
38	0	0	0	0	0	0
39	0	0	0	0	0	0
40	0	0	0	0	0	0

APPENDIX F

APPENDIX F

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD A

(Pretest)

Audio Only

SUB-JECT	QUESTION # (1-20)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
01	3	3	3	1	5	1	1	5	2	4	3	5	3	5	2	3	1	4	3	4
02	1	5	2	1	4	1	5	2	4	4	5	3	1	4	2	2	4	3	2	4
03	0	0	0	0	0	0	0	0	4	4	5	3	1	4	2	3	4	3	2	1
04	1	5	0	2	1	1	5	2	4	4	5	3	2	4	2	1	4	3	2	1
05	3	3	3	1	5	2	2	5	2	4	3	4	3	5	2	3	1	2	3	1
06	3	4	3	1	0	1	5	2	2	4	3	4	3	5	3	1	0	0	0	0
07	3	3	3	4	1	1	4	0	2	4	3	5	3	5	2	3	1	5	3	2
08	1	5	2	1	4	1	5	2	1	4	3	5	3	5	2	3	4	3	2	3
09	1	5	2	5	4	5	5	2	2	4	3	1	3	5	2	3	1	2	3	4
10	1	5	2	1	4	1	5	2	2	4	3	4	3	5	2	3	1	2	3	4

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD A
(Pretest)
Audio Only

SUB-JECT	QUESTION # (21-36)															
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
01	4	2	4	3	4	3	1	3	2	1	5	4	1	4	1	3
02	1	4	5	5	0	0	0	0	0	0	0	0	0	0	0	0
03	1	4	2	5	4	3	5	2	2	5	3	1	1	4	4	2
04	1	4	5	5	1	0	0	0	0	0	0	0	0	0	0	0
05	4	2	4	3	4	3	2	3	2	1	5	4	0	0	0	0
06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07	4	2	4	3	4	3	1	5	2	0	0	0	0	0	0	0
08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09	4	2	2	3	4	0	0	0	0	0	0	0	0	0	0	0
10	4	2	4	2	4	3	2	3	2	1	1	0	0	0	0	0

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD A
(Post Test)
Audio Only

SUB-JECT	QUESTION # (1-20)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
01	1	5	2	1	4	1	5	3	4	4	5	4	1	4	2	4	4	3	2	1
02	3	3	3	4	5	5	5	5	2	4	3	5	3	5	2	3	1	2	1	4
03	3	3	3	1	5	5	5	5	2	4	3	5	3	5	2	3	1	2	3	4
04	3	4	3	1	1	1	3	5	5	4	3	5	3	5	2	3	1	2	3	1
05	1	5	2	1	4	1	4	2	4	4	5	3	2	4	2	3	4	3	2	5
06	1	4	2	1	4	4	5	3	4	4	5	2	1	4	2	2	4	3	3	1
07	1	5	1	1	4	1	5	3	2	4	3	5	3	5	2	3	4	1	2	5
08	3	3	3	1	5	5	5	5	2	4	3	5	3	5	2	3	4	3	3	2
09	1	2	3	1	2	3	4	5	2	4	3	5	3	5	2	3	1	2	3	5
10	3	3	3	4	4	5	1	1	2	4	3	4	1	5	2	3	1	2	3	4

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD A
(Post Test)
Audio Only

SUB-JECT	QUESTION # (21-36)															
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
01	1	1	5	5	4	3	5	0	0	0	0	0	0	0	0	0
02	4	2	4	3	4	3	0	0	0	0	0	0	0	0	0	0
03	4	2	4	3	4	3	2	3	2	1	2	4	1	4	4	5
04	4	2	4	3	1	0	0	0	0	0	0	0	0	0	0	0
05	1	4	2	5	4	3	3	1	2	5	3	2	0	0	0	0
06	5	4	2	3	0	0	0	0	0	0	0	0	0	0	0	0
07	2	1	5	4	0	0	0	0	0	0	0	0	1	4	3	5
08	4	2	4	3	4	3	2	3	2	1	2	4	1	4	0	0
09	4	2	2	3	4	3	2	3	2	1	1	2	1	4	1	2
10	1	2	4	2	4	3	2	3	2	1	1	4	1	4	4	5

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD B

(Pretest)

Video Only

SUB-JECT	QUESTION # (1-20)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
11	3	3	3	1	5	5	1	2	2	4	3	5	3	5	2	3	1	2	3	4
12	1	5	2	1	4	1	5	2	4	4	5	3	0	0	0	0	0	0	0	0
13	3	3	3	1	5	3	1	5	2	4	3	5	3	5	2	5	1	4	3	1
14	1	5	2	1	4	1	2	1	4	4	5	3	1	4	2	5	4	3	2	1
15	1	5	2	1	4	1	5	2	4	4	5	3	1	4	2	3	4	3	2	1
16	1	5	2	1	4	1	5	2	4	4	5	3	1	4	2	5	4	3	2	1
17	3	3	3	2	5	5	2	5	2	4	3	5	3	5	2	3	1	2	3	4
18	3	3	3	1	5	1	1	2	2	4	3	5	3	5	2	3	1	2	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD B
(Pretest)
Video Only

SUB-JECT	QUESTION # (21-36)															
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
11	4	2	4	2	1	3	2	3	2	2	4	4	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	4	2	2	3	4	1	1	0	0	0	0	0	0	0	0	0
14	1	1	2	5	4	0	0	0	0	0	0	0	0	0	0	0
15	1	1	2	1	4	3	5	2	0	0	0	0	0	0	0	0
16	1	4	2	5	4	1	0	0	0	0	0	0	0	0	0	0
17	4	2	1	2	4	3	4	1	2	5	5	4	1	4	1	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD B
(Post Test)
Video Only

SUB-JECT	QUESTION # (1-20)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
11	1	5	1	1	4	1	5	2	4	4	5	3	1	4	2	3	4	3	2	1
12	3	3	3	1	5	5	5	5	2	4	3	5	0	0	0	0	0	0	0	0
13	1	0	2	1	4	1	5	0	4	4	5	3	1	4	2	5	4	3	2	1
14	3	1	3	1	5	5	5	4	2	4	2	5	3	5	2	3	4	1	1	1
15	3	3	3	1	5	1	5	5	2	4	3	5	3	5	2	5	1	2	0	4
16	3	3	3	1	5	1	5	5	2	4	5	4	3	5	2	1	1	2	3	4
17	1	5	2	1	4	1	5	4	4	4	5	3	1	4	2	4	4	3	2	1
18	1	1	2	5	4	1	5	2	4	4	5	3	1	4	2	3	4	3	2	1
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD B
(Post Test)
Video Only

SUB-JECT	QUESTION # (21-36)															
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
11	1	4	5	5	4	3	1	2	2	5	3	2	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	1	4	5	5	4	0	0	0	0	0	0	0	0	0	0	0
14	4	2	5	2	4	1	2	1	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	4	2	2	2	4	3	2	1	2	1	2	4	1	4	4	5
17	1	4	5	5	4	3	5	1	1	5	3	1	0	0	0	0
18	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD C

(Pretest)

Audio - Visual

SUB-JECT	QUESTION # (1-20)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	0	0	0	0	0	0	0	0	2	4	3	5	3	5	2	3	1	2	3	4
22	1	5	2	1	4	2	2	2	1	4	5	3	1	5	2	3	4	3	0	5
23	1	5	1	1	4	1	5	2	4	5	5	3	1	4	2	3	4	3	1	1
24	3	3	3	1	3	5	1	2	2	4	3	5	3	5	2	3	1	2	3	4
25	1	5	2	1	4	2	5	2	4	4	5	3	1	4	2	3	4	3	4	1
26	1	5	2	1	4	2	5	2	4	4	5	2	1	4	2	1	4	3	2	1
27	0	0	0	0	0	0	0	0	2	4	3	5	3	5	2	3	1	2	3	4
28	0	0	0	0	0	0	0	0	2	4	3	5	3	5	2	3	1	2	3	4
29	3	3	3	1	3	5	1	5	2	4	3	5	3	5	2	3	1	2	4	3
30	1	4	2	1	4	1	5	3	4	4	5	3	0	3	2	2	0	0	0	0

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD C

(Pretest)

Audio - Visual

SUB-JECT	QUESTION # (21-36)															
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
21	4	2	4	3	5	3	2	2	2	1	2	4	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	1	4	2	5	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	1	4	2	3	4	3	5	0	2	5	2	4	0	0	0	0
26	1	4	2	1	4	2	3	2	2	0	3	0	0	0	0	0
27	4	2	4	3	4	3	2	3	2	1	5	4	1	4	1	1
28	4	2	4	3	4	3	2	3	2	1	2	4	1	4	2	5
29	4	2	4	2	4	3	2	3	2	1	5	4	1	4	4	1
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX *F* (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD C

(Post Test)

Audio - Visual

SUB-JECT	QUESTION # (1-20)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	1	2	1	3	1	1	5	2	4	2	5	3	1	4	2	3	4	3	1	5
22	3	3	3	1	5	1	3	5	2	4	1	5	3	5	3	3	1	2	3	4
23	3	3	3	1	5	1	2	1	2	4	3	4	3	5	2	3	5	2	3	4
24	1	5	3	1	4	1	5	2	4	2	3	4	1	4	2	3	4	3	1	4
25	3	3	0	0	0	5	2	5	3	4	3	4	3	5	2	3	1	2	0	5
26	3	3	3	1	5	5	1	4	2	1	5	5	3	5	2	3	1	2	3	4
27	0	0	0	0	0	0	0	0	1	4	5	1	2	4	2	3	4	3	2	1
28	0	0	0	0	0	0	0	0	4	4	5	3	1	4	2	3	4	3	2	1
29	1	5	2	1	4	5	5	1	4	4	5	3	1	4	2	2	4	3	3	1
30	3	3	3	1	5	1	5	5	2	5	1	2	2	5	3	1	0	0	0	0

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD C

(Post Test)

Audio - Visual

SUB-JECT	QUESTION # (21-36)															
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
21	3	4	2	3	4	1	2	1	2	4	1	5	0	0	0	0
22	4	2	4	4	4	3	2	3	2	2	5	0	2	0	0	0
23	4	2	3	3	4	3	0	0	0	0	0	0	0	0	0	0
24	1	4	3	5	0	0	0	0	0	0	0	0	0	0	0	0
25	4	2	4	3	4	5	2	3	0	0	0	0	0	0	0	0
26	4	2	5	3	4	3	0	0	0	0	0	0	0	0	0	0
27	1	4	2	3	4	3	5	2	2	5	3	1	1	4	4	2
28	5	4	5	5	4	3	2	5	3	5	3	1	1	5	2	2
29	1	4	2	5	4	1	3	2	1	5	2	1	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD D
(Pretest)
Control

SUB-JECT	QUESTION # (1-20)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
31	1	5	2	1	4	1	5	2	4	4	5	1	1	4	2	2	4	3	1	1
32	3	3	3	1	5	1	2	5	2	4	3	5	3	5	2	3	1	2	3	3
33	0	0	0	0	0	0	0	0	4	4	5	3	1	5	2	3	4	3	2	5
34	3	3	3	1	4	5	5	5	2	4	3	5	3	5	2	3	1	2	3	1
35	3	3	3	1	5	5	5	5	2	4	3	5	3	5	2	3	1	2	3	4
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD D
(Pretest)
Control

SUB-JECT	QUESTION # (21-36)															
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
31	1	4	2	5	4	1	0	5	2	5	3	2	1	5	4	4
32	4	2	2	2	4	3	2	2	0	0	0	0	0	0	0	0
33	1	4	3	5	4	3	5	2	2	5	3	1	1	4	1	1
34	4	2	4	2	4	3	2	3	2	1	2	4	1	4	0	5
35	4	2	1	3	4	3	2	1	2	1	5	4	1	4	3	1
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD D
(Pretest)
Control

SUB-JECT	QUESTION # (21-36)															
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
31	1	4	2	5	4	1	0	5	2	5	3	2	1	5	4	4
32	4	2	2	2	4	3	2	2	0	0	0	0	0	0	0	0
33	1	4	3	5	4	3	5	2	2	5	3	1	1	4	1	1
34	4	2	4	2	4	3	2	3	2	1	2	4	1	4	0	5
35	4	2	1	3	4	3	2	1	2	1	5	4	1	4	3	1
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD D
(Post Text)
Control

SUB-JECT	QUESTION # (1-20)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
31	3	3	3	1	5	5	1	5	2	4	3	4	3	5	2	3	1	2	3	4
32	1	5	2	1	4	1	3	3	4	4	5	3	1	4	2	3	4	3	2	3
33	3	3	3	1	5	5	3	5	2	4	3	5	3	5	2	3	1	2	3	5
34	1	5	2	1	4	1	5	2	4	4	5	3	2	4	2	4	4	3	2	1
35	1	5	2	1	4	1	5	2	4	4	5	3	1	5	2	3	4	3	2	1
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX F (CONTINUED)

INDIVIDUAL ANSWERS OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD D

(Post Test)

Control

SUB-JECT	QUESTION # (21-36)															
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
31	4	2	4	2	4	3	2	5	2	3	5	4	2	4	4	3
32	5	4	2	5	4	3	5	1	2	5	3	4	1	4	4	3
33	4	2	4	3	4	3	2	3	2	1	5	4	1	4	5	0
34	1	3	2	5	4	3	5	2	2	5	3	1	1	4	4	0
35	1	4	2	5	4	2	4	2	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX G

APPENDIX G

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD A

(Pretest)

Audio Only

QUESTION NUMBER (1-18)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
1	4 - - - - 1	1 - 4 - - -
2	- - - - 4 1	1 - 3 - 1 -
3	- 3 - - - 2	- 1 4 - - -
4	3 1 - - - 1	3 - - 1 1 -
5	1 - - 3 - 1	1 - - 1 2 1
6	4 - - - - 1	3 1 - - 1 -
7	- - - - 4 1	1 1 - 1 2 -
8	- 4 - - - 1	- 2 - - 2 1
9	1 1 - 3 - -	- 5 - - - -
10	- - - 5 - -	- - - 5 - -
11	- - 2 - 3 -	- - 5 - - -
12	- - 3 1 1 -	1 - - 2 2 -
13	2 1 2 - - -	- - 5 - - -
14	- - - 3 2 -	- - - - 5 -
15	- 5 - - - -	- 4 1 - - -
16	1 1 3 - - -	1 - 4 - - -
17	1 - - 4 - -	4 - - - - 1
18	- 1 4 - - -	- 2 - 1 1 1

*Correct Choices Are Underlined

APPENDIX G

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD A

(Pretest)

Audio Only

QUESTION NUMBER (19-36)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
19	- 4 1 - - -	- - 4 - - 1
20	2 - 1 2 - -	1 1 - 2 - 1
21	3 - - 1 - 1	- - - 4 - 1
22	- 1 - 3 - 1	- 4 - - - 1
23	- 1 - 1 2 1	- 1 - 3 - 1
24	- 1 = - 3 1	- - 4 - - 1
25	1 - - 2 - 2	- - - 4 - 1
26	- - 2 - - 3	- - 3 - - 2
27	- 1 - - 1 3	2 1 - - - 2
28	- 1 1 - - 3	- - 2 - 1 2
29	- 2 - - - 3	- 3 - - - 2
30	1 - - - 1 3	2 - - - - 3
31	1 - 1 - - 3	- - - - 2 3
32	1 - - - - 4	- - - 2 - 3
33	1 - - - - 4	1 - - - - 4
34	- - - 1 - 4	- - - 1 - 4
35	- - - 1 - 4	1 - = - - 4
36	- 1 - - - 4	- - 1 - = 4

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD A

(Post Test)

Audio Only

QUESTION NUMBER (1-18)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
1	4 - - - - -	1 - 5 - - -
2	- - - 1 3 -	- 1 4 1 - -
3	1 3 - - - -	- - 6 - - -
4	4 - - - - -	4 - - 2 - -
5	- - - 4 - -	1 1 - 1 3 -
6	3 - - 1 - -	1 - 1 - 4 -
7	- - - 1 3 -	1 - 1 1 3 -
8	- 1 3 - - -	1 - - - 5 -
9	- 1 - 3 - -	- 5 - - 1 -
10	- - - 4 - -	- - - 6 - -
11	- - 1 - 3 -	- - 6 - - -
12	- 1 1 1 1 -	- - - 1 5 -
13	2 1 1 - - -	1 - 5 - - -
14	- - - 3 1 -	- - - - 6 -
15	- 4 - - - -	- 6 - - - -
16	- 1 2 1 - -	- - 6 - - -
17	- - - 4 - -	5 - - 1 - -
18	1 - 3 - - -	- 5 1 - - -

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD A

(Post Test)

Audio Only

QUESTION NUMBER (19-36)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
19	- 3 1 - - -	1 - 5 - - -
20	2 - - - 2 -	1 1 - 3 1 -
21	2 1 - - 1 -	1 - - 5 - -
22	2 - - 2 = -	- 6 - - - -
23	- 2 - - 2 -	- 1 - 5 - -
24	= - 1 1 2 -	- 1 5 - - -
25	- - - 2 - 2	- 1 - 5 - -
26	= - 2 - - 2	- - 5 - - 1
27	- - 1 - 1 2	- 4 - - - 2
28	1 = - - - 3	- - 4 - - 2
29	- 1 - = - 3	- 4 - - - 2
30	- - - = 1 3	4 - - - - 2
31	- - 1 - = 3	2 2 - - = 2
32	- 1 - = - 3	- 1 - 3 - 2
33	1 - - - - 3	4 - - - - 2
34	- - - 1 - 3	- - - 4 - 2
35	- = 1 - - 3	1 - = 2 - 3
36	- - = - 1 3	- 1 - - 2 3

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD B

(Pretest)

Video Only

QUESTION NUMBER (1-18)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
1	4 - - - - -	- - 4 - - -
2	- - - - 4 -	- - 4 - - -
3	- 4 - - - -	- - 4 - - -
4	4 - - - - -	3 1 - - - -
5	- - - 4 - -	- - - - 4 -
6	4 - - - - -	1 - 1 - 2 -
7	- 1 - - 3 -	3 1 - - - -
8	1 3 - - - -	- 2 - - 2 -
9	- - - 4 - -	- 4 - - - -
10	- - - 4 - -	- - - 4 - -
11	- - - - 4 -	- - 4 - - -
12	- - 4 - - -	- - - - 4 -
13	3 - - - - 1	- - 4 - - -
14	- - - 3 - 1	- - - - 4 -
15	- 3 - - - 1	- 4 - - - -
16	- - 1 - 2 1	- - 3 - 1 -
17	- - - 3 - 1	4 - - - - -
18	- - 3 - - 1	- 3 - 1 - -

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD B

(Pretest)

Video Only

QUESTION NUMBER (19-36)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
19	- 3 - - - 1	- - 3 - - 1
20	3 - - - - 1	1 - - 2 - 1
21	3 - - - - 1	- - - 3 - 1
22	2 - - 1 - 1	- 3 - - - 1
23	- 3 - - - 1	1 1 - 1 - 1
24	1 - = - 2 1	- 2 1 - - 1
25	- - - 3 - 1	1 - - 2 - 1
26	1 - 1 - - 2	1 - 2 - - 1
27	- - - - 1 3	1 1 - 1 - 1
28	- 1 - - - 3	1 - 1 - - 2
29	- = - - - 4	- 2 - - - 2
30	- - - - = 4	= 1 - - 1 2
31	- - = - - 4	- - - 1 1 2
32	= - - - - 4	- - - 2 - 2
33	= - - - - 4	1 - - - - 3
34	- - - = - 4	- - - 1 - 3
35	- - - = - 4	1 - = - - 3
36	- = - - - 4	- - - - = 4

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD B
(Post Test)
Video Only

QUESTION NUMBER (1-18)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
1	4 - - - - -	- - 4 - - -
2	1 - - - 2 1	1 - 3 - - -
3	1 3 - - - -	- - 4 - - -
4	3 - - - 1 -	4 - - - - -
5	- - - 4 - -	- - - - 4 -
6	4 - - - - -	2 - - - 2 -
7	- - - - 4 -	- - - - 4 -
8	- 2 - 1 - 1	- - - 1 3 -
9	- - - 4 - -	- 4 - - - -
10	- - - 4 - -	- - - 4 - -
11	- - - - 4 -	- 1 2 - 1 -
12	- - 4 - - -	- - - 1 3 -
13	4 - - - - ..	- - 3 - - 1
14	- - - 4 - -	- - - - 3 1
15	- 4 - - - -	- 3 - - - 1
16	- - 2 1 1 -	1 - 1 - 1 1
17	- - - 4 - -	2 - - 1 - 1
18	- - 4 - - -	1 2 - - - 1

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD B

(Post Test)

Video Only

QUESTION NUMBER (19-36)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
19	- 4 - - - -	1 - 1 - - 2
20	4 - - - - -	1 - - 2 - 1
21	3 - - 1 - -	- - - 2 - 2
22	- - - 3 - 1	- 2 - - - 2
23	- = - - 3 1	- 1 - = 1 2
24	- - = - 3 1	- 2 = - - 2
25	- - - 3 - 1	- - - 2 - 2
26	- - 2 - - 2	1 - 1 - - 2
27	1 - - - 1 2	- 2 - - - 2
28	1 1 - - - 2	2 - = - - 2
29	1 1 - - - 2	- 1 - - - 3
30	= - - - 2 2	1 - - - - 3
31	- - 2 - - 2	- 1 - - = 3
32	1 1 - - - 2	- - - 1 - 3
33	= - - - - 4	1 - - - - 3
34	- - - = - 4	- - - 1 - 3
35	- - = - - 4	- - = 1 - 3
36	- - - - = 4	- - - - 1 3

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD C

(Pretest)

Audio – Visual

QUESTION NUMBER (1-18)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
1	5 - - - - -	- - 2 - - 3
2	- - - 1 4 -	- - 2 - - 3
3	1 4 - - - -	- - 2 - - 3
4	5 - - - - -	2 - - - - 3
5	- - - 5 - -	- - 2 - - 3
6	2 3 - - - -	- - - - 2 3
7	- 1 - - 4 -	2 - - - - 3
8	- 4 1 - - -	- 1 - - 1 3
9	1 - - 4 - -	- 5 - - - -
10	- - - 4 1 -	- - - 5 - -
11	- - - - 5 -	- - 5 - - -
12	- 1 4 - - -	- - - - 5 -
13	4 - - - - 1	- - 5 - - -
14	- - 1 3 1 -	- - - - 5 -
15	- 5 - - - -	- 5 - - - -
16	1 1 3 - - -	- - 5 - - -
17	- - - 4 - 1	5 - - - - -
18	- - 4 - - 1	- 5 - - - -

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD C

(Pretest)

Audio - Visual

QUESTION NUMBER (19-36)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
19	1 1 - 1 - 2	- - 4 1 - -
20	3 - - - 1 1	- - 1 4 - -
21	3 - - - - 2	- - - 4 - 1
22	- - - 3 - 2	- 4 - - - 1
23	- 3 - - - 2	- - - 4 - 1
24	1 - 1 - 1 2	- 1 3 - - 1
25	- - - 2 - 3	- - - 3 1 1
26	- 1 1 - - 3	- - 4 - - 1
27	- - 1 - 1 3	- 4 - - - 1
28	- 1 - - - 4	- 1 3 - - 1
29	- 2 - - - 3	- 4 - - - 1
30	- - - - 1 4	4 - - - - 1
31	- 1 1 - - 3	- 2 - - 2 1
32	= - - 1 - 4	- - - 4 - 1
33	= - - - - 5	3 - - - - 2
34	- - - = - 5	- - - 3 - 2
35	- - - = - 5	1 1 = 1 - 2
36	- = - - - 5	2 - - - 1 2

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD C

(Post Test)

Audio - Visual

QUESTION NUMBER (1-18)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
1	3 - - - - 2	- - 5 - - -
2	- 1 - - 2 2	- - 5 - - -
3	1 1 1 - - 2	- - 4 - - 1
4	2 - 1 - - 2	4 - - - - 1
5	1 - - 2 - 2	- - - - 4 1
6	2 - - - 1 2	3 - - - 2 -
7	- - - - 3 2	1 2 1 1 -
8	1 2 - - - 2	1 - - 1 3 -
9	1 - - 4 - -	- 4 1 - - -
10	- 2 - 3 - -	1 - - 3 1 -
11	- - 1 - 4 -	2 - 2 - 1 -
12	1 - 3 1 - -	- 1 - 2 2 -
13	4 1 - - - -	- 1 4 - - -
14	- - - 5 - -	- - - - 5 -
15	- 5 - - - -	- 3 2 - - -
16	- 1 4 - - -	1 - 4 - - -
17	- - - 5 - -	3 - - - 1 1
18	- - 5 - - -	- 4 - - - 1

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD C

(Post Test)

Audio - Visual

QUESTION NUMBER (19-36)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
19	2 **2** 1 - - -	- - **3** - - 2
20	**3** - - 1 1 -	- - - **3** 1 1
21	**3** - 1 - 1 -	- - - **4** - 1
22	- - - **5** - -	- **4** - - - 1
23	- **3** 1 - 1 -	- - 1 **2** 1 1
24	- - **2** - 3 -	- - **3** 1 - 1
25	- - - **4** - 1	- - - **4** - 1
26	2 - **2** - - 1	- - **3** - 1 1
27	- 2 1 - **1** 1	- **2** - - - 3
28	1 **2** - - 1 1	- - **2** - - 3
29	1 **2** 1 - - 1	- **1** - - - 4
30	- - - 1 **3** 1	= 1 - - - 4
31	1 1 **2** - - 1	- - - - **1** 4
32	**3** - - - 1 1	- - - = - 5
33	**2** - - - - 3	= 1 - - - 4
34	- - - **1** - 3	- - - = - 5
35	- 1 - **1** - 3	- - = - - 5
36	- **2** - - - 3	- - - - = 5

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD D

(Pretest)

Control

QUESTION NUMBER (1-18)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
1	1 - - - - 1	- - 3 - - -
2	- - - - 1 1	- - 3 - - -
3	- 1 - - - 1	- - 3 - - -
4	1 - - - - 1	3 - - - - -
5	- - - 1 - 1	- - - 1 2 -
6	1 - - - - 1	1 - - - 2 -
7	- - - - 1 1	- 1 - - 2 -
8	- 1 - - - 1	- - - - 3 -
9	- - - 2 - -	- 3 - - - -
10	- - - 2 - -	- - - 3 - -
11	- - - - 2 -	- - 3 - - -
12	1 - 1 - - -	- - - - 3 -
13	2 - - - - -	- - 3 - - -
14	- - - 1 1 -	- - - - 3 -
15	- 2 - - - -	- 3 - - - -
16	- 1 1 - - -	- - 3 - - -
17	- - - 2 - -	3 - - - - -
18	- - 2 - - -	- 3 - - - -

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD D

(Post Test)

Control

QUESTION NUMBER (1-18)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
1	3 - - - - -	- - 2 - - -
2	- - - - 3 -	- - 2 - - -
3	- 3 - - - -	- - 2 - - -
4	3 - - - - -	2 - - - - -
5	- - - 3 - -	- - - - 2 -
6	3 - - - - -	- - - - 2 -
7	- - 1 - 2 -	1 - 1 - - -
8	- 2 1 - - -	- - - - 2 -
9	- - - 3 - -	- 2 - - - -
10	- - - 3 - -	- - - 2 - -
11	- - - - 3 -	- - 2 - - -
12	- - 3 - - -	- - - 1 1 -
13	2 1 - - - -	- - 2 - - -
14	- - - 2 1 -	- - - - 2 -
15	- 3 - - - -	- 2 - - - -
16	- - 2 1 - -	- - 2 - - -
17	- - - 3 - -	2 - - - - -
18	- - 3 - - -	- 2 - - - -

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD D

(Pretest)

Control

QUESTION NUMBER (19-36)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
19	1 1 - - - -	- - 3 - - -
20	1 - - - 1 -	1 - 1 1 - -
21	2 - - - - -	- - - 3 - -
22	- - - 2 - -	- 3 - - - -
23	- 1 1 - - -	1 1 - 1 - -
24	- - - - 2 -	- 2 1 - - -
25	- - - 2 - -	- - - 3 - -
26	1 - 1 - - -	- - 3 - - -
27	- - - - 1 1	- 3 - - - -
28	- 1 - - 1 -	1 1 1 - - -
29	- 2 - - - -	- 2 - - - 1
30	- - - - 2 -	2 - - - - 1
31	- - 2 - - -	- 1 - - 1 1
32	1 1 - - - -	- - - 2 - 1
33	2 - - - - -	2 - - - - 1
34	- - - 1 1 -	- - - 2 - 1
35	1 - - 1 - -	- - 1 - - 2
36	1 - - 1 - -	1 - - - 1 1

*Correct Choices Are Underlined

APPENDIX G (CONTINUED)

SUMMARY OF SUBJECT RESPONSES PER QUESTION OF PRE- AND POST-TESTS IN READING COMPREHENSION FOR ALL TREATMENTS

METHOD D

(Post Test)

Control

QUESTION NUMBER (19-36)	TEST FORM A RESPONSES PER CHOICE* 1 2 3 4 5 Blank	TEST FORM B RESPONSES PER CHOICE* 1 2 3 4 5 Blank
19	- 3 - - - -	- - 2 - - -
20	2 - 1 - - -	- - - 1 1 -
21	2 - - - 1 -	- - - 2 - -
22	- - 1 2 - -	- 2 - - - -
23	- 3 - - - -	- - - 2 - -
24	- - - - 3 -	- 1 1 - - -
25	- - - 3 - -	- - - 2 - -
26	- 1 2 - - -	- - 2 - - -
27	- - - 1 2 -	- 2 - - - -
28	1 2 - - - -	- - 1 - 1 -
29	- 2 - - - 1	- 2 - - - -
30	- - - - 2 1	1 - 1 - - -
31	- - 2 - - 1	- - - - 2 -
32	1 - - 1 - 1	- - - 2 - -
33	2 - - - - 1	1 1 - - - -
34	- - - 2 - 1	- - - 2 - -
35	- - - 2 - 1	- - - 1 1 -
36	- - 1 - - 2	- - 1 - - 1

*Correct Choices Are Underlined

APPENDIX H

APPENDIX H

GAINS FOR THE NUMBER OF QUESTIONS ATTEMPTED IN COMPREHENSION TESTING FOR ALL TREATMENTS

TREATMENT	NUMBER ATTEMPTED		GAIN	MEAN GAIN
	PRETEST	POST TEST		
Audio Only N=10	263	304	+41	+4.1
Visual Only N= 8	203	203	0	0
Audio-Visual N=10	255	268	+13	+1.3
Control N= 5	162	170	+ 8	+0.8

APPENDIX I

APPENDIX I

GAINS IN COMPREHENSION LEVELS (% RIGHT) FOR ALL TREATMENTS

TREATMENT	PRETEST			POST TEST			GAIN
	NO. RIGHT	NO. ATTEMPTED	% RIGHT	NO. RIGHT	NO. ATTEMPTED	% RIGHT	%
Audio Only N=10	195	263	74.2	196	304	64.4	- 9.8
Visual Only N= 8	171	203	83.9	162	203	79.4	- 4.5
Audio-Visual N=10	220	255	86.3	196	268	73.2	-13.1
Control N= 5	132	162	81.5	144	170	84.7	+ 3.2

APPENDIX J

APPENDIX J

STANDARD DEVIATION OF PRE- AND POST-TEST GAIN SCORES ON READING COMPREHENSION (NUMBER CORRECT) FOR ALL TREATMENTS

METHOD A

AUDIO ONLY

N = 10

SUBJECT	SCORE (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
01	-12	-15.3	234.09
02	6	2.7	7.29
03	9	5.7	32.49
04	1	- 2.3	5.29
05	- 7	-10.3	106.09
06	7	3.7	13.69
07	- 7	-10.3	106.09
08	15	11.7	136.89
09	9	5.7	641.92
10	12	8.7	75.69
TOTAL	33	0	717.61
MEAN ($\bar{X}$)	3.3		

$$S.D. = \sqrt{\frac{717.61}{10}}$$

S.D. = 8.4712

APPENDIX J (CONTINUED)

STANDARD DEVIATION OF PRE- AND POST-TEST GAIN SCORES ON READING COMPREHENSION (NUMBER CORRECT) FOR ALL TREATMENTS

METHOD B

VIDEO ONLY

N = 8

SUBJECT	SCORE (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
11	0	1.25	1.5625
12	- 1	.25	.0625
13	1	2.25	5.0625
14	- 4	-2.75	7.5625
15	-10	-8.75	76.5625
16	3	4.25	18.0625
17	- 1	.25	.0625
18	2	3.25	10.5625
19			
20			
TOTAL	-10	0	119.5000
MEAN ($\bar{X}$)	- 1.25		

S.D. = $\sqrt{\frac{119.5}{8}}$

S.D. = 3.8649

APPENDIX J (CONTINUED)

STANDARD DEVIATION OF PRE- AND POST-TEST GAIN SCORES ON READING COMPREHENSION (NUMBER CORRECT) FOR ALL TREATMENTS

METHOD C

AUDIO-VISUAL

N = 10

SUBJECT	SCORE (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
21	- 3	- .6	.36
22	11	13.4	179.56
23	0	2.4	5.76
24	- 2	.4	.16
25	- 8	- 5.6	31.36
26	- 2	.4	.16
27	- 1	1.4	1.96
28	- 7	- 4.6	21.16
29	- 9	- 6.6	43.56
30	- 3	- .6	.36
TOTAL	-24	0	284.40
MEAN ($\bar{X}$)	- 2.4		

$$S.D. = \sqrt{\frac{284.4}{10}}$$

S.D. = 5.333

APPENDIX J (CONTINUED)

STANDARD DEVIATION OF PRE- AND POST-TEST GAIN SCORES ON READING COMPREHENSION (NUMBER CORRECT) FOR ALL TREATMENTS

METHOD D

CONTROL

N = 5

SUBJECT	SCORE (X)	$(X-\bar{X})$	$(X-\bar{X})^2$
31	3	1	1
32	6	4	16
33	10	8	64
34	- 1	- 3	9
35	- 8	-10	100
36			
37			
38			
39			
40			
TOTAL	10	0	190
MEAN ($\bar{X}$)	2		

S. D. = $\sqrt{\frac{190}{5}}$

S. D. = 6.1644

APPENDIX K

APPENDIX K

EXPERIMENTAL DESIGN OVER VARIABLES

Independent Variables			Dependent Variables	
Variable Name	Pacing Characteristic Visual Pacing Stimuli	Pacing Characteristic Audio Pacing Stimuli	Reading Variable Measure Rate	Reading Variable Measure Comprehension
Audio/ Visual Pacing	Present	Absent	Rate Gain Scores	Comprehension Gain Scores
Visual Pacing	Present	Absent	Rate Gain Scores	Comprehension Gain Scores
Audio Pacing	Present	Absent	Rate Gain Scores	Comprehension Gain Scores
Control	Present	Absent	Rate Gain Scores	Comprehension Gain Scores

APPENDIX L

APPENDIX L

FIELDS OF STUDY OF Ss ASSIGNED TO TREATMENTS

SUBJECT	SEX	COLLEGE	MAJOR	MINOR
AUDIO				
01	M	Education	Social Science	Data Management
02	F	Education	Childhood Developments	Language Arts
03	F	Education	Music Education	-
04	F	Education	Childhood Developments	Social Studies
05	F	Education	Childhood Developments	Social Studies
06	F	Education	Social Sciences	Language Arts
07	F	Education	Elementary Education	Fine Arts
08	F	Arts & Sciences	English	Theater
09	F	Arts & Sciences	Natural Resources	Human Ecology
10	M	Education	Special Education	Fine Arts

APPENDIX L (CONTINUED)

FIELDS OF STUDY OF Ss ASSIGNED TO TREATMENTS

SUBJECT	SEX	COLLEGE	MAJOR	MINOR
VISUAL				
11	M	-	-	-
12	F	Education	Elementary Education	Social Sciences
13	F	Education	Language Arts	Fine Arts
14	M	Arts & Sciences	Communications	History
15	F	-	-	-
16	F	Education	Social Studies	Language Arts
17	M	-	-	-
18	F	Education	Social Studies	Fine Arts
19	-	-	-	-
20	-	-	-	-

APPENDIX L (CONTINUED)

FIELDS OF STUDY OF Ss ASSIGNED TO TREATMENTS

SUBJECT	SEX	COLLEGE	MAJOR	MINOR
AUDIO-VISUAL				
21	F	Education	Language Arts	Social Studies
22	F	Education	Special Education	-
23	-	-	-	-
24	F	Education	Special Education	Fine Arts
25	F	Arts & Letters	English	Spanish
26	F	Education	Fine Arts	Math
27	M	-	-	-
28	F	-	-	-
29	F	Education	Social Studies	Math/Science
30	F	Arts & Letters	Art	Education

APPENDIX L (CONTINUED)

FIELDS OF STUDY OF Ss ASSIGNED TO TREATMENTS

SUBJECT	SEX	COLLEGE	MAJOR	MINOR
31	M	Business	Business Education	Data Management
32	F	Education	Language Arts	Social Studies
33	F	-	-	-
34	F	Education	Social Studies	Fine Arts
35	F	Education	English	Social Studies
36	-	-	-	-
37	-	-	-	-
38	-	-	-	-
39	-	-	-	-
40	-	-	-	-

APPENDIX M

APPENDIX M

MALE AND FEMALE SUBJECTS ASSIGNED TO INDIVIDUAL TREATMENT CONDITIONS

Treatment	Male Subjects	% of Totals Per Treatment	Female Subjects	% of Totals Per Treatment
Audio	2	20%	8	80%
Visual	2	33.3%	6	66.7%
Audio/Visual	1	10%	9	90%
Control	1	20%	4	80%
Totals	6		27	

APPENDIX N

APPENDIX N

TESTING INSTRUCTIONS READ AND VIEWED BY SUBJECTS

A. Do not turn this page of the test booklet until directed to do so.

B. There are eight reading selections in this part of the test. Read a selection through completely. Then answer the questions to the right of it. When you have completed one selection, go to the next. Keep working until you have completed all eight selections or until you are told to stop. You may look back at the material you have read, if you wish, in order to answer the questions correctly, but do not puzzle too long over any one question. Pass on to the next after a reasonable effort.

C. The arrows on this page of the test booklet are positioned the same as those on Page 5. By aligning the test booklet to the answer sheet now, it will not be necessary to realign them when you turn to Page 5. When you are directed to do so, turn this page and start reading immediately. Do not take time to fold this page under the test booklet or to re-adjust the test booklet to the answer sheet.

D. You will have twenty minutes to do this test. The first minute will be used to measure your reading rate. When the examiner tells you to begin work, turn this page and start reading immediately the selection on Page 6. At the end of one minute, the examiner will call "mark". Stop on the line you are reading. Note the number printed to the right of that line. Locate the same number on your answer sheet and circle it. Then go on with your reading immediately. Wait for the signal to turn the page.

APPENDIX O

APPENDIX O

STANDARDIZATION DATA FOR THE NELSON-DENNY READING TEST - CASES CLASSIFIED BY GRADE LEVELS

Grade	Number Tested	Per Cent of Planned Sample	Number Used for Norms	Per Cent of Planned Sample
13	3205	80.1	3023	75.6
14	2046	51.2	1914	47.9
15	1582	45.2	1436	41.0
16	1124	32.1	1124	32.1

APPENDIX P

APPENDIX P

STANDARDIZATION DATA FOR THE NELSON-DENNY READING TEST/CASES CLASSIFIED BY INSTITUTION

Institution	Total Cases Tested	Total Possible	Per Cent Tested
Junior Colleges	609	1040	58.6
Universities	3010	7540	39.9
Liberal Arts Colleges	2629	4330	60.7
Technical Schools	472	600	78.7
Teachers Colleges	1314	1490	88.2
Total	8034	1500	53.6

APPENDIX Q

APPENDIX Q

STANDARDIZATION DATA FOR THE NELSON-DENNY READING TEST - STANDARD ERROR OF MEASUREMENT DATA

Grade Level	Rate		Comprehension	
	Form A	Form B	Form A	Form B
13	25.12	25.55	5.75	6.08
14	25.85	27.23	5.04	5.81
15	24.70	24.15	4.82	5.16
16	23.50	25.90	4.76	5.14

*According to the Nelson-Denny Reading Test Examiner Manual page 27 with S.E.M. = $\sqrt{1-r_{11}}$ S.D.

APPENDIX R

APPENDIX R

STANDARDIZATION DATA FOR THE NELSON-DENNY READING TEST - RELIABILITY DATA

TEST SECTION	r	N
Comprehension	.81	110
Rate before Training	.93	74
Rate after Training	.82	78

*According to the Nelson Denny Reading Test Examiner's Manual page 26

APPENDIX S

APPENDIX S

ANALYSIS OF VARIANCE - READING RATE

$$SST = \sum_{k=1}^{K}\sum_{i=1}^{N_k} X_{ik}^2 - \frac{(\sum_{k=1}^{K}\sum_{i=1}^{N_k} X_{ik})^2}{N_{total}}$$

$$SSB = \sum_{k=1}^{K}\left[\frac{(\sum_{i=1}^{N_k} X_{ik})^2}{N_k}\right] - \frac{(\sum_{k=1}^{K}\sum_{i=1}^{N_k} X_{ik})^2}{N_{total}}$$

$$SSW = SST - SSB$$

$$\sum_{k=1}^{K}\sum_{i=1}^{N_k} X_{ik}^2 = 597346$$

$$\frac{(\sum_{k=1}^{K}\sum_{i=1}^{N_k} X_{ik})^2}{N_{total}} = \frac{3246^2}{33} = \frac{10536516}{33} = 319288.36$$

Thus SST = 597346 - 319288.36 = 278057.64

$$\sum_{k=1}^{K}\left[\frac{(\sum_{i=1}^{N_k} X_{ik})^2}{N_k}\right] = \frac{769129}{10} + \frac{484416}{8} + \frac{2102500}{10} + \frac{49729}{5} = 76912.9 + 60552 + 210250 + 9945.8 = 357660.7$$

Thus SSB = 357660.7 - 319288.36 = 38372.34

SSW = 278057.64 - 38372.34 = 239685.3

$\nu_{SSB} = K - 1 = 4 - 1 = 3$

$\nu_{SSW} = N_{total} - K =$ 29

$MSB = \frac{SSB}{\nu_{SSB}} =$ 12790.78

$MSW = \frac{SSW}{\nu_{SSW}} =$ 8265.01

$F = \frac{MSB}{MSW} =$ 1.5475819

The tabled value for a one-tailed F with $\nu_A = \nu_{SSB} = 3$, $\nu_B = \nu_{SSW} =$ 29, and $\alpha = .05$ is 2.93.

Since the obtained F does not exceed 2.93, we cannot reject H_0.

H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$.

APPENDIX T

APPENDIX T

ANALYSIS OF VARIANCE - READING COMPREHENSION

$$SST = \sum_{k=1}^{K}\sum_{i=1}^{N_k} X_{ik}^2 - \frac{(\sum_{k=1}^{K}\sum_{i=1}^{N_k} X_{ik})^2}{N_{total}}$$

$$SSB = \sum_{k=1}^{K}\left[\frac{(\sum_{i=1}^{N_k} X_{ik})^2}{N_k}\right] - \frac{(\sum_{k=1}^{K}\sum_{i=1}^{N_k} X_{ik})^2}{N_{total}}$$

$$SSW = SST - SSB$$

$$\sum_{k=1}^{K}\sum_{i=1}^{N_k} X_{ik}^2 = \quad 1592$$

$$\frac{(\sum_{k=1}^{K}\sum_{i=1}^{N_k} X_{ik})^2}{N_{total}} = \quad \frac{9^2}{33} + \frac{81}{33} = 2.455$$

Thus SST = 1592 - 2.455 = 1589.545

$$\sum_{k=1}^{K}\left[\frac{(\sum_{i=1}^{N_k} X_{ik})^2}{N_k}\right] = \quad \frac{33^2}{10} + \frac{10^2}{8} + \frac{-24^2}{10} + \frac{10^2}{5} = \frac{1089}{10} + \frac{100}{8} + \frac{576}{10} + \frac{100}{5} =$$

$$108.9 + 12.5 + 57.6 + 20 = 199$$

Thus SSB = 199 - 2.455 = 196.545

SSW = 1589.545 - 196.545 = 1393

$\nu_{SSB} = K - 1 = 4 - 1 = 3$

$\nu_{SSW} = N_{total} - K = 29$

$MSB = \frac{SSB}{\nu_{SSB}} = 65.515$

$MSW = \frac{SSW}{\nu_{SSW}} = 48.034$

$F = \frac{MSB}{MSW} = 1.3639$

The tabled value for a one-tailed F with $\nu_A = \nu_{SSB} = 3$, $\nu_B = \nu_{SSW} = 29$, and $\alpha = .05$ is 2.93. Since the obtained F does not exceed 2.93, we cannot reject H_0.

H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$.