THE EFFECTS OF TELEGRAPHIC PROSE, COMPRESSED SPEECH, AND MODALITY UPON COMPREHENSION

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Polly Wietzke Peterson

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Byron H. Van Roekel
Major professor

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ABSTRACT

THE EFFECTS OF TELEGRAPHIC PROSE, COMPRESSED SPEECH, AND MODALITY UPON COMPREHENSION

By

Polly Wietzke Peterson

Information processing and learning efficiency have become the recent focus of vehement concern and conflict in behavioral science research. As the knowledge explosion is geometrically progressing at an ever increasing rate, investigations involving new concepts and techniques designed to attempt to increase the efficiency of information input are critical from both a theoretical and practical standpoint for all levels of education.

The purpose of this study was to investigate the effects of combining telegraphic style prose, time-compressed speech, and modality upon comprehension. These three independent main effects were analysed in two 3 x 4 factorial designs and in one 1 x 4 design with $\underline{n}$ = 20 $\underline{Ss}$ in each of 28 treatment cells. A 3 x 4 x 2 ANOVA was employed to compare the listening modality with that of combined listening and reading. The subject population was 560 University of Miami students.

A 2692 word fictional passage of appropriate interest and difficulty level for university $\underline{Ss}$ was generated in traditional prose form specifically designed to maintain the essential information in

the telegraphic versions in which 20, 40, and 60% of the words were deleted. The four versions of the prose story were each then aurally tape-recorded and time-compressed into three presentation rates: 175 wpm, 275 wpm, and 400 wpm.

Subjects were assigned randomly to 24 experimental treatments in which one-half (240) of the Ss were assigned to listen to one of the 12 telegraphic prose compressed speech combinations and the other half (240) were assigned to simultaneously listen and read. Eighty additional Ss were assigned to read one of the four story versions and these data were used as the control measure.

The dependent variables were an objective comprehension test, analysed in four parts; a measure of learning efficiency; and, for the reading treatments, reading rate and reading time. The Ss completed a pre-task self-rating form on preferred mode of learning, reading rate, and conversational speech rate. Subjects assigned to the combined listening/reading treatments also completed a post-test modality form.

Since no previous research has investigated either the combined inputs of telegraphic style prose and time-compressed speech or the effects of aural, visual, and aural/visual modalities upon this combination of learning techniques, hypotheses were largely exploratory in nature. In the listening treatments, a drastic decrement in comprehension was predicted at the highest deletion levels and presentation rates. The addition of the reading modality to the listening one was expected to recapture some of this decrement in comprehension. Main concerns of the study were to attempt to

quantify where the highest learning efficiency occurred and where diminishing returns occurred on the comprehension curves for these treatments. The issues of how informationally compact telegraphic messages are and the neurological limitations on central processing abilities were also studied.

The results were highly significant for each of the three main effects: deletion level, presentation rate, and modality. Significant interaction between these main effects was found only for the learning efficiency variable (EWC). For presentation rate, comprehension was maintained at the 275 wpm speed at almost the same level as at 175 wpm for both the listening and listening/reading treatment conditions. For deletion level, comprehension for the 20% reduced version was almost as high as that for the traditional version for both listening and listening/reading at the 175 and 275 wpm rates. Comprehension was maintained significantly better than expected at the 400 wpm rate for the traditional and 20% deleted story versions for both the listening and listening/reading modalities.

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LIST OF SYMBOLS

Telegraphic Prose Deletion Level

T = traditional story version

20 = 20% deletion of words

40 = 40% deletion of words

60 = 60% deletion of words

Compressed Speech Presentation Rate

1 = 175 words per minute

2 = 275 words per minute

4 = 400 words per minute

Modality

L = listening (aural)

R = reading (visual)

L/R = listening plus reading (aural/visual)

Other

EWC = effective wpm comprehension rate

Treatment Conditions

T_1 = traditional at 175 wpm

20_1 = 20% deletion at 175 wpm

40_1 = 40% deletion at 175 wpm

60_1 = 60% deletion at 175 wpm

T_2 = traditional at 275 wpm

20_2 = 20% deletion at 275 wpm

40_2 = 40% deletion at 275 wpm

60_2 = 60% deletion at 275 wpm

T_4 = traditional at 400 wpm

20_4 = 20% deletion at 400 wpm

40_4 = 40% deletion at 400 wpm

60_4 = 60% deletion at 400 wpm

CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

Overview of the Problem

At no previous time in history have educational methodology and the process of learning been the focus of such vehement concern and conflict. A basic challenge confronting education and related professions today is definitive research on the ways individuals process information and on new means and techniques for increasing the efficiency of learning.

The rationale for the crucial need to investigate the possibilities and potentialities of increasing rates of information input and of training high speed comprehension is twofold. First, a priori evidence exists to suggest it can be done; secondly, it can without question be shown that the need for it has never been so great. The knowledge explosion is prodigious. The volume of communication is enlarging each year as is the amount of information that is being taught at every level of education. The sum of material which an individual must master just in order to attempt to keep up academically or professionally is rising astronomically and yet the methods of presenting information , with few exceptions, remain the same as those which have been used throughout the long history of pedagogy.

In this age of technological brilliance, a number of new instructional concepts and methods are now feasible which could make it possible to bridge the gap between the available knowledge needed and the time required to process it. The didactic potentialities of establishing more efficient and effective methods of information input and storage appear limitless for application to both normal and handicapped learners. For example, while the invention of Braille in 1829 was a phenomenal breakthrough for the teaching of the blind, Braille reading rates for blind high school students average 90 wpm (Ethington, 1956) as compared to 251 wpm for sighted high school level readers (Harris, 1947). Thus the blind are tremendously handicapped in information processing when compared to normal learners who are themselves inundated with too much to learn and too little time to do so with the present traditional methods for the comprehension of material.

One exciting technique now available which is particularly applicable to the blind as well as to the normal learner is that of time-compressed speech which permits the rate of speech to be increased without distortion of pitch. Research investigations involving time-compressed speech which relies on the aural channel and other new techniques such as telegraphic prose which, using mainly the visual channel, seeks to increase learning efficiency through elimination of excess verbiage are barely at the threshold despite a recent burgeoning of interest and studies in these and other innovative concepts designed to increase information input.

As illustrated here and in the review of the literature which follows, learning techniques such as time-compressed speech and telegraphic prose appear to have significant potential for learners at all levels, but further scientific investigation of the contingent variables, relationship of modalities, and limitations of information input and storage is needed to specifically define and delimit the parameters involved.

A relatively small amount of research work has been reported regarding the telegraphic concept of written prose which employs techniques to reduce verbiage in order to speed up information input. Significantly more research investigations have studied the concept of time-compressed speech. The compressed speech literature has shown that Ss can process information via the aural modality at faster than normal presentation rates of connected speech but many questions remain unanswered or in conflict. Both of these learning techniques obviously depend on the basic communication channels of listening or reading. Despite an abundance of research efforts spanning many years, listening comprehension and reading comprehension continue to plague investigators with unresolved complexities regarding teaching, rate, central nervous system limitation, individual predilection for one or the other, and the effects of simultaneous exposure to both modalities. The existing research knowledge in telegraphic prose, time-compressed speech, and listening and reading comprehension is thus necessary to this study and is reviewed in the next section of this chapter.

One of the major problems of concern of the research that has been done on telegraphic prose is that of whether the message is more

highly informationally compact; and, if so, whether it is the compaction which renders the message more difficult and causes the consistent decrement of approximately 50% in reading rate on the highly reduced telegraphic materials. Since it is known that there is a drop off in comprehension as compression rate increases above a certain point, listening to high wpm compression rates can be used as a vehicle to test whether the telegraphic messages are more informationally compact and therefore more difficult to comprehend. Since the rate of information input is controlled by the compressed speech tape, there should be a differential drop off in comprehension and significant interaction between the wpm Presentation Rate and the telegraphic Deletion Level if the telegraphic materials are more compact and if it is the compaction which causes the material to be significantly more difficult and thus more time consuming to comprehend. This question is a central issue to be answered in the study of telegraphic prose. The relationships among reading rate, listening rate, speech compression, and telegraphic compaction require study which the design of this research will permit.

No known research has investigated directly the combined learning techniques of telegraphic style prose and compressed speech. Work analysing these with reading (visual), listening (aural), and combined listening/reading (aural/visual) modalities is also nonexistent. Thus this study is seeking definitive data in relatively uncharted territory.

Although it is believed that future research and technological advances may establish more efficient ways to process information, a basic assumption upon which this research study is based is that individuals have a limited capacity for input of information. The

intent of this research investigation is to study the effects of combining compressed speech and telegraphic style prose upon comprehension and to attempt to define where diminishing returns occur in tasks involving four levels of telegraphic prose combined with three rates of time-compressed speech and three modalities of material presentation. An additional concern is to pursue the relationship between the compression of speech and the compaction of prose materials.

The purpose of this study is to provide some critically needed additional data on the interrelationships among the quantity of information, the mode of presentation, and the rate at which it is transmitted. A major goal of this investigation is to obtain some normative data on the complexities of these interrelationships through the use of two specific learning techniques, telegraphic prose and compressed speech, combined with the effects that modality (reading, listening, and listening/reading) has upon curves of comprehension.

Review of the Literature

Language Redundancy and Telegraphic Prose

The concept of developing telegraphic materials was based upon the rules of formal English grammar and on the presence of redundancy in English prose. The grammatical structure of the English language results in the inclusion of words in sentences and phrases which may be insignificant in transferring the intended meaning of the sentence. The efficiency of grammatically correct English prose forms may thus be less than perfect in relation to the rate of information processing. Both written and spoken language contain many words and word sequences which are unnecessary for comprehension of the meaning. These sequential word dependencies and

the presence of redundancy form the theory from which the telegraphic prose concept was formulated.

The fact that redundancy is present in language and that subjects are aware of this redundancy has been demonstrated in research investigations originating primarily from the area of information theory. Although this research does not relate specifically to the telegraphic concept, it provides some support for the feasibility of increasing learning efficiency by the development of telegraphic materials. Garner (1962) has written a book on redundancy in English in which he presents a review of the literature concerned with problems in obtaining a direct measurement of redundancy in written English.

The initial attempts to estimate letter redundancy were made in relation to letters which were followed by studies of word associated redundancy. Shannon (1949) found that a printed message has 50% letter redundancy; that is only 50% of the available letters were necessary for the interpretation of the message. Using a new method based on the predictability of written English, Shannon (1951) concluded that a letter is at least 75% determined by what has preceded it. Shannon's (1951) model was used by Burton and Licklider (1955) and confirmed Shannon's estimate of letters being 75% redundant. Newman and Gerstman (1952), however, used a different method and estimated redundancy at only 52% using a 10,000 word extract from the King James version of the Bible.

Chapanis (1954) studied letter redundancy by subjects' ability to replace missing letters in words. Chapanis (1954) deleted letters in six amounts ranging from 10 to 67% in both random and

regular patterns from 13 prose passages which differed widely in style and content. Subjects were able to replace approximately 90% of the missing letters on the passage which had deleted 20% of the letters in a regular pattern. At 25% deletion on a regular basis, subjects were able to replace about 70%. For deletion levels above 33%, however, the ability to restore the missing letters decreased drastically. When 50% of the letters in the text were deleted, only 10% of the text could be correctly restored. One of the most important findings was that if the redundancy in the passage was high, reconstruction was significantly easier than when the passage had a low level of redundancy. Low redundancy made the deleted letters much more difficult for the subjects to replace. This finding may be of great importance to this present study and to the other research directly investigating telegraphic prose. In 1957, Miller and Friedman replicated Chapanis' results in a similar study. In an experiment designed to explore the recall of redundant strings of letters, Miller (1961) found that in a subject population of university students, the amount of material learned increased when the letter strings were redundant, but the amount of information, measured in bits, decreased. By this information measure, Miller concluded that redundancy in the materials to be learned does not increase the efficiency of learning.

The 26 letter English alphabet makes estimates and analyses of letter redundancy much easier than those for word redundancy where practially no limiting factor exists. Because of this the redundancy of words in written English has been studied in relation to general

frequency of occurrence. The Thorndike and Lorge (1944) word count on the occurrence frequency of 30,000 words provided the initial data of word associated redundancy.

Word recognition studies have provided further knowledge regarding word associated redundancy. Using tachistoscopic exposures to words, Solomon and Howes (1951) found that the recognition threshold of the word decreases as the Thorndike-Lorge (1944) frequency of the word increases. In a similar study, Solomon and Postman (1952) controlled the frequency of nonsense words tachistoscopically and found that the more frequent the occurrence of the nonsense word, the more easily it was recalled. Pierce and Karlin (1957) and Staats (1968) provide evidence that reading rates increase as word familiarity increases.

Although the research has established that a relatively large percentage of letters can be deleted without a significant loss in intelligibility, a fairly low percentage of word deletion results in serious impairment of a subject's ability to specifically replace the missing word. Morrison and Black (1957) and Aborn, Rubenstein, and Sterling (1969) found that accuracy in replacing just one deleted word from an otherwise complete sentence was only 40 to 50%. In a related study, however, Aborn and Rubenstein (1958) found that subjects were able to replace the deleted words with a similar, contextually meaningful word even though they had great difficulty in predicting the exact deleted word.

The preceding research substantiates redundancy as an important feature of language. While subjects are able to replace missing

letters and words with appreciable accuracy because of this redundancy, more of these studies investigated the effect of deletion upon comprehension. The research suggests, however, that some redundant features may be deleted from written English without loss of comprehension which lends credence to the telegraphic concept which is based on the elimination of nonessential information.

Studies on the early development of language in young children also support the concept of learning economy through use of a telegraphic paradigm. The work of Brown and Bellugi (1964), Carroll (1961), and Leopold (1961) establishes that in early acquisition of syntax, children speak in telegraphic style using mainly essential high information nouns and verbs. Although most modifying words are deleted, such early stages of language development are comprehendable. In the initial generation of language, children use single words to express whole sentences or phrases (Carroll, 1961). In the second half of the second year, two word structures are heard with syntactical constructions involving three or more words occurring toward the end of the second year of life. During the third year a child induces latent structure of language from the speech to which he is exposed (Brown and Bellugi, 1964). Thus while one of the main characteristics of the speech of very young children is its telegraphic nature, children are at the same time learning the structure of language through its distinctive features and redundancy. Brown and Bellugi's work (1964) not only provided significant breakthrough knowledge regarding the acquisition of language but related as well to the feasibility of the telegraphic concept as illustrated in the following quotation:

> We adults sometimes operate under a constraint on length and the curious fact is that the English we produce in these circumstances bears a formal resemblance to the English produced by two-year-old children. When words cost money there is a premium on brevity or to put it otherwise, a constraint on length. The result is "telegraphic" English and telegraphic English is an English of nouns, verbs, and adjectives. . . .We make the same kind of telegraphic reduction when time or fatigue constrain us to be brief, as witness any set of notes taken at a fast moving lecture.
>
> A telegraphic transformation of English generally communicates very well. It does so because it retains the high-information words and drops the low-information words.

The concept of telegraphic prose which, as noted previously, is based on the deletion of excess verbiage to increase learning efficiency has only recently begun to be investigated. Initial research on the feasibility of this concept was undertaken by Martin and Alonso (1967) in a project utilizing telegraphic prose in Braille as a method to increase information processing in visually handicapped students.

A total of 210 Braille readers were assigned to read one of three versions of material constructed in traditional form, medium telegraphic form, and high telegraphic form. Many problems of measurement exist in designing deletion schemes for existing meaningful prose material. A model developed by Dawes (1964), however, makes it feasible to hold the essential information constant in varying versions of passages specifically designed to use set relations for measurement. Martin and Alonso (1967) employed Dawes' method to construct the prose materials and test measures in this investigation.

The constructed story concerned two warring African nations. Martin and Alonso's (1967) traditional story version consisted of 1,620 words and was written in a typical English prose style.

The medium telegraphic version, containing 947 words, used traditional sentence form and reduced the original material 42%. The high telegraphic version contained only 455 words which was a 72% reduction of the original and was written in outline form. All reductions were based on Dawes' (1964) model so that the set relations or essential information were maintained in all three versions. As determined by the Dale-Chall readability formula, this original version was found to be appropriate for average seventh and eight grade readers.

The study imposed three recall conditions and analyses were done on comprehension, reading rate, and reading time. Learning and retention of the essential information on the telegraphic versions compared positively with the traditional version on almost all measures. Reading rate, however, decreased by almost 50% for the braille readers assigned to the highly telegraphic version of the story. It had been assumed that the same reading speed would be maintained for the telegraphic as for the traditional materials. To account for this unexpected finding, it was postulated that:

1. The unfamiliar format and style may have caused readers to reduce their normal reading rate and,

2. The compactness of information may have caused students to reduce speed in order to process the highly informational stimulus. The authors felt that the first postulate was the more plausible of the two explanations.

It had also been assumed that the descriptive narrative and extraneous detail of the traditional passage would not be recalled as it was not essential for complete understanding of the story. This assumption also proved to be wrong. On the delayed recall objective

test the results suggested that this extraneous information was contextually helpful in processing and storing the essential information of the story.

A major problem of telegraphic style prose was noted by the authors to be the absence of any systematic rules or methods by which to delete nonessential words from traditional materials. The results of the study in general, however, were interpreted as supporting the feasibility of the telegraphic concept.

Additional research on the telegraphic concept has been completed recently by Martin and Herndon (1971), Martin and Hope (1972), Pantalion (1972), and Sheffield (1972). The purpose of the Martin and Herndon (1971) study was to partially replicate Martin and Alonso's (1967) work to try to establish on a non-visually handicapped population the cause of the significant decrease in reading rate for highly reduced telegraphic materials. Sixty university undergraduate and graduate subjects were assigned to either read or to listen to the same seventh grade difficulty level materials about two warring African nations that were used in Martin and Alonso's (1967) study. Aurally presented messages force the student to process the information at a constant input rate rather than allowing voluntary change in input rate as reading does. It was reasoned therefore that if telegraphic materials are more difficult due to unique style or compactness, comprehension should drop for the listening condition. The results of this study found that reading rates dropped significantly on the high telegraphic materials, but comprehension was maintained at equivalent levels for both the reading and listening treatments. Since the aural tape presentation of the materials was

at a slow 120 wpm rate, this was stated as the reason comprehension was as high as on the visual telegraphic messages. No interaction was found between the modality and material format main effects which led the authors to suggest that comprehension of telegraphic materials is independent of the presentation mode.

In another study, Martin and Herndon (1971) investigated the base levels of acceptable deletion of words in telegraphic materials. From the results, the authors concluded that 10 percent of the words in prose reduction can be randomly deleted without significantly affecting reading rate or comprehension. No solutions regarding an objective method for deleting words from existing materials was considered, however.

Martin and Hope (1972) designed a study to test the two hypotheses formulated to account for the significant decrement in reading rate on highly telegraphic material in the Martin and Alonso (1967) study with Braille readers. These authors tested the two hypotheses with undergraduate university students. Tape recordings to provide a constant input rate were used to present the material aurally to one group of students while another student group read the same material at their own individual speeds. Three forms (Traditional, Medium Telegraphic, and High Telegraphic) of each story were constructed. The aural and the written or visual versions were identical for each form. Results of this were interpreted to support their previous hypothesis (1967) which speculated that in order to process extremely compact information effectively, students reduce their wpm reading speed. No support was found for the hypothesis that the reduction in reading rate was caused by the unique style of

telegraphic prose and that practice would increase reading speed. The major finding of significance in Martin and Hope's study, however, was that both actual total reading and listening time for the High-Telegraphic versions was almost 70% less than total time spent on the Traditional versions. The added finding that comprehension on the High-Telegraphic versions dropped at an average of less than 10% when compared to comprehension on the Traditional versions gives substantial support to the efficiency of the telegraphic prose concept.

One other interesting result of the experiment was that the aural mode of presentation produced significantly lower comprehension scores for all three traditional and telegraphic versions despite a slower wpm presentation time (average recording rate equaled 128 wpm) than average reading or speaking rates.

In another study using undergraduate students, Pantalion (1972) also found a significant saving of reading time in medium to high (40 to 50%) telegraphic passages in comparison to the traditional version. He also established the efficacy of a method termed SHORT (Subjective Hierarchy of Relevant Terms) which provides a basis for the generation of different deletion levels for sentences. This method is based upon subject ranking of words within each sentence on the basis of their functional communication value.

Sheffield (1972) examined the effects of subjectively reduced telegraphic passages upon comprehension, reading rate, and reading time in a study which used both blind and sighted sixth grade level subjects. Results of this study indicated that telegraphic reduction of 30% was possible without loss of comprehension or increase of reading time. Blind subjects were able to process the 50% reduced

version better than the sighted students which implies that there is a difference in the way blind and sighted readers process materials.

All of the studies on telegraphic prose have resulted in findings contradictory to those on which Dawes' set relations model is based. Dawes concluded that the extraneous material found in traditional prose would result in more overgeneralization or disjunctive errors due to information overload and that these errors would be reduced on the telegraphic passages. The opposite result was found in all of the previously cited telegraphic studies. It appears that the extraneous detail in traditional style prose may benefit the reader's recall and storage of the essential facts.

In summary, the concept of telegraphic prose appears to offer a means to facilitate the speed of information processing. Further research is needed to clarify its ideal efficiency in format or percent reduction and in modalities of presentation. Efficiency is, of course, defined as a measurement of the interrelationship between comprehension and the rate of information input. In order to attempt to increase information input, the telegraphic concept involves the manipulation of the basic structure of the stimulus. In addition to the pioneering work being done on the telegraphic concept, other research designed toward facilitating information input rates has been focused primarily on time-compressed speech and speed reading. Both of these techniques attempt to achieve greater efficiency by increasing the word per minute processing rate for the presented material. Time-compressed speech achieves the increased efficiency by manipulating the speed (aural) of the stimulus. Speed reading does so by altering

the individual's response rate (visual) to the stimulus. Reviews of pertinent literature regarding these two methods are presented in the following two sections.

Time-Compressed Speech

The advent of modern communication media has brought growing awareness of the educational importance of aural communication and listening skills. Only recently, however, has it become possible to gain effective control over rate of communication between speakers and listeners. Methods initially developed at the University of Illinois by Fairbanks, Everitt, and Jaeger (1954) have made it possible to increase the word rate of recorded speech without affecting intelligibility through distortion of pitch or voice quality. Significant research interest in speech rate has been generated by the availability of the Fairbanks method. Studies by a number of researchers (Orr, 1966; Sticht, 1968; Foulke, 1970) have shown experimentally that speech rate can be increased, without significant loss in comprehension, to about 275 wpm as compared to the average speaking rate of 125-175 wpm.

Great interest by educators and researchers in rate-controlled and time-compressed speech has developed. As a result, the Center for Rate-Controlled Recordings was established at the University of Louisville following the first Louisville Conference on Time-Compressed Speech in 1966. Two volumes produced from the 1966 and 1969 Louisville Conferences respectively, are essential sources of information to the total research literature on time-compressed speech (1967, 1971). A three volume anthology covering the entire history,

methods, research, and applications of compressed speech, edited by Duker is to be published in early 1974 (in press).

In a review of the research on time-compressed speech, Foulke and Sticht (1969) explain the technical procedure of producing accelerated speech tapes:

> The electromechanical process for accelerating speech is analogous to cutting out and discarding small, periodic samples of tape and splicing the remainder together to form a continuous tape. This process depends upon the fact that the duration of most speech elements is greater than actually needed for perception of the speech sounds. Due to this temporal redundancy, a considerable portion of a word may be deleted without totally impairing its intelligibility. Because the acceleration process reduces the amount of time required to present a message, the message is said to be time-compressed.

It really should not be too surprising that faster than normal speech rates are possible to comprehend since it has long been known that the human mind is capable of processing information at a more rapid rate than the human speech organs are capable of producing. According to Nichols (1972), one reason for poor listening is that, paradoxically, individuals think too fast. His work notes that although the average person talks at a speed of 125 wpm, he thinks at up to four times that rate. This fact can be used to explain the "mind-wandering" phenomenon, described by Cohen (1956), which constitutes one of the significant problems in effective and efficient listening comprehension.

Although it has been established that time-compressed speech is an exciting and workable learning technique, many controversies exist regarding the effects of training and practice, the limits to which speech can be compressed for effective learning, and its use with other modes of learning.

Many researchers have shown that compression is effective for information processing until the normal speech rate is doubled. Beyond 50% compression (275-300 wpm), however, comprehension suffers severely (Heise, 1971). In terms of learning efficiency, however, even though higher comprehension scores may be made at slower wpm rates, more efficient learning may take place at faster wpm rates (Woodcock, 1971). The two factors which determine the efficiency of compressed speech are intelligibility and comprehension. Foulke and Sticht (1967) studied the effect of compression on listening comprehension and word intelligibility. It was found that both comprehension and intelligibility decreased as the compression was increased but that comprehension declined significantly more rapidly than intelligibility. Sticht (1970) used 280 army inductees in a study designed to evaluate the relationship of mental ability and the capacity to comprehend compressed speech tapes of varying wpm speeds. Sticht concluded that "the comprehension of fast rates of speech appears to be a function of the information capacities of the listener." This investigation, as well as a number of other studies, has established that the processing capacity of the individual learner and not the fidelity of the time compressed stimulus determines the ceiling or comprehension of fast rates of speech. The problem of increasing information input beyond this ceiling is thus due primarily to human, rather than equipment, shortcomings. As Carver (1973) noted in a very recent article, compressed speech would be most beneficial and efficient when and if it becomes possible and practical for the individual to be able to control the input rate. Carver, who has also completed considerable research

on reading, even suggests that "further research on time-compressed speech may be paving the way toward the day when technical advances in the auditory presentation of verbal information make reading, and the teaching of reading obsolete."

The nature of the relationship between the rate of compressed speech and comprehension is critical from both the theoretical and practical standpoint. Some amount of processing time, which must vary according to individual ability, is necessary for encoding transduction of the material. In normal speech (125-175 wpm) there is more than enough time to perfect all of the necessary operations on all of this incoming material to make it fully understandable (Overmann, 1971). Often there is extra, unnecessary time which causes the individual's attention to wander and lose information as a result. As the wpm rate is increased, however, a rate is ultimately reached at which there is no surplus time in which the individual can perform the needed storage operations and comprehension then declines rapidly. Miller (1953, 1956) used a concept of a communication channel with finite capacity to explain the input threshold. If more information is presented than an individual can absorb, some of the information will be lost. Miller (1953, 1956) emphasized that compressed speech complicates the transduction process all the more. In the language of the computer storage model, fewer cues are present in the compressed word to assist the recognition process which demands that more items in the individual's store of vocabulary must be rejected before the correct match is discovered. The compression process essentially reduces the redundancy of the individual words in the message that is to be comprehended. Thus, as available

processing time decreases with increasing word rate, the growth in word uncertainty increases the demand for processing time. This explanation that decreased redundancy creates confusion and results in additional required processing time should be equally as applicable to telegraphic prose as to compressed speech. In telegraphic prose the visual rather than the aural stimulus is altered which reduces the redundancy and therefore, the repertoire of cues present to aid in both the word identification and the comprehension process. After the capacity of a channel is reached, comprehension should begin to decline, and the slope of this line should become gradually steeper as the rate of compression (or the level of deletion in telegraphic prose if a constant input rate were maintained) is increased. Foulke (1968) reviewed the compressed speech literature and found that the evidence offers tentative support for this hypothesis.

In a study using 140 undergraduate students, Overmann (1971) attempted to further investigate the question of comprehension decrement occurring from lack of enough processing time. An experiment was performed using both time-compressed tapes and tapes in which the compressed sentences were followed by pause time (which restored the tape time to the original normal speech production time). The author found that this additional processing time resulted in significant improvement in comprehension for the 250 and 325 wpm levels, but at the fastest 400 rate comprehension still remained below that of the control group which listened to the same material at a normal, uncompressed rate.

Most of the research in compressed speech has been completed with subject populations who have had no previous training in

listening to compressed speech. Since any exposure to speech rates of 200 wpm or over is rare in normal speaking environments, it would seem logical that practice or training sessions in listening to varying compression rates should result in improving a listener's ability to comprehend compressed materials. Studies investigating the effects of practice, however, have resulted in conflicting findings.

Blind students, of course, depend almost solely on the aural channel for the processing of information so it would be expected that their capacity for aural input rates would be higher than that of most sighted normal learners. Blind students, for example, are known to have trained themselves to listen with good comprehension to normally recorded tapes or records played at a faster than recorded rate which to the untrained listener would sound like Donald Duck. Foulke (1964), however, evaluated the efficiency of four different training methods with blind subjects and found that none of the four yielded any significant improvement in the comprehension of compressed speech. Using sighted subjects Voor and Miller (1965) found that practice improved comprehension in the initial warm-up stage of adjustment to listening to compressed speech but not thereafter. In a study using 700 students including mentally retarded and culturally deprived in grade levels from three to six, Woodcock (1971) found that after the initial two or three exposures to compressed speech recordings, continued practice produced little improvement in performance. Orr and Friedman (1967), by contrast, found a significant practice effect on the comprehension of compressed speech in work done with normal learners at the American Institutes for Research. According to Orr (1971), much of

the conflict in research findings on the effects of practice in compressed speech may center around the problem of measurement. Some of the shortcomings of measurement which Orr cited and cautioned other researchers to be aware of were the difficulties in constructing valid and reliable multiple choice tests, accounting for prior knowledge of the listener, and the actual definition of comprehension.

Sticht (1971) reviewed all of the research on the effects of listening to compressed materials twice in immediate succession. Although the compressed materials could be presented twice in the same amount of time required to listen to the uncompressed message once, a number of studies have found that, although comprehension improves when the compressed message is repeated, it does not improve over that obtained in a single listening session to the uncompressed messages. Sticht (1971) concluded the following on the basis of his data and that of others:

> It appears as though the technique of trading time for information has not resulted in more information being processed by the listener for short-term retention. Most significantly, this has been true for materials compressed to speech rates of 275-300 wpm for which listening "efficiency", that is, the amount learned per unit of listening times has actually been higher than obtained with "normal" materials. Thus, the implication that, because of improved listening efficiency more information can be learned in a unit of time with moderate compression, has yet to be substantiated.

Sticht (1971) cautioned, however, that all of the studies on which his conclusion was based used the time saved only to immediately repeat, in a single setting, the compressed message. Thus, a short break or even substantial delay in repeating the material might be more beneficial. Also, the savings of time could be used by the listener to learn something entirely different or by the

instructor to teach another group of listeners.

A number of studies in the compressed speech literature have investigated the effects of adding a visual stimulus to the compressed aural message. Woodcock (1971), in one of his interrelated compressed speech studies, found that listening plus viewing of slides was a more effective and efficient medium for learning than listening alone, and in this elementary school level population which included mental retardates, listening alone was better than reading as many of the subjects had not yet become good readers. Travers (1964) presented passages through compressed speech listening alone, reading alone, and combined listening and reading. At the lower compression rates no advantage was found for the audio-visual presentation, but at higher speeds the two combined modalities proved to be superior. Parker (1971) sought to find an efficient method of learning for junior college students of varying aptitudes. On tasks involving both listening alone to compressed speech of three different speeds and simultaneously listening and reading, Parker found that combined listening plus reading resulted in significantly better comprehension for all aptitude levels hearing compressed speech. For the groups hearing normal rate recordings, the combined audio-visual presentation was superior for those of average aptitude, but not for high or low aptitude students. Except for the groups with low aptitude, students' comprehension was maintained without significant loss up to the one-half or 50 percent compression rate for the simultaneous listening plus reading presentations. Comprehension decreased significantly at 50% compression (275-300 wpm) for the listening only treatment which led Parker (1971) to conclude that the

combined modalities should be used if the compression rate is 50% or above.

Walker (1971) designed a study using compressed speech as one of two techniques tested to attempt to increase reading rates in 77 gifted sixth-grade students. All of the students had obtained a score of 130 or more on a Weschler Intelligence Scale for Children (WISC) or on a Stanford-Binet in order to qualify for the special class. Walker noted that "these students will most likely continue their formal education after high school and will probably have the greatest need to increase their rate of reading because of the demands placed upon them." On the basis of sex and a pretest of reading rate the students were assigned randomly to a compressed speech, self-improvement, or control group. The experimental treatments were taught and practiced daily for six weeks. The compressed speech group began practice at a compression level assigned according to the pretest reading rate. Compression levels were increased during the six week period in which the students simultaneously read and listened daily. Results indicated that compressed speech was valuable in helping children increase their reading rate and this was the first known study which individualized the tapes in accordance with the initial reading rates. The major caution was the extreme expense of providing compressed speech materials in a public school setting.

Significantly more research has been completed on compressed speech than on telegraphic prose. Although much interest has been generated in compressed speech and it has been established as a

feasible learning technique, the preceding review has illustrated that a myriad of research questions regarding it remain unanswered or in conflict.

Listening and Reading Comprehension

As the foundation of the compressed speech and telegraphic prose techniques for the processing of information, listening and reading comprehension have been basic to the literature reviews presented in the two preceding sections of this chapter. An additional related review and summary of the literature on the relationship of listening and reading will complete the necessary background of knowledge pertinent to this study.

A number of excellent evaluations of research are available on the relationship between reading and listening (Berg, 1955; Witty and Sizemore, 1958, 1959). It is agreed that reading and listening are closely related receptive communication skills which are related to such factors as intelligence and age. Because of measurement and definition problems, however, many contradictions continue in the research despite a plethora of investigations.

An annotated bibliography on listening by Duker (1964) notes 880 articles on listening and many hundreds more have appeared since that time. Although listening is far less emphasized at all levels of education than reading, writing, and speaking, it is the skill used to greater extent than any of the other communication skills. Markgraf (1957) and Witty (1966) have demonstrated that well over 50% of the time that a child is awake is devoted to listening activity of some kind.

The answer concerning the relative effectiveness of reading and listening for learning purposes has been sought in many studies for almost a century. Seymour (1965) found that college freshmen enrolled in a one semester course in listening showed a significant increase in reading ability. Other studies have shown no effects on one modality by training in the other.

Much of the literature stresses the advantages of reading or the visual modality over listening or the aural modality. Foulke (1969) summarized these advantages by noting that the visual reader can control his own rate, can preview or retrace with no difficulty, can scan and skim; and, uses the whole organizational structure of sentences, paragraphs, and headings to assist comprehension. The listener, or a blind student who is accomplishing the process of reading by listening can do none of the above through the auditory channel. A blind individual who must read by listening is dependent on the oral reader's rate, pitch, pause durations and emphasis, for cues for understanding the message.

It is widely accepted that efficient readers listen to or hear at either a conscious or subconscious level the material being read visually. This appears to be an important part of processing and storing the information read. The listening modality lacks this distinctive advantage as the listener does not receive comparable visual cues.

Staats' (1968) work in reading indicates that information storage is increased if, after reading, the material is repeated by the reader to himself either vocally or subvocally. Vernon (1937) stressed that

in reading "some type of auditory or vocal process is always reported." Although reading courses generally attempt to break the subvocalization barrier, there is good evidence that even fluent readers use silent speech (or in a sense listening to themselves) especially when dealing with difficult text. The view that silent reading is a motor-based speech activity appears to be one of credence (Edfeldt, 1960).

No means to allow the listener to control and change at will the auditory input rate is yet available. That good readers should be flexible in adjusting reading rate according to the difficulty of the material and the reading purpose, however, has long been accepted and emphasized in the field of reading. Yet remarkably little evidence exists to support that readers actually do alter speed in relation to reading purposes and materials. A number of studies have shown that even fluent readers alter reading speeds only to a small degree and tend to be rather inflexible (Levin, 1968; Rankin, 1970; Rankin and Hess, 1970). A recent study by McConkie and others (1973) increased the flexibility of university level readers through monetary rewards based on reading time and comprehension on texts of varying difficulty.

Redundancy was discussed as an important factor in both listening and reading in the preceding reviews of telegraphic prose and compressed speech. The psycholinguistic approach to reading provides additional support for the essential role that redundancy has in aiding the fluent reader to identify essential features of letters and words and in facilitating comprehension (Smith, 1971).

Another controversy exists regarding the benefits of simultaneous listening and reading. While many different kinds of research

studies have found that comprehension is increased by the joint use of the two modalities, some researchers believe that this is caused only because the individual can then select and rely upon the one modality to which he is most adapted. Broadbent (1958) and Jester (1966) contend that only a single modality channel, and not two, can be used efficiently at any given time.

The final relationship between listening and reading that requires consideration is that of rate or capacity of input speed. As noted in the review of compressed speech, comprehension falls rapidly above rates of 250-300 wpm. Despite claims to the contrary, the average university student does not read over 300 wpm (Kolers, 1972) although many readers can, with good comprehension, read at 400 to 500 wpm. The added cues and advantages of the visual mode evidently allow greater capacity processing levels. Miller (1956) explains this by the "chunking" concept which is based on the reader dealing with words in units or chunks rather than singly. Since a listener is much less able to do this, the upper limits on listening rate may be significantly less flexible than those for reading.

While reading and listening rates can both be increased according to the individual capacities of the learner, the claims of some of the high speed reading advocates appear outrageous in the face of knowledge about human information processing capabilities.

Speed reading is very likely predicated on the same principle as the telegraphic concept of cueing in on key words of high informational value. Despite claims by Evelyn Wood (Gallup, 1964) and other advocates of high speed reading that word per minute rates of 1,000 and above without

significant loss of comprehension are entirely reasonable, recent research presents substantial findings to refute these. Most reading researchers agree that rates above 800-1,000 are physiologically impossible. Taylor (1962) found that the average individual reading rate increased from 80 wpm in first grade to 280 wpm in college. Depending on ability and the difficulty of the material much reading research supports that 150-300 wpm rates are the average for readers. After studying reading research and conducting speed reading experiments Carver (1972) has concluded that speed reading is "5% sense and 95% nonsense." His evidence suggests that increasing reading speeds adversely affects comprehension. When the limits of speed are approached he has documented a decrement in quality as well as quantity of information input. One very recent experiment completed by Carver (1972) showed a test of comprehension used for a speed reading course was insensitive to major losses in comprehension. In the research, one group of students took the comprehension test over the material without previously reading the selection. Average scores were 57% comprehension for this group while comprehension scores for the group of speed readers who had read the selection averaged at 68%. Such findings suggest significant fallacy in the means commonly used by speed reading advocates to measure comprehension or effective wpm reading rate and the need for careful analysis of design and measurement in experiments dealing with information input.

A current advertisement on national television for the Evelyn Wood Reading Dynamics program features a twelve year old boy posed with a book saying, "I read about 4,000 words per minute. I read this book in less than an hour and I read every word and every comma."

By contrast, a recent report on reading from the National Assessment of Educational Progress project evaluated reading rate and comprehension of 7,850 readers at four age levels by region, sex, race, parental education, and community size and type. Only 17 of these readers read faster than 750 wpm while 149 read less than 50 wpm. Average rates were 100-299 wpm.

Both high speed reading and compressed speech of too high a degree fail to consider the significance of the internal sampling and reconstruction process a good reader/listener goes through to input and preserve coherently the message he is receiving. Kolers (1972) has done recent studies involving unusual presentations on printed letters, words, and sentences. His findings show that a good reader proceeds by generating internal grammatical messages based on clues in the text and on a kind of reconstruction process that is similar to what one does in speaking. Kolers' (1972) work emphasizes the continuing investigative challenge of unanswered questions in the way humans process information.

Hypotheses

The primary purpose of the present study was to determine the effects of telegraphic prose, compressed speech, and modality upon learning efficiency and comprehension. The efficiency measure was designed for this particular study and was calculated as a function of total number of words in the traditional story version divided by the time required for task completion multiplied by the percent of comprehension $\left(\frac{2{,}692 \text{ words}}{\text{Reading or tape time}} \times \%\ \text{correct} = \text{EWC}\right)$. This measure was

termed effective word per minute comprehension rate to be designated as EWC.

The rationale for the objective of this EWC measure is explained as follows: The experimental alteration of the stimulus material (traditional written prose version) explores the possibility of increasing the student's learning efficiency relative to time. It is postulated that some combination of compression (Presentation Rate) and word reduction (Deletion Level) will enable students to comprehend the information contained in the traditional version in a shorter unit of time. Thus, a means to measure this must not only consider time to task completion and comprehension but amount of information processed as extrapolated back to the traditional version. Effective word per minute comprehension (EWC) will be used to denote the word per minute rate of comprehension under experimental conditions and is to be differentiated from word per minute reading rate which refers only to the actual wpm rate based on time required for task completion without taking comprehension into account.

Example:

> A 1000 word traditional prose story is reduced to 750 highly informational words. It is presented aurally at 300 wpm taking a time unit of 2.5 minutes (750wpm ÷ 300 wpm). The subject (S) scores 80% comprehension on the test over the essential information. His effective word per minute comprehension would be:

$$\frac{1000 \text{ words}}{2.5 \text{ minutes}} \times .80 = 320 \text{ EWC}$$

Since no previous research has investigated either the combined inputs of telegraphic style prose and time-compressed speech or the effects of visual, aural, and aural/visual modalities upon this

combination of learning techniques, the present study was largely exploratory in nature. The lack of comparative data limited the predictions that reasonably could be made. On the basis of other research work completed in the separate techniques of telegraphic prose and compressed speech and on studies of listening and reading comprehension as well, the following list notes the exploratory hypotheses which were advanced and the variables that were investigated.

1. A differential drop off in comprehension will occur as a function of increasing the Presentation Rate (compressed speech tapes) and the Level of Deletion or compaction (telegraphic prose).

2. The effective word per minute comprehension rate (EWC) will be highest at the 275 wpm presentation rate for the Traditional and 20% deleted material. EWC will fall on the 40 and 60% reduced material at 275 wpm and for all story versions at the fastest 400 wpm rates.

3. Presentation of the material at the highest reduction level and fastest presentation rate will result in significant decrements in comprehension. It is assumed that at these levels the information input rate will exceed the processing capacity of the learner.

4. The combined Listening/Reading Modalities will enhance comprehension compared with the single listening modality or reading modality. If so, whether this is a result of the efficient use of both modalities or the selective use of one will be studied.

5. Reliance by the majority of Ss on the Reading Modality alone is predicted for the 40 and 60% telegraphic versions at the 275 and 400 wpm rates for the combined Listening/Reading Modalities. The aural tapes will be extremely difficult to comprehend for these treatments.

An additional exploratory aspect of the study was the comparison of all experimental treatments to determine the most ideal combinations of telegraphic prose, compressed speech, and modality for learning efficiency.

Summary

The need for more knowledge regarding learning efficiency and the processing of information is great. Learning techniques such as time-compressed speech and telegraphic prose offer innovative means to increase learning efficiency but the contingent variables, relationship of communication channels or modalities, and limitations of information input and storage present unresolved complexities and controversies which require investigation. The specific research problem and the pertinent areas of related research have been the subject of this chapter. The methods and procedures of investigation used in the research design are reported in Chapter II. The statistical results of the experimental treatment conditions are analysed in Chapter III while the discussion of the results and general conclusions are presented in Chapters IV and V, respectively.

CHAPTER II

METHODS AND PROCEDURES

Subjects

The Ss for this study were 560 undergraduate and graduate students in the Schools of Education, Psychology, and Architecture at the University of Miami. A total of 480 Ss were assigned randomly to each of the 24 Listening and Listening/Reading treatments with 20 Ss in each group. Table 2.1 presents the number of males, females, graduates, major fields of study, and minority populations in each of these 20 treatment conditions as a result of random assignment. All males, graduates, and Ss with Spanish as a first language were randomized as separate populations. Participation was a class requirement for approximately one-half of these students and was on a volunteer basis for the other 50%. All of these Ss were given appointment hours outside of class time for this project.

The additional 80 Ss for the four control Reading treatments were enrolled in four sections of a developmental reading course in the Department of Educational Psychology. On the basis of their individual scores on the Nelson-Denny Reading Test, the students enrolled in this course were judged to be a representative sample of the undergraduate population. The developmental reading classes included students in class rank from freshman to senior whose purpose in

TABLE 2.1

Number of Male, Female, Graduate, Cuban, Black, Physical Education and Architecture Ss Randomly Assigned to the Twenty-Four Treatment Conditions*

Treatment Conditions		Total		Grad		Cuban (Span.)		Black		Phys Ed		Arch	
Listening		F	M	F	M	F	M	F	M	F	M	F	M
175	T	14	6	1		4		1			1		3
	20	14	6	1		2		1			1		
	40	15	5	2	1	1		2			3		
	60	16	4		1	2					2	1	
275	T	15	5	2			1				1		
	20	16	4	4	1			1	1				
	40	14	6	1				2			1		
	60	13	7	2				1	1	1	3		
400	T	14	6	1	2	1				0	0		1
	20	13	7	3	1	1	1			0	0		2
	40	14	6	2						1	1		1
	60	12	8	1						1	1		3
Listening/Reading													
175	T	15	5	1			1			1			2
	20	14	6	1		4		1					3
	40	15	5	2	0	5		2					2
	60	15	5	0	1	1	1						
275	T	16	4	1	0	1	1				2		
	20	15	5	1	1	0	0	1	1				
	40	15	5	1	0	1	0						1
	60	14	6	1	0	3		1			1		2
400	T	16	4	2	1	1		1					
	20	14	6	2	1	1			1		2		
	40	14	6	2			3	1			1	1	2
	60	11	9	1		1	2	1			1		5
Total		344	136	35	10	29	10	16	4	4	21	2	27

*The remaining Ss in each group were undergraduate Psychology or Education majors.

taking the course ranged from specific remediation in reading vocabulary or study skills to development of increased rate and flexibility in preparation for graduate school admission. Of these 80 control Ss, 59% were male as compared to 28% males in the 480 Ss for the experimental treatment conditions. Participation in this study was a class requirement and was accomplished during the regular class period in each of the four sections of the course.

Materials

Basic Structure of the Four Story Versions

Traditional Story

The basic material for all 28 treatments was a fictional prose composition authored in 1972 by a technical writer specifically for use by the Texas A&M Research Foundation. This story was created as part of a federally funded (Bureau for the Education of the Handicapped) project directed by Dr. Clessen J. Martin and entitled Development of an Analytical Approach to Telegraphic Communication.

Criteria followed in creating the 2,692 word Traditional (T) version of "San Francisco" and the test to accompany it were: (1) the story should be of sufficient interest to college undergraduate students to promote positive motivation among the Ss in the testing situation; (2) the reading level of the prose material should be of appropriate difficulty for college students; (3) the test questions assessing students' comprehension should have high reliability; (4) the length of the story and its comprehension test should be designed to allow all Ss to complete them comfortably in one 50

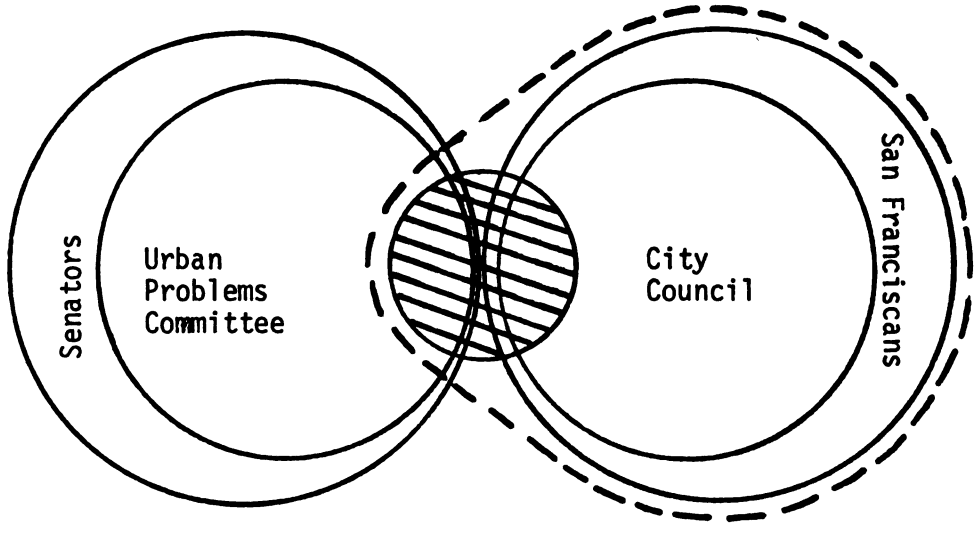
minute class period. The story "San Francisco" focuses on the impact of a devastating earthquake in the major urban area of San Francisco Bay. Work of the city and state officials interacting in the aftermath of the destruction plus the evacuation and rescue work provided by a commune group which had previously borne the resentment of the local police are the central events depicted. The story was written to be analyzable by Dawes' (1964) set relations model. The full text of the T version appears in Appendix A.

Dawes' Set Relations Model

As noted in Chapter I, the major feature of this model is the structure of artificially constructed meaningful material into set relationships to make it possible to keep the amount of essential information constant among different versions of the specially constructed passages. To meet the criteria of the Dawes' model, the changing relationships among the groups throughout the course of events were systematically maintained in all versions of "San Francisco." As shown in Figures 2.1 and 2.2, the essential structure of "San Francisco" is illustrated by the use of Venn diagrams.

Telegraphic Versions

Telegraphic forms of the story were generated from the T version of "San Francisco" using the SHORT (Subjective Hierarchy of Relevant Terms) method of creating telegraphic materials developed by Pantalion (1972). The 151 sentences in the T version of the story were divided into 24 sentence sets of six or seven sentences each. Two hundred and fifty-six freshman



Area surrounded by Dashes = leadership of Mayor St. John

Shaded Area = Action Group

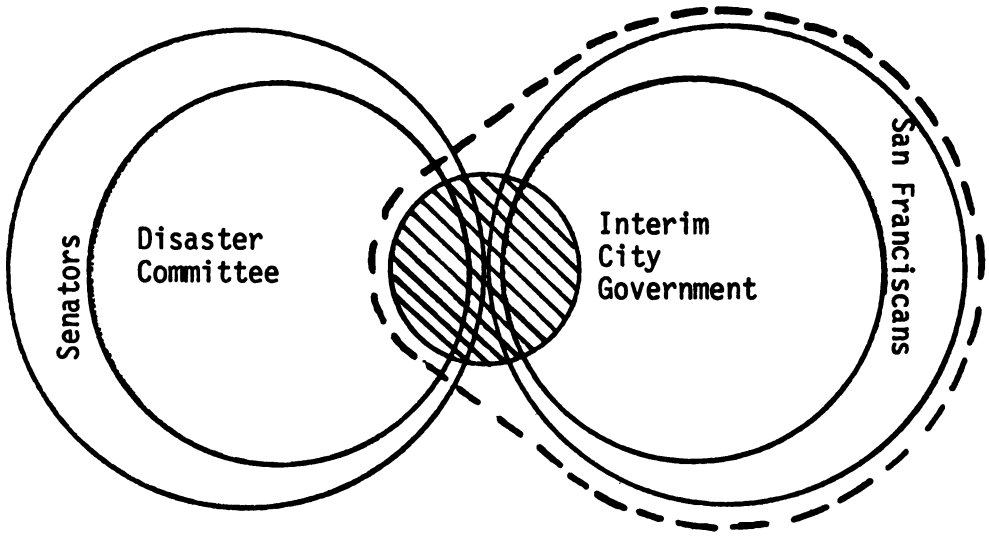
Nested Relations

All members of the Urban Problems Committee were senators
All city councilmen were San Franciscans
All San Franciscans were under the leadership of Mayor St. John
All city councilmen were under the leadership of Mayor St. John
All of the Action Group were under the leadership of Mayor St. John

Disjunctive Relations

Some Senators were under the leadership of Mayor St. John
Some members of the Urban Problems Committee were under the leadership of Mayor St. John
Some Senators were in the Action group
Some members of the Urban Problems Committee were in the Action Group
Some San Franciscans were in the Action Group
Some city councilmen were in the Action Group

Figure 2.1. Set relations existing before the earthquake as described in all four treatment versions of "San Francisco."



Area surrounded by Dashes = followers of Atkins

Shaded Area = Volunteers for Hope

Nested Relations

All of the Disaster Committee members were senators
All officials of the Interim City Government were San Franciscans
All San Franciscans were followers of Atkins
All officials of the Interim City Government were followers of Atkins
All Volunteers for Hope were followers of Atkins

Disjunctive Relations

Some of the senators were followers of Atkins
Some of the Disaster Committee members were followers of Atkins
Some of the senators belonged to the Volunteers of Hope
Some of the Disaster Committee members belonged to the Volunteers for Hope
Some of the San Franciscans belonged to the Volunteers for Hope
Some of the officials of the Interim City Government belonged to the Volunteers for Hope

Figure 2.2. Set relations existing after the earthquake as described in all four treatment versions of "San Francisco."

psychology students at Texas A&M University served as judges. Each judge was asked to read the entire story and then to rank order the words in each of the sentences in his assigned sentence set. Judges rank ordered words from least to most important on the basis of each word's importance in conveying the essential idea communicated in the original sentence. The rank orderings were keypunched on IBM cards for analysis by the SHORT computer program.

The computer printout gave the mean rank of each word in each sentence based on the rank orderings of all judges. A Kendall Coefficient of Concordance was computed for the rank orderings of each sentence. Using the results of the Kendall coefficient, a Chi-square and a p-value were also obtained. For each sentence, the obtained p-value was $p<.001$ which revealed a significant degree of agreement among judges in their rank orderings.

The SHORT method generated telegraphic versions by deleting 10, 20, 30, 40, 50, and 60% of the words judged to be least important. The passages were then typed maintaining original sentence and paragraph form. When the first word of a sentence was deleted, the next remaining word was capitalized.

All versions contained the same essential information. The same sequence of events was maintained and the same persons and groups of persons were identified in all versions. The 20, 40, and 60% deleted versions were selected for use with the traditional version in this study. The full texts of the three deleted story versions appear in Appendices B, C, and D.

Grammar, Punctuation, and Style Changes in the Deletion Process

The four versions of the story contain words by grammatical category as shown in Table 2.2.

TABLE 2.2

Number of Words in Each Grammatical Category in the Four Versions of San Francisco

Grammatical Category	T	Number of Words 20	40	60
Nouns	644	633	582	483
Pronouns	200	176	121	56
Verbs	533	498	434	324
Adjectives	324	274	173	82
Adverbs	232	157	89	50
Prepositions	349	265	167	66
Articles	280	70	14	4
Conjunctions	130	85	37	10

The flowing narrative style of the traditional passage is rich in descriptive words and phraseology. The low telegraphic (20% deletion) maintains the same basic style and sentence structure. The medium telegraphic (40% deletion) is less fluid because of the omission of phrases and connecting words. The high telegraphic (60% deletion) is extremely compact and eliminates all extraneous content. Nouns, pronouns, and verbs were eliminated less frequently than words of other grammatical categories in the deleted versions.

Traditional

In June that year, the first earthquake came. More than halfway up the Richter scale, it was strong enough to cause a pretty solid loss of life in the old buildings, those relics of rebuilding in 1906 that had somehow weathered urban renewal and freeway right-of-way acquisition. The Mayor hopped into his helicopter to the flight to Sacramento to seek state help. (62 words)

Low Telegraphic - 20% Deletion

June year, the first earthquake came. Halfway up Richter scale, it was strong enough to cause loss of life in old buildings, those relics of rebuilding of 1906 that had somehow weathered urban renewal, freeway right-of-way acquisition. The Mayor hopped into helicopter flight to Sacramento to seek state help. (49 words)

Medium Telegraphic - 40% Deletion

June year, first earthquake came. Halfway up Richter scale, it was strong enough to cause loss of life in buildings, relics of 1906 weathered urban renewal, freeway acquisition. Mayor hopped into helicopter to Sacramento to seek help. (37 words)

High Telegraphic - 60% Deletion

First earthquake came. Halfway up Richter scale strong enough cause loss of life in buildings, relics weathered renewal. Mayor hopped helicopter Sacramento to seek help. (25 words)

The total word counts for the four versions of "San Francisco" are:

1. Traditional, uncondensed form 2692 words
2. Twenty percent deletion (Low-Tel) 2158 words
3. Forty percent deletion (Med-Tel) 1617 words
4. Sixty percent deletion (High-Tel) 1075 words

Calculation of Readability Level

The readability level of the T version of "San Francisco" was calculated by Flesch's (1949) formula which was developed for the evaluation of upper-grade and adult materials. The Flesch formula has been used in determining the reading level of difficulty of materials for use by the United Nations and in the development and use of technical service manuals for the Armed Forces. It also has been used widely in the evaluation of textbooks for secondary school use.

The steps involved in using the formula require taking 100-word samples from each 500 words of text. The number of sentences in each sample is noted and the total number is divided into 100 to obtain the average sentence length. A sentence portion at the end of the sample that contains less than half of its total words within the sample is not counted. A syllable count is then made for the sample and the total number of syllables in the sample is located on the Flesch Formula Chart. The same procedure is followed for the sentence length scale and an intersecting line is plotted. The Reading Ease Score for each sample is that level on the center column of the chart where the line crosses. Both a numerical score and a general categorical rating of reading difficulty can be obtained.

The Flesch Formula scores, descriptive categories, and the grade range equivalents are presented in Table 2.3 while Table 2.4 gives the Flesch Readability scores for "San Francisco."

Although Flesch Readability scores were not calculated for the

TABLE 2.3

Flesch's Reading Ease Categories

Score	Descriptive Category	Grade Range
90 to 100	Very Easy	5th Grade
80 to 90	Easy	6th Grade
70 to 80	Fairly Easy	7th Grade
60 to 70	Standard	8th & 9th Grades
50 to 60	Fairly Difficult	10th through 12th Grades
30 to 50	Difficult	College Undergraduates
0 to 30	Very Difficult	College Graduates

TABLE 2.4

Flesch Readability Scores for "San Francisco"
Traditional Version of 2692 Words

Sample Number	Word Count In Passage	Sentences Per Sample	Words Per Sentence	Syllables Per Sample	Formula Score
1	112-211	5	20	151	59
2	553-652	8	12.5	144	72
3	1277-1376	6	16.6	154	60
4	1924-2023	5	20	168	45
5	2205-2304	6	16.6	159	56
				Average (Fairly Difficult)	58

telegraphic versions, the level of difficulty definitely increases with each higher percentage of deletion. Even though sentence length decreased in telegraphic forms, the word reduction process omitted significantly more one syllable connecting and modifying words than the generally more meaningful multi-syllabic words in the telegraphic versions as compared to the traditional.

Reading Material Format

The four versions of "San Francisco" were typed in double space on white 8 1/2" x 11" paper (as shown in Appendices, A, B, C, and D) for use by the 320 Ss who were assigned to a treatment condition which required reading.

Time-Compressed Tape Recordings

The four versions of "San Francisco" were sent in written form to the Center for Rate-Controlled Recordings at the University of Louisville. Each of the story versions was recorded by a male reader at his natural speaking rate. Information on these original recordings is shown in Table 2.5. The highly compact format of the 40 and 60 versions appears to have caused the reader to automatically decrease his rate of speaking. As noted in Table 2.5, a second recording of the 60 (High-Tel) version had to be made because the original one was too slow (105 wpm) to be time-compressed smoothly to the fastest (400 wpm) rate which this project required. Each of these four original recordings was then time-compressed to 175, 275, and 400 word per minute (wpm) rates. A discard

interval of 20 milliseconds which is the optimum level of discard for intelligibility was used for all of the compressions. The recordings were open-reel recorded on separate one-half inch width tapes at seven and one-half inches per second which resulted in 12 individual tapes (four story versions x three presentation rates). Exact wpm rate accuracy plus or minus 5% is guaranteed by the University of Louisville's Center for Rate-Controlled Recordings. Table 2.6 presents the specific data on the time-compressed tapes.

TABLE 2.5

Information on the Original Recordings of "San Francisco"

Version	No. of Words	Tape Time	WPM Rate
T	2692	16.25	165.7
20	2158	14.75	146.3
40	1617	13.60	118.9
60	1075	8.15*	131.9

*Second recording

Evaluation Material

Multiple Choice Items

Sixty multiple choice questions with four alternatives for each item were constructed from the factual material available in the 60% deleted version of "San Francisco." After the questions were constructed, they were all checked against the T, 20, and

TABLE 2.6

Data on the Time-Compressed Speech Tapes for "San Francisco"

	T/2692 wds	20/2158 wds	40/1617 wds	60/1075 wds
175 WPM				
*Perfect Tape Time	15.38	12.33	9.34	6.14
Actual Tape Time	15.58	12.75	9.75	6.55
Actual WPM	173	169	166	164
*EWC	173	211	276	411
275 WPM				
*Perfect Tape Time	9.78	7.85	5.88	3.90
Actual Tape Time	9.93	8.23	6.23	4.23
Actual WPM	271	262	260	265
*EWC	271	327	432	636
400 WPM				
*Perfect Tape Time	6.73	5.40	4.04	2.69
Actual Tape Time	6.70	5.58	4.24	2.87
Actual WPM	402	387	381	375
*EWC	402	482	635	938

*Perfect Tape Time = Errorless time-compressed recording such as $\frac{\text{T/2692 wds}}{\text{175 wpm}} = 15.38$

*Effective WPM Comprehension = $\frac{\text{2692 wds of T version}}{\text{Tape Time}}$

40 deleted versions to ascertain that no conflicting detail was present which might cause confusion due to the greater amount of descriptive material in these versions. These items assessed mainly the recall of factual information and it was assumed that this method of measuring comprehension approximates typical methods used in the classroom. These 60 items followed the sequence of the story in their order of presentation in the text.

Set Relations Items

Twenty questions were constructed to test comprehension of the two types of set relations, nested and disjunctive. The first 10 items tested recall of nested sets before the earthquake occurred and the second 10 items tested comprehension of disjunctive sets of relationships following the earthquake. These questions had two alternatives for each item.

As presented in Chapter I, Dawes (1964) found more overgeneralization errors as tested in the disjunctive items than pseudo-discrimination errors as tested by the nested items. The explanation which he presented for this was that overgeneralization errors occur as a result of information overload. Since the deleted versions contain less extraneous information, Dawes' model predicts proportionately fewer overgeneralization errors in the telegraphic forms of the story. It is the extraneous material which increases the amount of total information that may interfere with the recall of the basic set relations found in all versions of the material. Analysis of the set relations recall errors may permit the determination of whether or not telegraphic materials make less imposition upon

memory than T prose materials.

The 20 set relations items were added in sequence to the 60 multiple choice questions to create an 80-item total test. The total 80-item test is presented in Appendix E.

Pilot Test of the Questions

The questions were pilot tested on male and female Ss enrolled in undergraduate psychology classes at Texas A&M University. All Ss read the T passage and then answered all test questions on IBM 503 answer sheets which were machine scored. Kuder-Richardson #20 correlations, point-biserial correlations, and item discrimination values were computed. Table 2.7 shows the summary statistics for both parts of the test.

TABLE 2.7

Summary Statistics of the Two-Part Test Developed for "San Francisco"

	Multiple Choice Questions	Set Relations Questions
K-R#20	0.88	0.45
Mean Point Biserial	0.34	0.27
Mean Item Discrimination	0.27	0.28
Mean Item Difficulty	0.83	0.70
	N = 49	N = 53

Recording and Playback Equipment

Three Wollensack tape recorders equipped with listening stations were used for the presentation of the tape recorded material.

Each listening station had six jacks for headsets which permitted up to six Ss to listen to the same tape simultaneously. The headsets which were used for each S insured the best intelligibility from the tapes, allowed individual adjustment of the volume, and reduced distractions from the presence of other Ss or outside noise.

Additional Materials

Additional items used were a combined scheduling and self-rating form, IBM answer sheets, a modality preference sheet, a stopwatch, and a cardfile.

Prior to the study, Ss completed a time preference sheet in order to permit scheduling participation time at their convenience. On this same sheet, Ss were asked to rate their own preferred mode of learning, reading rate, and conversational speech rate. This form is shown in Appendix F.

The 240 Ss who were assigned to the combined Listening/Reading treatment groups were given a form immediately following the presentation task to indicate the modality they believed they relied upon most for comprehending the material (Appendix G).

All Ss completed the test using IBM 503 answer sheets. For the 80 Ss in the Reading treatment group, a stopwatch was used and the elapsed time was written on the blackboard in five second intervals to enable each S to record his individual reading time.

Except for the 80 Ss in the Reading treatment groups, the name, sex, class, first language if other than English, and the randomly assigned treatment group for each S were written on a 4" x 6" index card. These 480 cards were alphabetically indexed in a cardfile

and then refiled by treatment group number (1-24) after the participation of each S. This facilitated setting up the specific treatment condition for each S, kept an exact count of the status of each treatment group, and allowed the recording of Ss' specific comments following the task.

Procedure and Design of the Study

Listening and Listening/Reading Treatment Conditions

The 480 Ss were assigned randomly to one of the 24 treatment conditions. Twelve groups of 20 Ss each were assigned to the Listening treatments and 12 additional groups of 20 Ss each were assigned to the Listening/Reading treatment conditions.

Equivalent situations were maintained for all Ss. The basic study was originally explained in each of 30 education and educational psychology classes from which volunteers for the project were sought. When Ss came to participate (by either individual appointment time or a weekly schedule sheet given to each S), specific instructions were given individually or in very small groups. Because most of the Ss were totally unfamiliar with even the concept of compressed speech or telegraphic prose, instructions were modified according to the randomly assigned treatment condition. Subjects were given a detailed explanation of the level of speech rate and percent of word reduction to which they would be listening or simultaneously listening and reading.

In a pre-study presentation of the compressed speech tapes to a number of graduate students who were not in the S population, it

became evident that the unique style and speed commanded Ss' attention at least initially and therefore interfered with concentration on the content of the material. This occurred especially on the 400 wpm tapes and the highest deletion levels at any of the three presentation speeds. Thus, the rationale for explaining the assigned word per minute speed and deletion level to each S was not only an appropriate but necessary procedure.

The basic instructional sets for the Listening and Listening/Reading treatments were as follows:

Listening Treatment Groups

> This project is concerned with finding out how well university students can comprehend material presented at faster than average speech rates and with varying percentages of words deleted.
>
> Listen as carefully as possible to the story on the tape. You will be listening at 275 wpm which is twice as fast as normal speech rate for tape recordings. Forty percent of the words have been deleted from the original version so it will sound something like a telegram being read at a very fast rate. (The two previous sentences were modified according to the exact treatment condition.) The volume should be set correctly, but you may adjust it if you wish. The tape will be started as soon as you have the earphones on and are ready. Some students find it helpful to close their eyes or to put their heads down while listening; you may want to try this to maintain maximum concentration. Remove the earphones as soon as the tape ends and you will then be given an 80-item objective test which covers the important facts, events, and names in the story.

Listening/Reading Treatment Groups

> Instructions were identical with those for the Listening groups except for the following essential changes:
>
> . . . You will be listening to the story and reading it at the same time. Therefore read or follow the written text while you listen to the identical selection on the tape.

> The same words have been omitted from the text as from the tape recording. . . . As soon as you have the earphones on and are ready, the tape will be started and you may turn the story booklet over and begin reading at the same time. You must stop reading as soon as the aural tape is finished.

Reading Treatment Conditions

The 80 Ss were enrolled in four sections of a developmental reading course. Each S read the story and completed the test during one 50 minute period in one of the four sections of the class. The four story versions were distributed randomly in the classes. Specific instructions were given to each of the four groups as follows:

> The purpose of this study is to determine the effects of deleting varying percentages of words from a story on comprehension and reading rate. Twenty students will read the story in its original 2692-word form. Others will read the same typed story in one of three versions from which 20, 40, or 60% of the words have been deleted. You each have on your desk a story booklet and an IBM answer sheet.
>
> The exact procedure for the experiment is as follows: Read the story as rapidly as you can without sacrificing comprehension. Those of you who are reading the highly deleted versions may find the telegraphic style disconcerting but read it as rapidly as possible, again without undue sacrifice of comprehension.
>
> As soon as you finish reading raise your hand and look up at the blackboard to note your exact reading time. Your instructor will write the elapsed times on the blackboard at five second intervals as soon as the first student in the class finishes reading. [This is the procedure these classes normally followed in recording reading time.] Record your reading time on the IBM answer sheet which you have. As soon as you have done this you will be given a test booklet. The test has 80 items and takes approximately 25 minutes to complete. You will have ample time to finish it comfortably during this class period. Note that the answer sheets are numbered horizontally across the page.
>
> Please put both your name and the version of the story which you will be reading, designated by T, 20, 40, or 60 at the top of your reading booklet, on the IBM answer sheet at

this time. You will be given your wpm reading rate, test score, and ranking for the group of 20 students who will be reading each version of the material next week in this class. Are there any questions? Please turn your reading booklet over and begin reading.

Additional Procedures

Comprehension Test

No time limit was imposed for the test which took 25-30 minutes for most students to complete. All tests were hand-scored with a separate items correct score given for multiple choice, nested, disjunctive, total set relations, and for the total test. The tests were then filed according to treatment groups.

Modality Form and Posttest Comments

The 240 Ss assigned to the 12 Listening/Reading treatment groups completed a post-task check form asking which modality they had relied on most to comprehend the material: Aural, Visual, or Aural/Visual equally. This form was attached to the IBM answer sheet (Appendix G). All participating Ss were invited to write comments about the particular treatment conditions on this form or on the back of the answer sheet.

Reporting Results to the Subjects

In order to enhance motivation and interest in performing well, all Ss in the Listening and Listening/Reading groups were given a postal card along with the test. These 480 Ss were told to self-address the card if they wished to know their individual test score and rank in the treatment group of 20. All Ss except one wanted to receive this information and self-addressed the card. These results were mailed as soon as the study was completed.

For the 80 Ss in the Reading groups, individual cards listing total test score, wpm reading rate, effective wpm comprehension (EWC), and rank within the treatment group of 20 were given to every S.

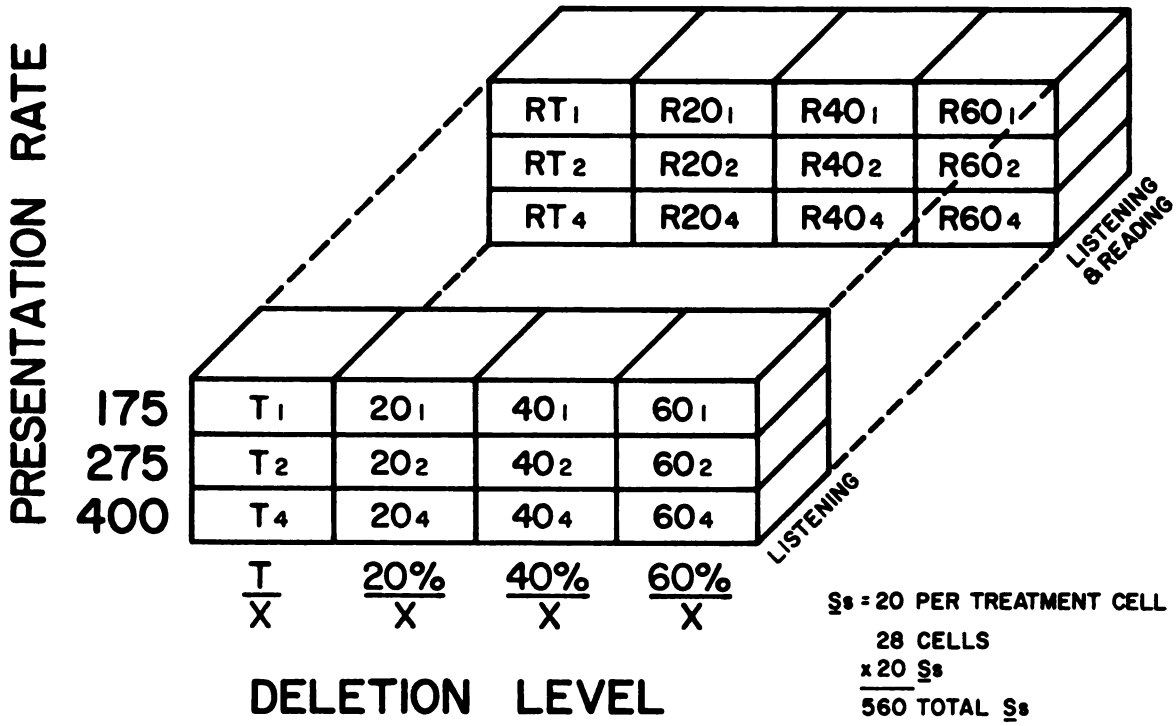
Posttest Optional Participation

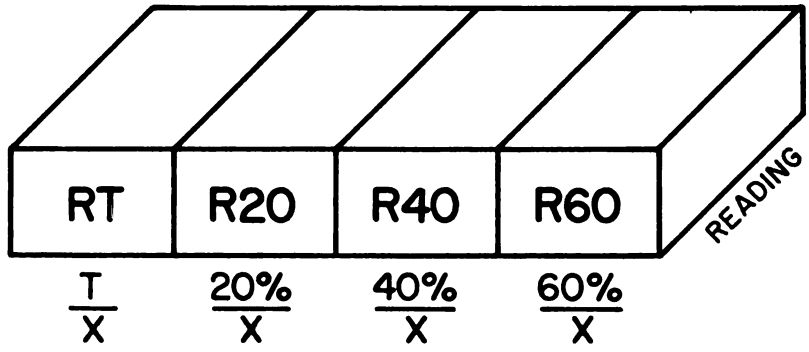
After completing the test, Ss in the 24 Listening and Listening/Reading treatment conditions were invited to listen to tape segments from other treatment conditions in order to understand more clearly the combined concepts of time-compressed speech and telegraphic prose. The great majority of the Ss were interested in doing so and many remained to listen to several complete tapes.

Design and Analysis

Figure 2.3 presents the research design and legend for the study. The experimental design was composed of two separate 3 x 4 factorial analysis designs and a 1 x 4 design. The factors in the 3 x 4 designs were three Presentation Rates (175, 275, and 400 wpm) and four Deletion Levels (T, 20, 40, and 60%). The modality was Listening (Aural) for one of these designs and Listening/Reading (Aural/Visual) for the other one. Factors for the 1 x 4 design were Word Per Minute Reading Rate and the same four Deletion Levels as in the 3 x 4 designs. The study had 28 treatment conditions with N = 20 Ss for each treatment cell.

The major analyses of this study involved three sets of data: (1) data from Ss who listened to the prose materials, (2) data from Ss who listened and read simultaneously, (3) data from Ss who read





LEGEND:

T = TRADITIONAL	1 = 175 WPM
20 = 20% DELETION	2 = 275 WPM
40 = 40% DELETION	4 = 400 WPM
60 = 60% DELETION	R = READING

EXAMPLE:

401 = 40% DELETION AT 175 WPM
LISTENING

R401 = 40% DELETION AT 175 WPM
LISTENING & READING

FIGURE 2.3 RESEARCH DESIGN SHOWING TREATMENT CONDITIONS ANALYSED BY THE ANALYSIS OF VARIANCE MODEL.

the prose materials. In addition to the separate analyses performed on these three sets of data, a fourth set of analyses compared the performance of Ss who listened with that of Ss who concomitantly read while listening to the prose materials.

Analyses of variance were performed on the means of the five dependent comprehension variables. The total scores from the multiple choice, set relations, nested, and disjunctive test items were analyzed. A measure of comprehension efficiency called effective word per minute comprehension (EWC) was computed for each S by dividing the total number of words (2692) in the Traditional story by the tape or reading time (T_T or R_T) and multiplying it by the percent correct of the multiple choice test items (C). Thus,

$$EWC = \frac{2692}{T_T \text{ or } R_T} \times \%C.$$

For the Reading treatment groups, word per minute reading rate and reading time were additionally analysed. The Scheffé post hoc comparison was used to determine the precise nature of the differences among treatment means yielding significant F values.

Item analyses were completed on both parts of the test for indices of difficulty and discrimination (for Ss in the Reading treatment conditions). The Kuder-Richardson #20 coefficient for test reliability was computed.

The data were analysed through the services of the Human Learning Research Laboratory and the Data Processing Center at Texas A&M University. An IBM 360-65 computer was used and the computer program was written in WATFIV Fortran language.

CHAPTER III

RESULTS

The results are organized into four major sections based upon the treatment modalities being analysed. Analyses of variance are reported for the three levels of the Presentation Rate main effect, for the four Deletion Levels main effect, and for the Modality main effect. The four major sections are:

1. Reading (Visual) Treatments - 1 x 4 ANOVA
2. Listening (Aural) Treatments - 3 x 4 ANOVA
3. Listening/Reading (Aural/Visual) Treatments - 3 x 4 ANOVA
4. Listening compared to Listening/Reading Treatments - 3 x 4 x 2 ANOVA

Factorial ANOVAs were performed across all treatment conditions for each of the following dependent variables: Multiple Choice Test Score, Set Relations Test Score, Nested Set Relations Score, Disjunctive Set Relations Score, and Effective Word Per Minute Comprehension Rate (EWC). Two additional dependent variables, Reading Rate and Reading Time, were analysed for the Reading treatment conditions. As reading is the prime mode of learning in formal education, the four Reading groups were used as control conditions for comparison with the 24 experimental groups in which the mode of learning was Listening or combined Listening/Reading.

Table 3.1 presents the item analysis of the 60-item multiple choice test and the 20-item set relations test. The 80 tests from the four Reading treatments were selected for this analysis because reading is the modality on which most comprehension tests are based. Previous item analyses of this test have been completed on comparable S populations at Texas A&M University (Table 2.7). Twenty different Ss read each of the four versions of the prose material. Mean comprehension scores for the total 80 Ss were 64 and 62%, respectively, for the multiple choice and set relations tests.

TABLE 3.1

Item Analysis of the Total Multiple Choice Items (60) and Set Relations Items (20) for the Reading Treatments

Item Statistics	Multiple Choice	Set Relations
Mean Score for test	38.41	12.29
Standard Deviation	9.06	2.55
Mean item discrimination	0.37	0.29
Mean point biserial correlation	0.34	0.28
Kuder-Richardson #20	0.87	0.42
Standard error of measurement	3.26	1.95

Ebel (1965) states that the reliability of an item increases as the discrimination index reaches .40 and above. Thus, he recommends that items have a minimal discrimination value of .30. The .37 mean discrimination value for the multiple choice test was above this

while the .29 discrimination value of the set relations test approached the recommended value within acceptable limits.

The mean point biserial correlation measures the relationship between performance on the items and total test score. The Kuder-Richardson No. 20 (K-R#20) coefficient indicated a high degree of reliability for the multiple choice items. Although the corresponding reliability coefficient for the set relations items was considerably lower, it is suggested that the relatively small number of items in the set relations test and the apparent difficulty of these 20 items may have been the two significant factors depressing the correlation. As shown in Table 3.1, the mean number of total correct responses for the 20-item set relations test was 12.29 with the expected chance score on this test being 10.00. Analysis of the 12.29 mean score indicated that it was not significantly above the chance level.

Reading Treatments

The means and standard deviations for reading times, reading rates and EWC are presented in Table 3.2. Tables 3.3 and 3.4 show the significant ANOVAs for reading rate and reading time.

Reading times were found to be significantly different [$F(3,76) = 5.96$, $p<.005$] among the four groups in the 1 x 4 ANOVA design. The Scheffé test revealed that reading time was reduced by 2.22 minutes on the 40 as contrasted with the T version. For the 60 material, reading time was not significantly different from the T. Subjects assigned to the 60, containing 1075 words, read it at an average of 8.39 minutes while the T Ss read 2692 words at an average of 9.33

TABLE 3.2

Means and Standard Deviations for Reading Time, Reading Rate, and Effective Word Per Minute Comprehension Rate (EWC) in the Reading Treatments

Treatment Conditions	N	Reading Time Mean	Reading Time SD	Actual WPM Rate Mean	Actual WPM Rate SD	EWC Mean	EWC SD
Deletion							
T	20	9.33	1.35	294.81	45.74	235.22	54.52
20	20	7.96	1.96	285.15	62.30	228.92	71.80
40	20	7.10	1.30	236.58	54.45	221.30	68.93
60	20	8.39	2.02	135.86	35.08	191.05	52.33

TABLE 3.3

Results of 1 x 4 ANOVA for Reading Rate in the Reading Treatments

Source	df	MS	F	p
Groups	3	105904.60	41.68	<.001
Error	76	2541.05	-	-
Total	79	6466.25	-	-

TABLE 3.4

Results of 1 x 4 ANOVA for Reading Time in the Reading Treatments

Source	df	MS	F	p
Groups	3	17.07	5.96	<.005
Error	76	2.86	-	-
Total	79	3.40	-	-

minutes. This represents a significant increase in effective reading time on a word per minute basis for the 60 version.

Reading rates were significantly different [$F(3,76) = 41.68$, $p<.001$] among all four story versions except T and 20. The Scheffé post hoc comparison revealed that reading rates were reduced 20% in the 40 version ($p<.01$) and 55% in the 60 version ($p<.001$) as compared to the T passage. Reading rate decreased 18% on the 40 ($p<.05$) and 53% on the 60 ($p<.001$) when compared to the 20 version. Reading rate decreased by 100 words per minute (43%) on the 60 material as compared to Ss reading the 40 version.

Figures 3.1 and 3.2 illustrate the differential effects of reading rates and reading times for the four reading groups.

Four 1 x 4 ANOVAs were employed to analyse the four additional dependent variables for the four Deletion Levels. The means and standard deviations for these variables are presented in Table 3.5.

As shown in Table 3.6, the ANOVA for the multiple choice test revealed highly significant differences for the Deletion Level main effect.

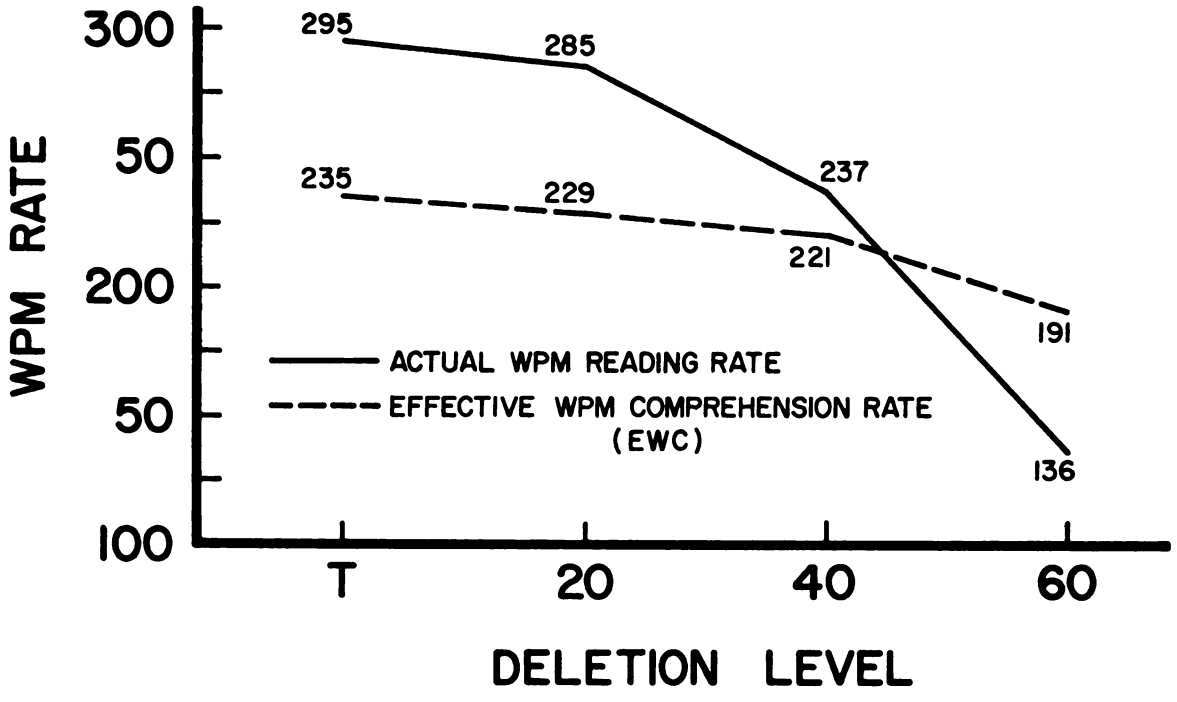


FIGURE 3.1 EFFECT OF DELETION LEVEL ON THE TWO MEASURES OF READING RATE FOR THE READING TREATMENTS.

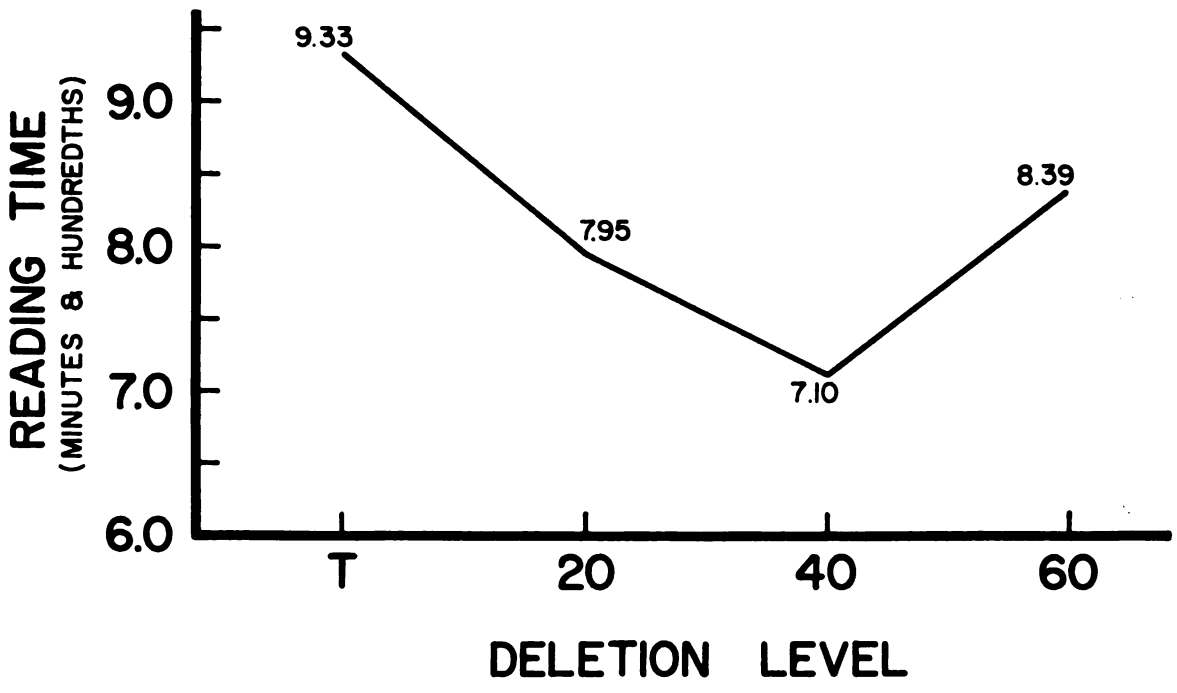


FIGURE 3.2 EFFECT OF DELETION LEVEL ON READING TIME FOR THE READING TREATMENTS.

TABLE 3.5

Means and Standard Deviations for Four Dependent Variables in the Reading Treatments

Treatment Conditions	N	Multiple Choice Mean	Multiple Choice SD	Set Relations Mean	Set Relations SD	Nested Mean	Nested SD	Disjunctive Mean	Disjunctive SD
Deletion									
T	20	47.20	6.79	12.60	2.98	6.70	1.81	5.90	1.65
20	20	38.70	9.18	12.05	2.63	6.35	1.46	5.70	1.45
40	20	33.75	6.40	12.40	1.60	6.15	1.42	6.15	1.04
60	20	34.10	5.78	12.35	2.89	6.40	1.85	5.95	1.39

TABLE 3.6

Results of 1 x 4 ANOVA for Multiple Choice in the Reading Treatments

Source	df	MS	F	p
Groups	3	843.90	16.49	<.001
Errors	76	51.18	-	-
Total	79	81.29	-	-

The Scheffé test revealed that the T story form resulted in significantly higher comprehension scores when compared with each of the three telegraphic versions.

Subjects assigned to read the T version answered 18, 28, and 27% more questions correctly than Ss reading the 20, 40, and 60 versions, respectively. No significant differences were found between groups 20 and 40, 20 and 60, or 40 and 60 percent deletion.

No significant differences were found in the 1 x 4 ANOVAs for set relations scores, nested scores, disjunctive scores, or effective word per minute comprehension rate (EWC) across the four Deletion Levels. The ANOVAs for these dependent variables are presented in Appendix H.

Listening Treatments

The 3 x 4 ANOVA for the multiple choice test revealed highly significant differences across the three Presentation Rates [$F(2,228) = 28.00$, $p<.001$] and the four Deletion Levels [$F(3,228) = 38.18$,

$p<.001$]. No significant interaction was found between these two main effects.

The Scheffé test was used to determine the precise nature of the differences among treatment means. The T and 20 deletion versions were significantly superior at all three Presentation Rates. Comprehension at the 275 wpm rate was equivalent to the 175 wpm presentation for all four versions of the material. For the T version, comprehension decreased 8% (from 68 to 60%) at 400 wpm as compared to the 175 and 275 wpm presentations. Twenty percent deletion affected comprehension negatively only at the 400 wpm rate. At this speed, Ss answered 12% fewer items correctly than at the 175 and 275 wpm rates. The Scheffé comparison further revealed significant differences between the T and 40, T and 60, and 20 and 60 story versions ($p<.001$). Significant differences were also found between the 20 and 40 ($p<.005$) and between the 40 and 60 ($p<.05$) deletions. For the Deletion Level main effect, comprehension decreased from a mean of 65% for the T story to 60% for the 20 version, to 50% on the 40 version, and to 42% on the 60 version across the three Presentation Rates.

The set relations test score was analysed as a 20-item unit and then divided into a 10-item nested score and a 10-item disjunctive score with each subjected to a separate 3 x 4 ANOVA. A significant F-value was obtained for the set relations mean score across the Deletion Levels [$F(3,228) = 4.24$, $p<.01$]. The Scheffé test revealed that Ss scored significantly higher on the T than on the 40 ($p<.05$) and 60 ($p<.06$) versions. No significant differences for Presentation Rate were found. Table 3.7 presents means and standard deviations

TABLE 3.7

Means and Standard Deviations for Multiple Choice and Set Relations for Presentation Rate and Deletion Level Main Effects in the Listening Treatments

Variables	N	Multiple Choice Mean	Multiple Choice SD	Set Relations Mean	Set Relations SD
Rate					
175	80	35.23	10.34	12.38	2.71
275	80	35.10	9.07	12.44	2.30
400	80	27.22	8.63	11.84	2.80
Deletion					
T	60	39.18	8.13	12.98	2.67
20	60	35.72	10.55	12.58	2.61
40	60	29.95	8.26	11.60	2.33
60	60	25.22	6.92	11.70	2.64

for the multiple choice and set relations main effects. The ANOVAs for multiple choice and set relations are shown in Tables 3.8 and 3.9.

Analysis of the set relations data into nested and disjunctive scores indicated that the disjunctive test scores were responsible for the significant difference found in the set relations scores. While the 3 x 4 ANOVA for nested items showed significant differences for the Deletion Levels [$F(3,228 = 2.69, p<.05$], the Scheffé test failed to indicate where the differences existed. The only relationship to approach significance ($p<.10$) was between the 20 and 40 deletion levels. Significant differences were found in the same location for disjunctive scores as for the total set relations scores. The disjunctive F-ratio [$F(3,228) = 3.57, p<.01$] was shown to exist due to significantly higher scores on the T than on the 40 ($p<.09$) and 60 ($p<.05$) versions. The means and standard deviations for nested and disjunctive items are shown in Table 3.10. Tables 3.11 and 3.12 present the ANOVA results.

Table 3.13 presents the means and standard deviations of the five dependent variables for each of the 12 Listening Treatment groups. The differential effects of Presentation Rates and Deletion Levels on these 12 treatments for the multiple choice test are summarized in Figure 3.3.

For effective word per minute comprehension (EWC) significant differences [$F(2,228) = 95.16, p<.001$] were found for Presentation Rate and for Deletion Level [$F(3,228) = 32.48, p<.001$], but no significant difference was found on analysis between these two main effects. The Scheffé test indicated that Ss listening to the 275 wpm comprehended the material for all versions at an average of 84 wpm

TABLE 3.8

Results of 3 x 4 ANOVA for Multiple Choice in the Listening Treatments

Source	df	MS	F	p
Between Conditions	11	944.04	-	-
Presentation Rate (WPM)	2	1608.74	28.00	<.001
Deletion Level (DL)	3	2291.43	38.18	<.001
WPM x DL	6	44.96	0.75	ns
Within Conditions	228	60.02	-	-
Total	239	101.22	-	-

TABLE 3.9

Results of 3 x 4 ANOVA for Set Relations in the Listening Treatments

Source	df	MS	F	p
Between Conditions	11	14.61	-	-
Presentation Rate (WPM)	2	8.70	1.35	ns
Deletion Level (DL)	3	27.39	4.24	<.01
WPM x DL	6	10.20	1.58	ns
Within Conditions	228	6.47	-	-
Total	239	6.84	-	-

TABLE 3.10

Means and Standard Deviations for Nested and Disjunctive for Presentation Rate and Deletion Level Main Effects in the Listening Treatments

Variables	N	Nested Mean	Nested SD	Disjunctive Mean	Disjunctive SD
Rate					
175	80	6.36	1.81	5.97	1.49
275	80	6.30	1.42	6.15	1.42
400	80	6.03	2.03	5.78	1.63
Deletion					
T	60	6.37	1.77	6.58	1.50
20	60	6.68	1.94	5.85	1.57
40	60	5.88	1.69	5.70	1.24
60	60	5.98	1.58	5.73	1.60

TABLE 3.11

Results of 3 x 4 ANOVA for Nested in the Listening Treatments

Source	df	MS	F	p
Between Conditions	11	5.44	-	-
Presentation Rate (WPM)	2	2.58	2.69	<.05
Deletion Level (DL)	3	8.11	0.86	ns
WPM x DL	6	5.06	1.68	ns
Within Conditions	228	2.17	-	-
Total	239	2.31	-	-

TABLE 3.12

Results of 3 x 4 ANOVA for Disjunctive in the Listening Treatments

Source	df	MS	F	p
Between Conditions	11	5.14	-	-
Presentation Rate (WPM)	2	2.82	1.30	ns
Deletion Level (DL)	3	10.39	4.78	<.01
WPM x DL	6	5.06	1.68	ns
Within Conditions	228	2.17	-	-
Total	239	2.31	-	-

TABLE 3.13

Means and Standard Deviations for Each of the Five Dependent Variables in the 12 Listening Treatments

Treatment Conditions	Variables: Multiple Choice Mean	Multiple Choice SD	Set Relations Mean	Set Relations SD	Nested Mean	Nested SD	Disjunctive Mean	Disjunctive SD	EWC Mean	EWC SD
T_1	41.00	7.25	13.25	3.27	6.85	2.01	6.40	1.57	118.07	20.89
20_1	39.40	11.29	12.40	2.56	6.50	1.73	5.75	1.94	138.65	39.74
40_1	33.65	9.25	11.40	2.80	5.80	2.09	5.60	1.19	154.85	42.55
60_1	26.85	6.98	12.45	1.88	6.30	1.26	6.15	1.09	184.26	47.42
T_2	40.80	8.67	13.45	1.79	6.65	1.27	6.80	1.06	184.35	39.16
20_2	39.15	9.50	12.80	2.63	6.65	1.91	6.30	1.22	213.43	51.82
40_2	32.25	6.03	11.25	1.71	5.75	1.64	5.50	1.32	232.25	43.46
60_2	28.20	5.50	12.25	2.49	6.30	1.13	6.00	1.78	299.11	58.36
T_4	35.75	7.66	12.25	2.71	5.60	1.76	6.55	1.82	239.40	51.27
20_4	28.60	6.93	12.55	2.74	7.05	2.21	5.50	1.43	229.96	55.73
40_4	23.95	5.67	12.15	2.37	6.10	1.74	6.00	1.21	244.22	57.82
60_4	20.60	5.91	10.40	3.03	5.35	2.06	5.05	1.70	322.04	92.33

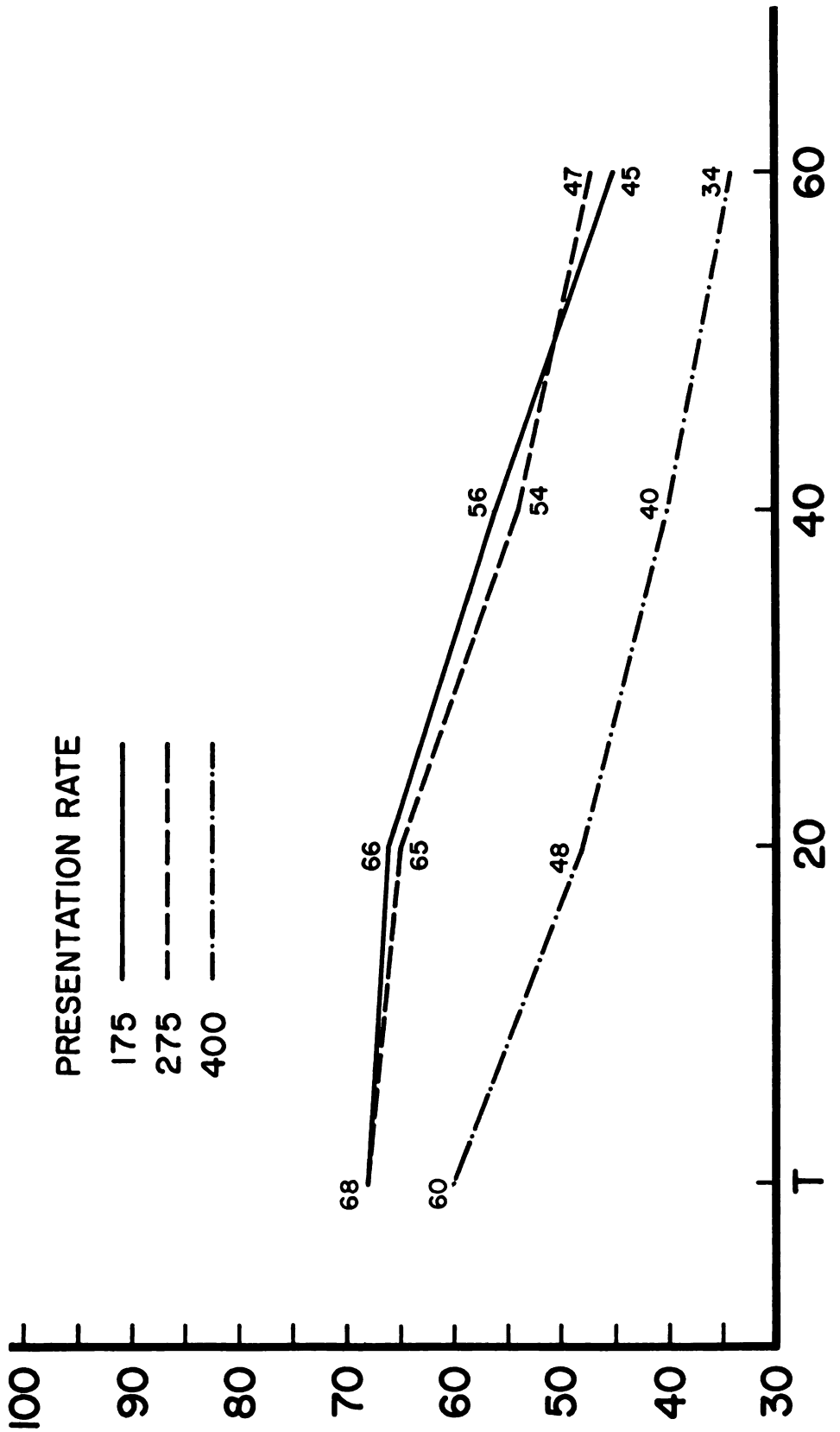


FIGURE 3.3 MEAN COMPREHENSION LEVELS FOR MULTIPLE CHOICE IN THE 12 LISTENING TREATMENTS.

(36%) faster than Ss listening at 175 wpm ($p<.001$). At the 400 wpm level, Ss processed the information more efficiently by 110 wpm (43%) as compared to the 175 wpm ($p<.001$) and 27 wpm (11%) faster than at the 275 wpm rate ($p<.01$).

On the basis of EWC, comprehension was more efficient at each increased deletion level. The Scheffé comparison revealed a higher efficiency rate of 30 wpm (14%) and 88 wpm (33%) respectively for the 40 and 60 deletion levels over the T version ($p<.001$). The 60 deletion level was also significantly different ($p<.001$) from both the 20 and 40 deletions at an increased wpm efficiency of 74 (28%) and 58 (22%), respectively. Tables 3.14 and 3.15 present the data resulting from the analysis of EWC.

Listening/Reading Treatments

The pattern of results for the combined Listening/Reading Modalities is comparable to the significant findings for the Listening Modality.

The major difference between the two analyses is that comprehension scores and information processing efficiency were consistently better for all of the 12 experimental groups in the combined Listening/Reading treatments than for the Listening Modality.

Analysis of the combined Listening/Reading Modalities revealed larger F values in the 3 x 4 ANOVA of multiple choice scores for both the Presentation Rate [$F(2,228) = 31.78$, $p<.001$] and Deletion Level main effects [$F(3,228) = 54.45$, $p<.001$].

TABLE 3.14

Means and Standard Deviations for EWC for Presentation Rate and Deletion Level Main Effects for Multiple Choice in the Listening Treatments

EWC	N	Mean	SD
Rate			
175	80	148.95	45.32
275	80	232.28	63.96
400	80	258.90	74.88
Deletion			
T	60	180.60	63.11
20	60	194.01	63.08
40	60	210.44	62.16
60	60	268.45	90.89

TABLE 3.15

Results of 3 x 4 ANOVA for EWC for Multiple Choice in the Listening Treatments

Source	df	MS	F	p
Between Conditions	11	74916.18	-	
Presentation Rate (WPM)	2	263213.90	95.16	<.001
Deletion Level (DL)	3	89854.62	32.49	<.001
WPM x DL	6	4673.76	1.69	<.12 ns
Within Conditions	228	2766.03	-	
Total	239	6086.57	-	

Table 3.16 presents the multiple choice and set relations means and standard deviations for the main effects in the Listening/ Reading conditions. The ANOVAs for these variables are shown in Tables 3.17 and 3.18. For Presentation Rate, the Scheffé test revealed the differences to exist between the 175 and 400 wpm rates and between the 275 and 400 wpm presentation speeds. Subjects answered 20 and 16% fewer questions correctly at 400 wpm than at the respective 175 wpm and 275 wpm rates.

As in the Listening treatments, comprehension at the 175 and 275 wpm rates was equivalent for the T and 20 deletion materials. For the Deletion Level main effect, significant differences were found to exist for both T and 20 in comparison with the 40 and 60. The exact probability of F was less than .001 in the comparison of both the T with 40 and 60, and with the 20 in comparison to the 40 and 60 deletions. Comprehension scores decreased by 25 and 32% for the 40 and 60 versions respectively, as compared to T, and 20 and 27% for those same medium and high telegraphic forms as compared to the 20 version.

As in the Listening treatment conditions, no significant interaction was found for the main effects. Figure 3.4 presents the mean comprehension levels for the multiple choice test in Listening/ Reading treatments.

For the set relations test, significant differences were found for the Deletion Level main effect [$F(3,228) = 4.57$, $p<.005$] in the 3 x 4 ANOVA as shown in Table 3.18. (The means and standard deviations are presented in Table 3.16). The Scheffé test revealed that Ss scored significantly higher on the T than on the 40 ($p<.05$) and 60 ($p<.05$) versions.

TABLE 3.16

Means and Standard Deviations for Multiple Choice and Set Relations for Presentation Rate and Deletion Level Main Effects in the Listening/Reading Treatments

Variables	N	Multiple Choice Mean	Multiple Choice SD	Set Relations Mean	Set Relations SD
Rate					
175	80	40.81	9.03	12.85	2.26
275	80	38.76	8.80	12.65	2.25
400	80	32.37	9.28	12.68	2.60
Deletion					
T	60	44.52	8.83	13.65	2.37
20	60	41.23	8.24	12.60	2.60
40	60	33.17	7.52	12.23	2.27
60	60	30.33	6.56	12.42	1.99

TABLE 3.17

Results of 3 x 4 ANOVA for Multiple Choice in the Listening/Reading Treatments

Source	df	MS	F	p
Between Conditions	11	1029.88	-	-
Presentation Rate (WPM)	2	1554.65	31.78	<.001
Deletion Level (DL)	3	2663.67	54.45	<.001
WPM x DL	6	38.06	0.78	ns
Within Conditions	228	48.92	-	-
Total	239	94.07	-	-

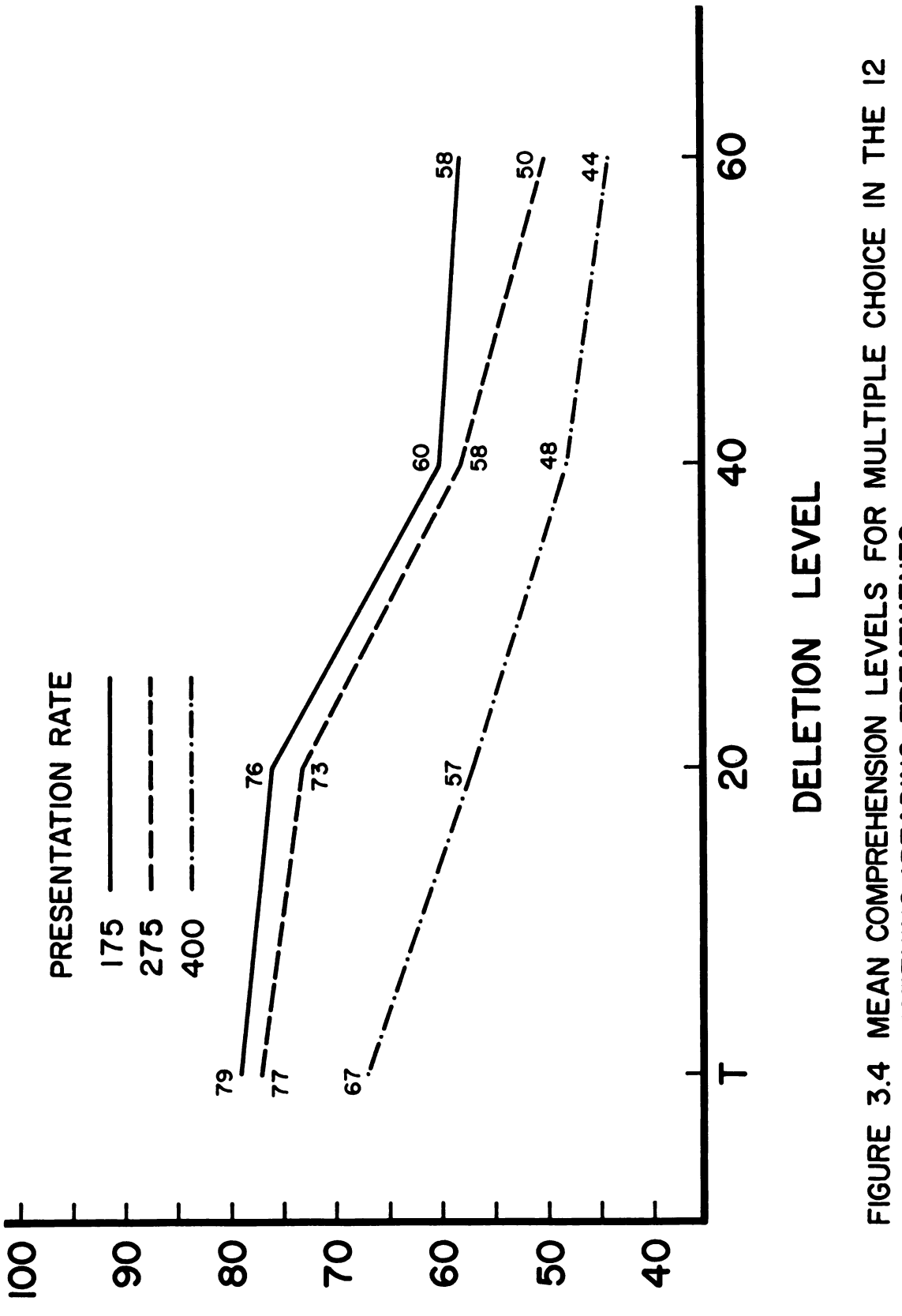


FIGURE 3.4 MEAN COMPREHENSION LEVELS FOR MULTIPLE CHOICE IN THE 12 LISTENING/READING TREATMENTS.

TABLE 3.18

Results of 3 x 4 ANOVA for Set Relations
in the Listening/Reading Treatments

Source	df	MS	F	p
Between Conditions	11	12.37	-	-
Presentation Rate (WPM)	2	0.95	0.18	ns
Deletion Level (DL)	3	24.16	4.57	<.005
WPM x DL	6	10.28	1.94	ns
Within Conditions	228	5.29	-	-
Total	239	5.62	-	-

As found in the Listening treatments, the disjunctive items produced the significant difference found in the set relations scores [$F(3,228) = 5.37$, $p<.005$]. The Scheffé analysis showed that significantly higher scores were obtained on the T than on the 40 ($p<.005$) and 60 ($p<.05$) versions. The means and standard deviations for nested and disjunctive items are presented in Table 3.19 and the ANOVAs are shown in Tables 3.20 and 3.21.

Significant differences in the analysis of effective word per minute comprehension (EWC) based on the multiple choice test were found for Presentation Rate [$F(2,228) = 145.19$, $p<.001$] and for Deletion Level [$F3,228) = 61.69$, $p<.001$]. Tables 3.22 and 3.23 present the main effect means, standard deviations and the ANOVA for EWC. No significant differences were found between the two main effects.

TABLE 3.19

Means and Standard Deviations for Nested and Disjunctive for Presentation Rate and Deletion Level Main Effects for the Listening/Reading Treatments

Variables	N	Multiple Choice Mean	Multiple Choice SD	Set Relations Mean	Set Relations SD
Rates					
175	80	6.69	1.55	6.17	1.28
275	80	6.38	1.72	6.27	1.42
400	80	4.49	1.81	6.24	1.56
Deletion					
T	60	6.92	1.72	6.73	1.35
20	60	6.28	2.07	6.38	1.37
40	60	6.45	1.45	5.78	1.45
60	60	6.42	1.42	6.02	1.36

TABLE 3.20

Results of 3 x 4 ANOVA for Nested for the Listening/Reading Treatments

Source	df	MS	F	p
Between Conditions	11	4.06	-	-
Presentation Rate (WPM)	2	2.01	0.72	ns
Deletion Level (DL)	3	4.58	1.63	ns
WPM x DL	6	4.48	1.60	ns
Within Conditions	228	2.80	-	-
Total	239	2.86	-	-

TABLE 3.21

Results of 3 x 4 ANOVA for Disjunctive for the Listening/Reading Treatments

Source	df	MS	F	p
Between Conditions	11	3.53	-	-
Presentation Rate (WPM)	2	0.20	0.10	ns
Deletion Level (DL)	3	10.44	5.37	<.005
WPM x DL	6	1.19	0.61	ns
Within Conditions	228	1.95	-	-
Total	239	2.02	-	-

TABLE 3.22

Means and Standard Deviations for EWC for Presentation Rate and Deletion Level Main Effects for Multiple Choice in the Listening/Reading Treatments

Variables	N	Mean	SD
Rate			
175	80	174.53	49.56
275	80	254.79	57.59
400	80	312.10	91.22
Deletion			
T	60	204.31	70.62
20	60	225.26	63.50
40	60	236.43	73.91
60	60	322.56	95.31

TABLE 3.23

Results of 3 x 4 ANOVA for EWC for Multiple Choice in the Listening/Reading Treatments

Source	df	MS	F	p
Between Conditions	11	116128.30	-	-
Presentation Rate (WPM)	2	282040.30	145.19	<.001
Deletion Level (DL)	3	162312.60	61.68	<.001
WPM x DL	6	4398.91	1.67	ns
Within Conditions	238	2631.33	-	-
Total	239	7855.039	-	-

For Presentation Rate, the Scheffé test revealed that Ss simultaneously listening and reading processed the material for all versions at a mean rate of 80 wpm (32%) faster at 275 and 137 wpm (44%) faster at 400 than at the 175 presentation rate. Subjects also comprehended more efficiently by 57 wpm (19%) at 400 than at the 275 rate. The probability of F was (<.001) among all three Presentation Rates.

Comprehension was also more efficient on the basis of EWC for each increased Deletion Level. As compared to T, the Scheffé test showed that Ss had a higher efficiency rate of 32 wpm (14%) for 40 and 118 wpm (37%) for the 60 deletion level. The 60 was also significantly higher ($p<.001$) from both the 20 and 40 deletion versions at an increased wpm comprehension of 98 (30%) and 86 (27%), respectively.

The Scheffé test showed that the Listening/Reading treatments produced significantly higher EWC rates at a probability level of less than .001 for all four story versions at 275 wpm and 400 wpm as compared to the T version presented at the 175 rate. The 60 at the 400 rate was processed more efficiently by 174 wpm (42%) than the 60 at the 175 rate and 92 wpm (22%) faster than 60 at the 275 rate.

As Figure 3.5 illustrates, EWC consistently increased for each Presentation Rate and Deletion Level for both the Listening and the Listening/Reading treatments. Because the multiple choice test scores were significantly higher for the Listening/Reading treatments than for the Listening treatments, EWC is also significantly higher for the Listening/Reading groups.

The means and standard deviations for the five dependent variables for the 12 Listening/Reading treatment conditions are presented in Table 3.24.

Listening Treatments Compared to Listening/Reading Treatments

The 3 x 4 x 2 ANOVA design used to assess the relationship of the main effects for the multiple choice test revealed significant differences for Presentation Rate [$F(2.456) = 58.64$ $p<.001$], Deletion Level [$F(3,456) = 90.34$, $p<.001$], and for Modality [$F(1,456) = 50.67$, $p<.001$]. No significant interaction was obtained. The means and standard deviations for the multiple choice test for main effects are presented in Table 3.25. Results of the ANOVA are shown in Table 3.26.

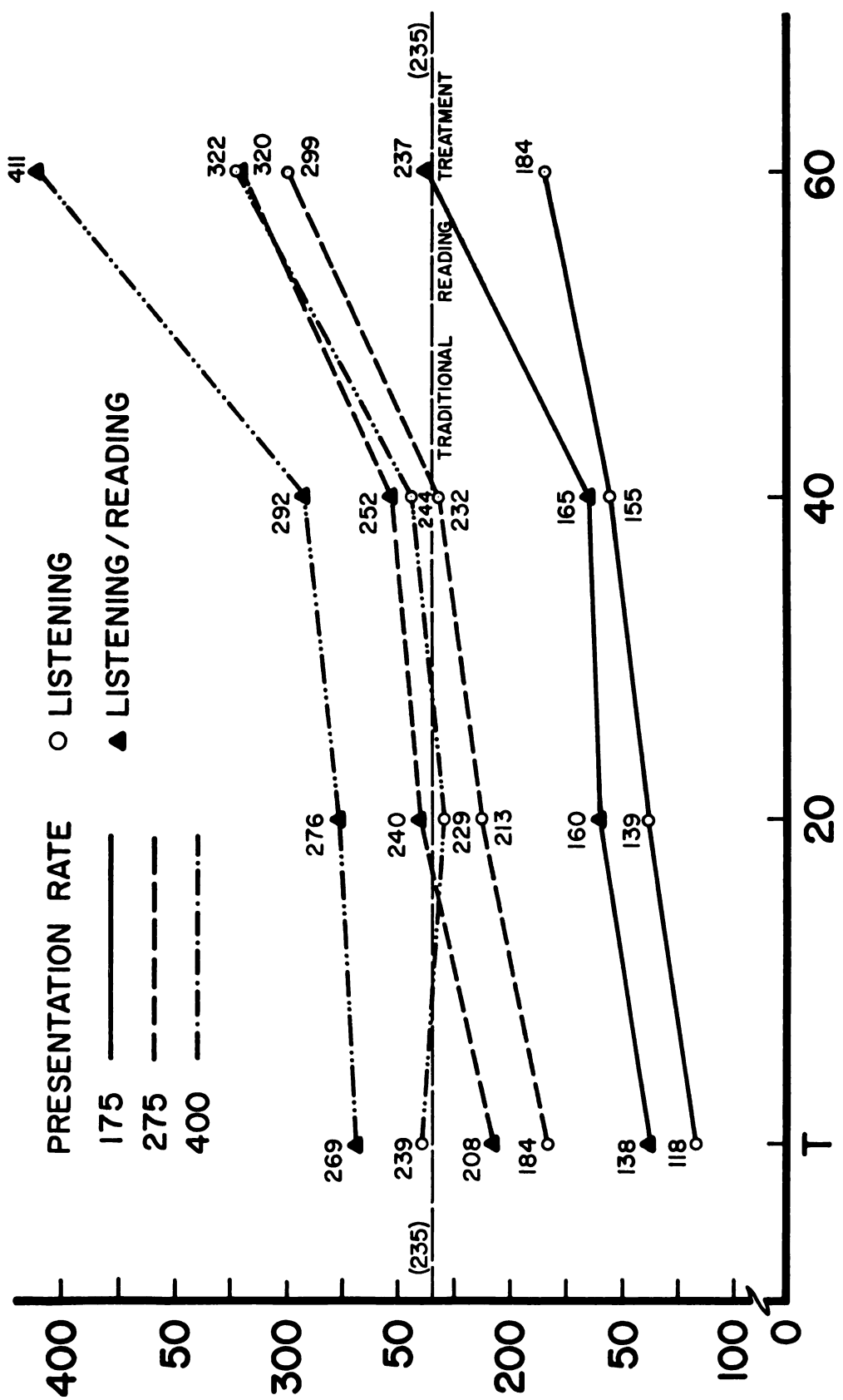


FIGURE 3.5 EWC RATES COMPARING THE LISTENING AND LISTENING/READING TREATMENTS AND THE CONTROL READING TREATMENT.

TABLE 3.24

Means and Standard Deviations for Each of the Five Dependent Variables in the 12 Listening/Reading Treatments

Treatment Conditions	Variables: Multiple Choice Mean	Multiple Choice SD	Set Relations Mean	Set Relations SD	Nested Mean	Nested SD	Disjunctive Mean	Disjunctive SD	EWC Mean	EWC SD
T_1	47.50	7.45	13.10	2.31	6.65	1.63	6.45	1.28	136.79	21.46
20_1	45.35	7.43	13.35	2.64	6.95	1.90	6.40	1.35	159.58	26.14
40_1	35.80	6.92	12.70	2.34	6.75	1.33	5.95	1.39	164.74	31.83
60_1	34.60	6.71	12.25	1.65	6.40	1.31	5.90	1.07	237.01	45.95
T_2	45.95	6.60	13.95	1.73	7.05	1.64	6.90	1.17	207.62	29.81
20_2	43.95	5.17	12.35	2.64	5.90	2.10	1.45	1.43	239.60	28.16
40_2	35.05	7.49	12.50	1.73	6.60	1.14	5.90	1.45	252.42	53.92
60_2	30.10	4.46	11.80	2.33	5.95	1.70	5.85	1.46	319.52	46.87
T_4	40.10	10.54	13.90	2.94	7.05	1.93	6.85	1.60	268.53	70.60
20_4	34.40	7.37	12.10	2.47	6.00	2.13	6.30	1.38	276.60	59.29
40_4	28.65	6.28	11.50	2.59	6.00	1.77	5.50	1.54	292.14	64.00
60_4	26.30	5.69	13.20	1.77	6.90	1.07	6.30	1.53	411.15	89.03

TABLE 3.25

Means and Standard Deviations for Multiple Choice and Set Relations for Presentation Rate and Deletion Level Main Effects in the Listening Treatments Compared to the Listening/Reading Treatments

		Multiple Choice		Set Relations	
Variables	N	Mean	SD	Mean	SD
Rate					
175	160	38.02	10.07	12.61	2.50
275	160	36.93	9.10	12.54	2.27
400	160	29.79	9.30	12.26	2.73
Deletion					
T	120	41.85	8.86	13.32	2.54
20	120	38.47	9.83	12.59	2.59
40	120	31.56	8.03	11.92	2.31
60	120	27.77	7.19	12.06	2.36
Listening	240	32.52	10.06	12.22	2.62
Listening/Reading	240	37.31	9.90	12.72	2.37

TABLE 3.26

Results of 3 x 4 x 2 ANOVA for Multiple Choice in the Listening Treatments Compared to the Listening/Reading Treatments

Source	df	MS	F	p
Between Conditions	23	1069.31	-	-
Presentation Rate (WPM)	2	3194.39	58.64	<.001
Deletion Level (DL)	3	4921.08	90.34	<.001
Modality (M)	1	2759.78	50.67	<.001
WPM x DL	6	56.20	1.03	ns
WPM x M	2	41.02	0.75	ns
DL x M	3	34.04	0.62	ns
WPM x DL x M	6	26.82	0.49	ns
Within Conditions	456	54.47	-	-
Total	479	103.20	-	-

For Presentation Rate, the Scheffé analysis indicated significant differences ($p<.001$) between Ss assigned to both the 175 wpm rate ($\bar{X}$ = 38.02) and 275 wpm rate ($\bar{X}$ = 36.93) when these were compared to the highest 400 wpm rate ($\bar{X}$ = 29.79). Subjects given the 400 wpm rate answered 22% fewer items correctly than Ss assigned to the 175 wpm rate and 19% fewer items correctly than Ss assigned to the 275 wpm rate.

The Scheffé comparison yielded significant differences between each of the four Deletion Levels. Subjects assigned T answered significantly more items correctly than Ss assigned the 20, 40, and 60 reduced versions. Subjects assigned to the T story answered 34% more items correctly than Ss who were assigned to the 60% deleted material. In addition, on the 20 version Ss answered 18% more items correctly than on the 40 version and 29% more items correctly than on the 60 version. The comparison of the 40 and 60 versions revealed that Ss answered 13% more items correctly on the 40% reduced story.

The means and standard deviations for the 3 x 4 x 2 ANOVA for set relations are presented in Table 3.25. The ANOVA which is presented in Table 3.27, yielded significant differences for the main effects of Deletion Level [$F(3,456) = 8.22$, $p<.001$] and Modality [$F(1,456) = 5.29$, $p<.05$]. A significant interaction effect was found among the three main effects of Presentation Rate, Deletion Level, and Modality [$F(6,456) = 3.18$, $p<.005$]. The Scheffé analysis revealed that significant differences existed between the T and 40 and between the T and 60 story materials. Subjects answered 7% fewer items on both 40 and 60 than on the T version. The Scheffé test failed to reveal where the differences were in the

TABLE 3.27

Results of 3 x 4 x 2 ANOVA for Set Relations in the Listening Treatments Compared to the Listening/Reading Treatments

Source	df	MS	F	p
Between Conditions	23	14.26	-	-
Presentation Rate (WPM)	2	5.75	0.98	ns
Deletion Level (DL)	3	48.31	8.22	<.001
Modality (M)	1	31.10	5.29	<.05
WPM x DL	6	1.81	0.31	ns
WPM x M	2	3.90	0.66	ns
DL x M	3	3.24	0.55	ns
WPM x DL x M	6	18.67	3.18	<.005
Within Conditions	456	5.88	-	-
Total	479	6.28	-	-

pairwise comparisons of the 24 treatment conditions.

Means and standard deviations for the 3 x 4 x 2 ANOVA for nested and disjunctive are shown in Table 3.28. The separate 3 x 4 x 2 ANOVA designs, presented in Tables 3.29 and 3.30, performed on the nested and disjunctive items yielded significant differences for both parts of the set relations test. For the nested items an F of 2.82, df = 6.456, $p<.05$ was found for the interaction of the combined main effects of Presentation Rate, Deletion Level, and Modality. The respective probability levels were .09, .06, and .08 for Deletion Level, Modality, and Deletion x Modality; the Scheffé analysis, however, failed to reveal where the exact differences were in the pairwise comparisons for all 24 treatment conditions.

TABLE 3.28

Means and Standard Deviations for Nested and Disjunctive for Presentation Rate and Deletion Level in the Listening Treatments Compared to the Listening/Reading Treatments

		Nested		Disjunctive	
Variables	N	Mean	SD	Mean	SD
Rate					
175	160	6.52	1.69	6.07	1.39
275	160	6.34	1.57	6.21	1.42
400	160	6.26	1.93	6.01	1.61
Deletion					
T	120	6.64	1.76	6.66	1.42
20	120	6.48	2.01	6.12	1.49
40	120	6.17	1.59	5.74	1.34
60	120	6.20	1.51	5.88	1.49
Listening	240	6.23	1.77	5.97	1.52
Listening/Reading	240	6.52	1.69	6.23	1.42

TABLE 3.29

Results of 3 x 4 x 2 ANOVA for Nested in the Listening Treatments Compared to the Listening/Reading Treatments

Source	df	MS	F	p
Between Conditions	23	4.97	-	-
Presentation Rate (WPM)	2	3.04	1.05	ns
Deletion Level (DL)	3	6.27	2.16	ns
Modality (M)	1	9.91	3.41	ns
WPM x DL	6	1.36	0.47	ns
WPM x M	2	1.55	0.53	ns
DL x M	3	6.41	2.21	ns
WPM x DL x M	6	8.19	2.82	<.05
Within Conditions	456	2.91	-	-
Total	479	3.01	-	-

TABLE 3.30

Results of 3 x 4 x 2 ANOVA for Disjunctive in the Listening Treatments Compared to the Listening/Reading Treatments

Source	df	MS	F	p
Between Conditions	23	4.51	-	-
Presentation Rate (WPM)	2	1.77	0.86	ns
Deletion Level (DL)	3	19.64	9.54	<.001
Modality (M)	1	8.26	4.01	<.05
WPM x DL	6	1.26	0.61	ns
WPM x M	2	1.26	0.61	ns
DL x M	3	1.19	0.58	ns
WPM x DL x M	6	3.22	1.56	ns
Within Conditions	456	2.06	-	-
Total	479	2.18	-	-

For the disjunctive items, significant differences were found to exist for the Deletion Level [$F(3,456) = 9.54$, $p<.001$] and Modality [$F(1,456) = 4.01$, $p<.05$] main effects. The Scheffé comparison revealed significant differences between groups T and 20 ($p<.05$), T and 40 ($p<.001$), and T and 60 ($p<.001$). Subjects assigned to the T material answered 6% more items correctly than Ss assigned the 20 version, and 8% more items correctly than Ss assigned to the 40 and 60 versions.

Means, standard deviations, and the ANOVA for EWC are presented in Tables 3.31 and 3.32. The 3 x 4 x 2 ANOVA design for effective word per minute comprehension rate (EWC) revealed highly significant differences for Presentation Rate [$F(2,456) = 234.87$, $p<.001$], Deletion Level [$F(3,456) = 9.29$, $p<.001$], and for Modality [$F(1,456) =$

TABLE 3.31

Means and Standard Deviations for EWC for Presentation Rate and Deletion Level Main Effects in the Listening Treatments Compared to the Listening/Reading Treatments

Variables	N	Mean	SD
Rate			
175	160	161.74	49.05
275	160	243.54	61.71
400	160	285.50	87.36
Deletion			
T	120	192.46	67.74
20	120	209.64	64.95
40	120	223.44	69.24
60	120	295.51	96.63
Listening	240	213.38	78.02
Listening/Reading	240	247.14	88.63

TABLE 3.32

Results of 3 x 4 x 2 ANOVA for EWC in the Listening Treatments Compared to the Listening/Reading Treatments

Source	df	MS	F	p
Between Conditions	23	97314.18	-	-
Presentation Rate (WPM)	2	633842.00	234.87	<.001
Deletion Level (DL)	3	246367.40	91.29	<.001
Modality (M)	1	136800.40	50.69	<.001
WPM x DL	6	6943.26	2.57	<.05
WPM x M	2	11409.78	4.23	<.05
DL x M	3	5800.02	2.15	ns
WPM x DL x M	6	2126.82	0.79	ns
Within Conditions	456	2698.68	-	-
Total	479	7241.81	-	-

50.69 $p<.001$]. In addition, there was a significant interaction effect between Presentation Rate and Deletion Level [$F(6,456) = 2.57$, $p < .05$]. Figure 3.6 presents the nature of this interaction. A significant interaction effect was found to exist also between Presentation Rate and Modality [$F(2,456) = 4.23$, $p<.05$]. Figure 3.7 shows the nature of this interaction effect.

The pairwise comparisons of these three main effect independent variables by the Scheffé test indicated significant differences. The three levels of Presentation Rate were all found to differ at the <.001 level of probability. Effective word per minute comprehension (EWC) mean rates were 161.74 for the 175 wpm presentation speed, 243.54 for 275 wmp, and 285.50 for the 400 speed. The 400 presentation speed was 124 wmp (43%) more efficient than the 175 wpm rate and 42 wpm (15%) faster than at the 275 wpm rate.

Significant differences were found for Deletion Levels between the T story version and the 40 [$F(3,456) = 7.11$, $p<.001$] and between the T and the 60 [$F(3,456) = 78.71$, $p<.001$]. The 20 and 60 versions and the 40 and 60 versions were significantly different also at the .001 level of probability. EWC was 31 wpm (14%) faster for the 40 and 104 wpm (35%) for the 60 as compared to the T version. In addition. EWC for the 60 version was 86 wpm (29%) faster than for the 20 and 70 wpm (25%) faster than for the 40. The mean EWC rates for the T, 20,40, and 60 versions were 192.45, 209.64, 223.44, and 295.51, respectively.

The means and standard deviations for the five dependent variables for the 12 Listening treatments compared to the 12 Listening/ Reading treatments are presented in Table 3.33.

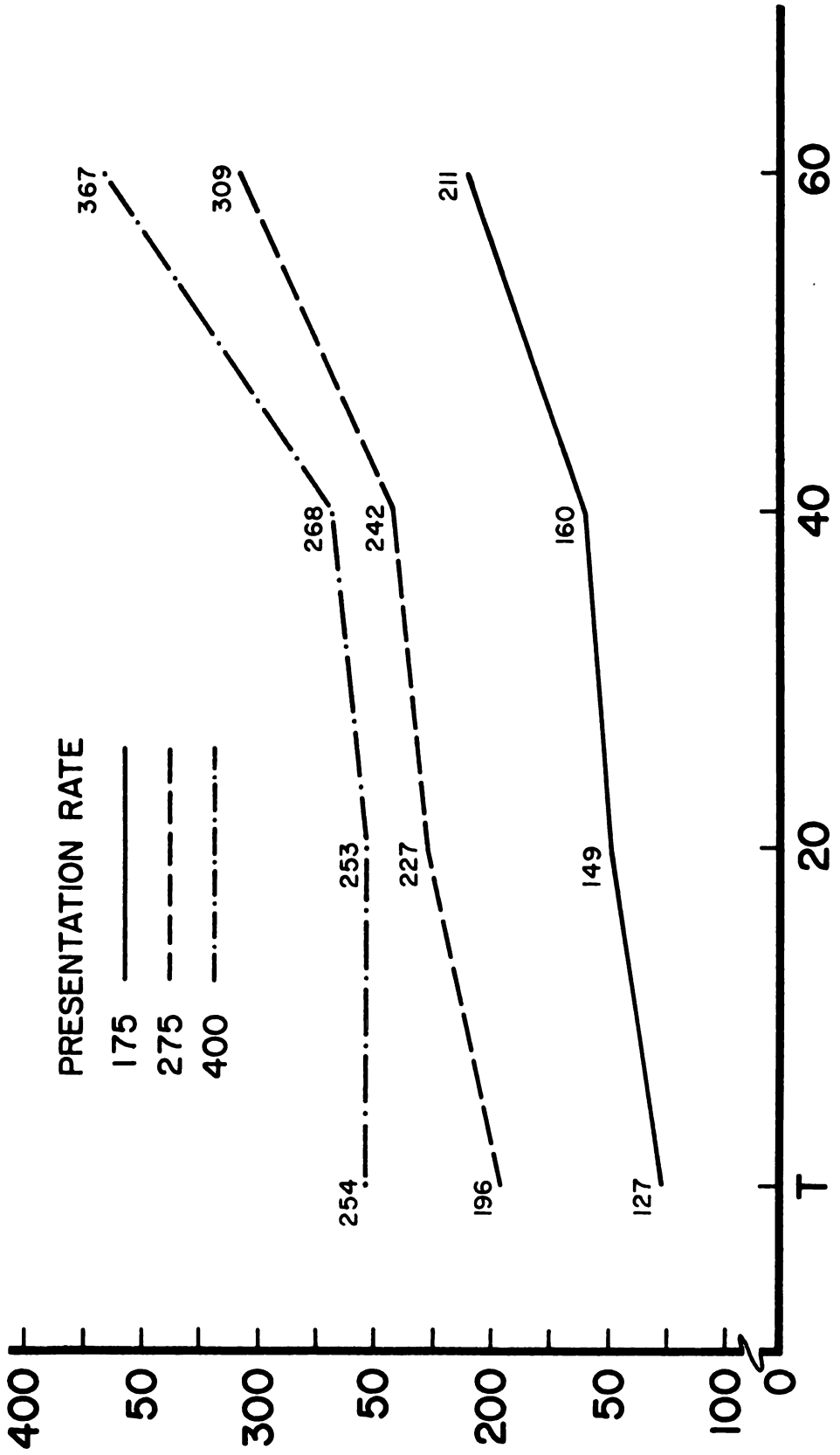


FIGURE 3.6 INTERACTION BETWEEN PRESENTATION RATE AND DELETION LEVEL MAIN EFFECTS FOR EWC IN THE 3 x 4 x 2 ANOVA.

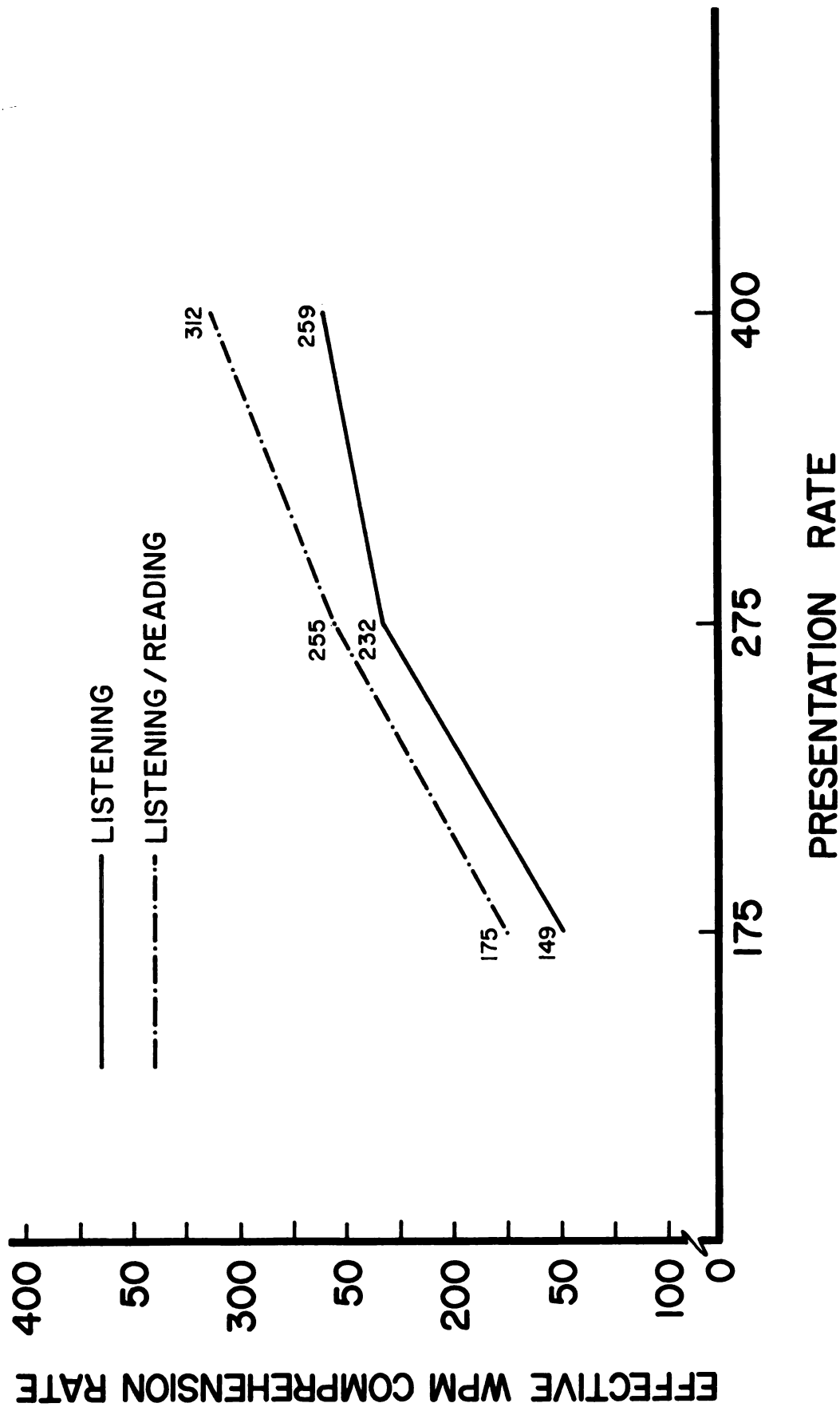


FIGURE 3.7 INTERACTION BETWEEN PRESENTATION RATE AND MODALITY FOR EWC IN THE 3 x 4 x 2 ANOVA.

TABLE 3.33

Means and Standard Deviations for Each of the Five Dependent Variables in the Listening Treatments Compared to the 12 Listening/Reading Treatments

Treatment Conditions	Variables: Multiple Choice Mean	Multiple Choice SD	Set Relations Mean	Set Relations SD	Nested Mean	Nested SD	Disjunctive Mean	Disjunctive SD	EWC Mean	EWC SD
T_1	44.25	7.97	13.17	2.80	6.75	1.81	6.42	1.41	127.43	22.95
20_1	42.38	9.90	12.88	2.61	6.72	1.81	6.08	1.69	149.11	34.85
40_1	34.72	8.13	12.05	2.63	6.27	1.80	5.78	1.29	159.79	37.43
60_1	30.72	7.82	12.35	1.75	6.35	1.27	6.03	1.07	210.63	53.27
T_2	43.38	8.04	13.70	1.76	6.85	1.46	6.85	1.10	195.98	36.32
20_2	41.55	7.93	12.57	2.61	6.20	2.00	6.38	1.31	226.51	43.24
40_2	33.65	6.86	11.88	1.81	6.17	1.22	5.70	1.38	242.34	49.40
60_2	29.15	5.04	12.02	2.39	6.13	1.44	5.93	1.61	309.32	53.26
T_4	37.92	9.36	13.07	2.91	6.32	1.97	6.70	1.70	253.96	62.66
20_4	31.50	7.65	12.32	2.59	6.52	2.21	5.90	1.45	253.28	61.51
40_4	36.30	6.37	11.82	2.47	6.05	1.74	5.75	1.39	268.18	64.91
60_4	23.45	6.41	11.80	2.83	6.13	1.80	5.68	1.72	366.59	100.26

CHAPTER IV

DISCUSSION

The results of this multifactor design were highly significant for each of the three main effects of Presentation Rate, Deletion Level, and Modality. On the 3 x 4 x 2 ANOVA significant interaction ($p<.005$) was present for the set relations test score but the Scheffé post hoc analysis revealed the differences to exist solely between the T form as compared to the 40 and 60 reduced versions of "San Francisco." No other significant interactions were found by the Scheffé test on the pairwise analysis of the 24 experimental groups for the set relations data. The most significant interaction was obtained in the 3 x 4 x 2 ANOVA for the effective word per minute comprehension (EWC) variable. This interaction existed between Presentation Rate and Deletion Level and between Presentation Rate and Modality. (Figures 3.6 and 3.7).

Presentation Rate

For Presentation Rate, comprehension was maintained at the 275 wpm speed at almost the same level as at 175 wpm for both the Listening and Listening/Reading treatment conditions. Comprehension was 68% at these two speeds for Listening and 79% for Listening/Reading for the T story form. Comprehension for Ss assigned to the 400 wpm rate decreased to 60% for Listening and to 67% for Listening/Reading on the T version. The Ss assigned to the Reading treatment condition

read the T story at a mean rate of 295 words per minute with almost the same comprehension (80%) as Ss assigned to the T version at the 275 wpm rate in the Listening/Reading treatment condition (77%).

Deletion Level

For Deletion Level, comprehension for the 20% reduction was almost as high as that for the T version for both Listening and Listening/Reading at the 175 and 275 wpm rates. The Reading modality resulted in a significant decrease (14%) in comprehension for the 20 as compared to the T story. The actual wpm reading rate for Ss assigned to the T and 20 versions for the Reading treatments was almost as fast for the 20 (285 wpm) as for the T (295 wpm).

The 20 version resulted in significantly reduced comprehension from that of the T version for both Listening and Listening/Reading at the 400 wpm rate. At 40% deletion, comprehension dropped significantly for all treatment conditions as compared to the T and 20 materials. Subjects assigned to the 40 version, however, answered almost the same percentage of answers correctly at 275 wpm as at 175 wpm for the Listening (55%) and the Listening/Reading (59%) treatment conditions. In addition, for the Reading treatments, Ss assigned to the 40% deletion story scored an average of 56% correct at a mean reading rate of 237 wpm. The high telegraphic version of 60% deletion resulted in a 1% higher comprehension score than the 40% deletion in the Reading treatment conditions. Actual wpm reading rate decreased by a significant 101 wpm for the 60 as compared to the 40, however. The Ss assigned to the 60 at 175 wpm for the Listening/Reading modality obtained an average comprehension score of 58% as compared to 57% for the 60 for the Reading modality where Ss

mean reading rate was 136 words per minute. The most significant decrements in comprehension for both the Listening and Listening/Reading groups occurred between the 20 and 40 Deletion Levels at all except the fastest 400 wpm presentation. At 400 wpm even the 20% Deletion Level resulted in a significant reduction in comprehension for both the Listening and Listening/Reading treatments. As shown in Table 4.1, the 40% deletion resulted in significant loss of comprehension in all treatment conditions and was the point of diminishing returns for efficiency in telegraphic style prose for this study.

Table 4.1 compares each of the total 28 treatment conditions by the percent of items correct on the multiple choice test. This table shows both the effect of Deletion Level on comprehension within each Presentation Rate and the effect of Presentation Rate on comprehension within each Deletion Level. In addition, the percent of increase in comprehension for Listening/Reading as compared to Listening is presented for each treatment condition.

Modality

As can be observed in Table 4.1, the Modality main effect resulted in consistently higher comprehension scores for the Listening/Reading treatments as compared to the Listening treatment conditions. The Listening treatments also resulted in lower comprehension scores than the T story Reading treatment. This finding corresponds to the Martin and Hope (1972) study in which the aural modality was found to produce consistently lower comprehension scores than the visual (reading) modality. The reason for this may be that normal college level Ss are not as accustomed to learning by listening without at least

TABLE 4.1

Percent Correct for Multiple Choice Test Showing the Effect of Deletion Level, Presentation Rate, and Modality for All 28 Treatment Conditions

Reading			
Control Treatment Conditions	Reading Rate	% Correct	% Difference
T	295	80	
20	285	65	-15
40	237	56	- 9
60	136	57	+ 1

Experimental Treatment Conditions	Listening			Listening/Reading			% Increase of L/R over L
	%C	%DL	%PR	%C	%DL	%PR	
T_1	68			80			+12
20_1	66	- 2		76	- 4		+10
40_1	56	-10		60	-16		+ 4
60_1	45	-11		58	- 2		+13
T_2	68		0	77		- 3	+ 9
20_2	65	- 3	- 1	73	- 4	- 3	+ 8
40_2	54	-11	- 2	58	-15	- 2	+ 4
60_2	47	- 7	+ 2	50	- 8	- 8	+ 3
T_4	60		- 8	67		-10	+ 7
20_4	48	-12	-17	57	-10	-16	+ 9
40_4	40	- 8	-14	48	- 9	-10	+ 8
60_4	34	- 6	-13	44	- 4	- 6	+10

Legend: C = % items correct.

DL = % difference in items correct due to Deletion Level within one wpm rate as between T_{125} and 20_{175}

PR = % difference in items correct due to Presentation Rate within one level of deletion as between T_{175} and T_{275}

reinforcement of the material through reading or the writing of notes as in class lectures.

The Listening/Reading modality failed to produce higher comprehension scores in any of the 12 treatment conditions than the T story version Reading treatment. As illustrated in Table 4.1, however, the combined Listening/Reading modality produced better comprehension scores on five treatments (T_1, 20_1, T_2, 20_2, T_4) than the 20 version Reading treatment. In addition, all but three of the 12 Listening/Reading treatments exceeded the 40 and 60 Reading treatments.

A possible explanation for the Listening/Reading treatments failure to produce comprehension scores any higher than the T story Reading treatment may lie in Ss' total lack of experience or exposure to either the presentation style of telegraphic prose or compressed speech. An additional reason for this which might be posed is the unresolved controversy in the research literature regarding information processing with combined aural and visual inputs. Broadbent (1958) and Jester (1966) believe that individuals cannot efficiently use the two modalities concomitantly.

Jester's work has established that some individuals are more adapted to the aural modality than to the visual or vice versa. Since individuals from each of the modality class preferences have been used as Ss in research involving the simultaneous presentation of visual and aural modalities without taking this individual propensity for learning into account, Jester states that this has led to the erroneous conclusion that the joint presentation of the two modalities is the most effective. His research indicates that it is inevitable that a simultaneous listening and reading task would yield higher comprehension scores than when only one modality was used due to the

fact that each S selects the one modality that he finds most efficient.

The Ss' preference for and reliance upon listening and reading for learning (see Tables 4.5 and 4.6) in this study, however, tend to negate the idea that only one modality at a time can be used efficiently by an individual.

Reading Rate

The Ss in the developmental reading course who were assigned to the Reading treatment conditions had been given intensive training in increasing reading speed and comprehension for eight weeks in the semester prior to this study. Thus, in effect, these 80 Ss could be interpreted to have received training for this study while the 480 Ss in the Listening and Listening/Reading treatment groups did not.

The obtained reading rates were significantly higher than those obtained on comparable S populations for the same "San Francisco" materials at Texas A&M University. Whether or not this was a result of the training received in the developmental reading course cannot be unquestionably established. The effect of these higher than expected reading rates, however, was to make the experimental Listening and Listening/Reading treatments appear less efficient by comparison than these treatment conditions may actually be. Had the reading rates obtained at Texas A&M University been used for the comparison control, the experimental treatments would have appeared significantly more efficient. In addition, it could be argued that the Ss in the Listening and Listening/Reading treatments should have received prior intensive training because it has been established that Ss' comprehension can be improved significantly for fast rates of compressed

speech when practice sessions are given prior to a test of comprehension (Orr, 1965).

In the Reading treatment conditions less actual time was required to read the three telegraphic versions than the traditional, uncondensed text. The mean reading times for the 20, 40, and 60 versions were 15, 24, and 10% less than for the T version. Reading time for the 60, however, was 5% longer than for the 20 and 14% longer than for the 40 version. This resulted in a significant decrease in wpm reading rate for the 40 and 60 telegraphic versions in comparison to the T text. The 60 version was read at less than one-half the rate of the T version. As predicted on the basis of this same finding in the Martin and Alonso (1967), Martin and Herndon (1972), Pantalion (1972), and Sheffield (1972) studies, the high telegraphic version was read at a markedly reduced rate.

High telegraphic material seems unquestionably more difficult to comprehend as Ss must both compensate for the deleted words and deal with the extreme compaction of information in the input process. Thus, in order to read such material with adequate comprehension, Ss automatically decrease their normal reading speed. Martin and Hope (1972) concluded the slower rate to result from the compactness of information. It is speculated here that the decrease in redundancy may be the cause of this drastic decrement.

In the Listening and Listening/Reading groups when Ss were forced to increase their voluntary rate of information processing, multiple choice comprehension scores were 12% lower for Listening to the 60 at 175 wpm and yet only 10% lower for 60 at 275 wpm than the score for Reading the 60 for which the mean reading rate was 136 wpm. The

Listening/Reading mean score for the 60 at 175 wpm was equivalent to the Reading 60 at 136 wpm, and the Listening/Reading comprehension score for the 60 at 275 wpm was only 7% less than the Reading 60 at 136 wpm (which was less than one-half of the Listening/Reading presented rate).

The decrease in reading rate on the 40 and 60% reduced story versions, as established in the previous research studies on telegraphic prose, supports the notion that the telegraphic material is more informationally compact and therefore more difficult. The ability of Ss to process the material with only 7% less comprehension when they were forced to double their voluntary reading rate in the 275 wpm Listening/Reading treatment was thus somewhat surprising. Two possible explanations are proposed for this:

1. The combined Listening/Reading modality may have served as a significant reinforcer especially in the 40 and 60% reduced versions. Students may have used the two simultaneously presented modalities more efficiently than the Reading or Listening modality alone.

2. Although Ss voluntarily decrease their reading rate when faced with high telegraphic materials, they actually may be able to comprehend the material at a faster input rate if they are forced to do so. Many Ss assigned to the Listening/Reading 60 version at 275 wpm noted that although they believed they had little recall of the material at the end of the presentation, facts seemed to come to mind when the test questions were read. The objective test measure surely aided such recall more than an essay evaluation would have done.

Specific Comparison of Treatments

Basic to this study was the determination of which treatment conditions produced acceptable levels of comprehension. The comparison of one modality against the others was thus essential in order

to find which treatment conditions produced the most efficient processing of information. Reading is without question the mode of learning which is: (1) required of and therefore relied upon by students at every educational level, (2) fundamental to every academic learning environment, and (3) essential to the total foundation of formal education. Thus, to further illustrate the effect of each treatment condition, Table 4.2 shows which of the experimental Listening and Listening/Reading treatment conditions corresponded most closely to the four control Reading treatments for comprehension scores and word per minute rates.

In order to compare each treatment condition for its practical efficiency in yet an additional form than presented in Tables 4.1 and 4.2, the mean 80% comprehension level of the T story Reading treatment was established as the reference measure. As the norm, this 80% (or raw score of 47.70) was thus assigned a standard value of 100% which permitted comparison with each of the 12 Listening, the 12 Listening/Reading, and the three remaining Reading experimental conditions. Table 4.4 presents this comparison of the total 28 treatment groups. Therefore, the raw score of 47.70 (48) or 80% correct equals the baseline by which to calculate what percentage of this standard norm each group achieved. The mean raw scores and percentages were rounded to the nearest whole number for this comparison. The EWC variable, as explained previously, is a measure of learning efficiency calculated by dividing the total number of words in the T story version (2692) by the tape time (or reading rate for the Reading treatments) and then multiplying the resulting number by the percent of test items correct.

TABLE 4.2

Reading Treatment Conditions Compared to Listening and Listening/Reading for Multiple Choice Test

Reading Conditions				Listening or Listening/Reading Conditions Corresponding Most Closely to Reading			
Deletion Level	$\bar{X}$ WPM	$\bar{X}$ Score	% Correct	Treatment Condition	$\bar{X}$ WPM	$\bar{X}$ Score	% Correct
T	295	47.70	80	L/R T_1	175	47.50	80
				L/R 20_1	275	45.95	76
				L/R T_2	175	45.35	77
				L/R 20_2	275	43.95	73
20	285	38.70	65	LT_2	275	40.80	68
				L/R T_4	400	40.10	67
				L 20_1	175	39.40	66
				L 20_2	275	39.15	65
40	237	33.75	56	L/R 40_2	275	35.05	58
				L/R 20_4	400	34.40	57
				L 40_1	175	33.65	56
				L 40_2	275	32.25	54
60	136	34.10	57	LT_4	400	35.75	60
				L/R 60_1	175	34.60	58
				L/R 40_2	275	35.05	58
				L/R 20_4	400	34.40	57

The data from the Reading group of 20 Ss assigned to the T story were used as the control or baseline for the comparison of the two other modalities, Listening and Listening/Reading, for all 24 experimental treatment conditions. The results of the Control Reading treatment, (Traditional story version) are reviewed as follows in Table 4.3.

TABLE 4.3

Reading Comprehension for the Traditional Version for the Multiple Choice Test

	Mean
Reading Time	9.3 minutes
Reading Rate	295 wpm
Raw Score	47.50
Percent Correct	80 (Range 95-57%)
EWC (295 wpm x 80%)	235 wpm

As inspection of Table 4.4 shows, Listening at 400 wpm to the T version was slightly more efficient on EWC than reading the T version. Although comprehension decreased for the T story at the 400 wpm rate for Listening, the input rate was 105 wpm faster than for the T version Reading condition, making it more efficient when task time and comprehension level were analyzed together. This is somewhat surprising for three reasons. First, the aural modality was expected to and did result in lower comprehension scores generally for normal college Ss who are not used to relying solely on listening in learning

TABLE 4.4

Comparison of All of the Experimental Treatment Conditions to the Control Reading Condition (Traditional) for the Multiple Choice Test

Treatment Condition	Mean Raw Score	% of Normal	EWC	+ 235	* $235\bar{c}$ 75-89%	** $235\bar{c}$ 90-100%
READING						
T (CONTROL)	48	100	235			
20	39	81	229			
40	34	70	221			
60	34	72	191			
LISTENING						
T_1	41	85	118			
20_1	39	81	139			
40_1	34	71	155			
60_1	27	56	184			
T_2	41	85	184			
20_2	39	81	213			
40_2	32	67	232			
60_2	28	58	299	+		
T_4	36	75	239	+	*	
20_4	29	60	230			
40_4	24	50	244	+		
60_4	21	44	322	+		
LISTENING/READING						
RT_1	48	100	137			
R 20_1	45	94	160			
R 40_1	36	75	165			
R 60_1	35	73	237	+		
RT_2	46	96	208			
R 20_2	44	92	240	+	*	**
R 40_2	35	73	252	+		
R 60_2	30	63	320	+		
RT_4	40	83	269	+	*	
R 20_4	34	71	277	+		
R 40_4	29	60	293	+		
R 60_4	26	54	411	+		

and testing situations. Martin and Hope's study (1972) also found that listening comprehension scores were lower than reading scores even at a normal conversation speech rate (120 wpm). However, listening comprehension for the T story at 400 wpm was better than predicted and produced a higher EWC rate than the Reading control treatment. Secondly, the research in compressed speech has established that presentation rates of over 275 to 300 wpm result in greatly reduced comprehension of material. Thirdly, these Ss had no experience or training in listening to compressed speech and the initial sound and speed of the 400 wpm tape had an obvious startling and distracting effect on most Ss.

The 20 version at 275 wpm for Listening (20_2) was equivalent in comprehension (81%) and EWC to the Reading condition with 20% deletion. Actual wpm reading rate for the 20 version Reading treatment was 285 wpm which is also comparable to the 275 wpm aural tape. The equivalency of these two groups was also somewhat unexpected as the Listening treatments were predicted to produce a lower level of learning efficiency in general than the Reading treatments.

EWC for treatment condition L/R 60_1 (Listening/Reading, 60 deletion at 175 wpm) was also equivalent to condition T_4 (Listening, T version at 400 wpm) and to the Reading rtreatment for the 20 version of the material although actual comprehension was lower for the L/R 60_1 group. The Listening/Reading condition for the 20 version at 275 wpm (L/R 20_2) was the treatment corresponding most closely to the T version Reading control treatment for EWC.

For the Listening modality, the T and 20 treatments at 275 wpm (T_2 and 20_2) and the T at 400 wpm (T_4) were most efficient. The same

three conditions L/RT_2, L/RT_4 were the most efficient for the Listening/Reading modality.

Effective Word Per Minute Comprehension (EWC)

The EWC measure is of significance in assessing information processing via telegraphic prose/compressed speech techniques as studied in this research. EWC is a relatively simple concept which was designed for this research project to measure learning based on both presentation time and amount of material recalled. Its formula results in a word per minute rate calculation similar to that consistently used in education and psychology to calculate an individual's reading rate. EWC is the more meaningful of the two measures, however, as it is a ratio of both comprehension and speed. The basic goal of this research was to study the effects of the combined techniques of telegraphic prose and compressed speech on the efficiency of information processing. The experimental alteration of the stimulus material (traditionally written prose version) and the rate of input(compressed speech tapes) was designed to study the potential of increasing the Ss' learning efficiency relative to time. Consequently, an appropriate measure of rate of word comprehension had to be based on the total number of words found in the tradtional or original version of the prose material to accurately assess the amount of information processed from the reduced telegraphic materials. Thus, EWC (Table 4.4) denotes specifically the efficiency of each experimental condition. The EWC dependent variable is probably the most important one of this study and the understanding of it is essential to analysing the adequacy of each of the experimental treatments.

Prestudy Self-Rating Form

A total of 486 undergraduate Ss completed a self-rating form on preferred mode of learning, reading rate, and conversational speech rate (Appendix F). This was done in 22 different classes by Ss volunteering to participate prior to the actual study.

As shown in Table 4.5, the majority of Ss (65%) indicated that the combined modes of listening and reading were the most efficient for learning. This was not an expected finding, as it had been assumed that a greater percentage of Ss would cite reading as the most efficient mode of learning. Thus, the additional fact that significantly more Ss cited listening than reading as the most efficient method of learning was totally unexpected. Twenty percent of the female Ss and 33% of the male Ss believed listening to be the best means of learning as contrasted with the respective 14% and 4% who believed reading is most efficient. Thirty-three percent of the male Ss also ranked their own reading rate as slow. Only 6% of the male Ss ranked their reading rate as fast.

Speculation on the significance of these findings might be postulated regarding basic pedagogic approaches to learning and the need for new instructional modes to be developed and made readily available to increase individual learning efficiency.

Posttest Modality Form for Listening/Reading Treatments

The modality check form used is shown in Appendix G. As Table 4.6 illustrates, the majority of Ss, by their own judgment, relied equally on the aural and visual modalities for input of information in the combined Listening/Reading treatment conditions. Reliance on

TABLE 4.5

Results of Subjects' Self-Rating on Mode of Learning Efficiency, Reading Rate, and Conversational Speech Rate

Question	Female		Male		Total Subjects Male-Female	
	Number	Percent	Number	Percent	Number	Percent
Most Efficient Mode of Learning						
Listening	77	20%	33	33%	110	23%
Reading	53	14%	4	04%	57	12%
Combined Listening/ Reading	256	66%	63	63%	319	65%
Conversational Speech Rate						
Slow	6	02%	10	10%	16	03%
Average	266	69%	74	74%	340	70%
Fast	114	29%	16	16%	130	27%
Reading Rate						
Slow	75	19%	33	33%	108	22%
Average	252	65%	61	61%	313	64%
Fast	59	16%	6	06%	65	14%
TOTAL	386		100		486	

TABLE 4.6

Modality Relied Upon Most in Listening/Reading Treatment Conditions as Checked by Each Subject

Treatment Condition	Female			Male		
	Aural	Visual	A/V Equally	Aural	Visual	A/V Equally
175 WPM						
T	2	2	10	2	1	3
20	1	3	10	0	1	5
40	1	2	12	3	0	2
60	4	1	10	3	1	1
275 WPM						
T	3	4	9	0	1	3
20	3	4	9	0	1	3
40	2	2	11	2	1	2
60	2	5	7	3	1	2
400 WPM						
T	2	3	11	1	2	1
20	2	6	6	2	1	3
40	0	9	5	1	3	2
60	0	4	7	1	8	0
Total						
175	8	8	42	8	3	11
275	10	5	36	5	4	10
400	4	5	29	5	14	6
Total	22	45	107	18	21	27
Percent of Total	13%	26%	61%	27%	32%	41%
Females/174						
Males/66						
Total % for All 240 Ss	17%	27%	56%			

listening only was predicted to decrease for the 40 and 60 deletions especially at the 275 and 400 wpm rates. However, increased reliance on reading only, rather than on the combined modalities equally, was also predicted for those treatment conditions. Significantly more males (27%) than females (13%) preferred to rely on listening alone. This is noteworthy because only 4% of the 100 males responding to the prestudy self-rating form checked reading as their most efficient mode of learning.

The results of this form lend support to Ss' preference for and ability to use two sensory modalities simultaneously in learning. It is also in agreement with the prestudy self-rating form (Table 4.5) on which the majority of Ss indicated that combined listening/reading is more efficient for learning than either of these modes of learning alone.

Telegraphic Prose

Problems continue to exist in determining the most efficient means to generate telegraphic prose. Although research is presently continuing in this area, no objective reduction method has yet been found which compares to the systematic discard rules existing for the compression of speech. The definition of essential information within varying deletion levels of telegraphic material is another unsolved problem. The Dawes' (1964) set relations model which provides a basis for defining and measuring the essential information in different versions of prose material was not supported in this study. Similar results contradictory to Dawes' data and theory were found by Martin (1967) and Sheffield (1972). More

reliable means of defining and measuring the essential information must be determined before telegraphic prose can be made efficient for broader pedagogic use. Objective measurement to compare the different levels of word deletion contained some bias even in this study in which the prose and test materials were specifically created for application of the telegraphic concept. Although the 60 multiple choice and 20 set relations items in the test were designed from the most reduced, 60% deleted version, the omission of key words in this version caused significant ambiguity in answers to a number of the questions. As part of this project, two impartial adult readers were asked to try to correctly answer all test items from this 60% reduced version. Despite careful study of the text, both of these readers judged several questions to be confusing and unanswerable.

In comparing this highly-telegraphic form of the story with the T and 20% deleted versions, it was evident that not only the text but the test itself was more difficult for Ss assigned to the 60 and possibly the 40 versions. Despite these problems, telegraphic prose appears to be a valid and as yet untapped concept which could be applied effectively in a variety of learning environments. The existing technical problems discussed here are being investigated by continuing research under the direction of Dr. Clessen J. Martin at Texas A&M University.

Comparison of Findings with Previous Telegraphic Prose Research

Although Pantalion's (1972) study indicated that up to 40% deletion of material produced no significant loss in comprehension and

Sheffield (1972) concluded that the point of optimum reduction was somewhere between 30 and 50%, Martin and Herndon (1972) found a significant decrease in comprehension at the 30% deletion level. Martin and Herndon used a university level subject population equivalent to that used in the present study. The prose story used by Martin and Herndon was at the sixth grade level of reading difficulty which is markedly less difficult than the 12th grade reading difficulty level of "San Francisco" which was used in this project. The higher difficulty material used here is suggested as one reason why there was a significant drop in comprehension for all treatment conditions assigned to the 40% deleted version. In addition, the difficulty level of "San Francisco" is more appropriate than any easier level materials for assessing the efficiency of telegraphic prose for a college level population. On this basis, the results of this study indicate that 40% deletion is too great both for acceptable comprehension and relative security and ease in processing the information regardless of the presentation mode of learning.

Significant interaction was found for the Modality main effect in the 3 x 4 x 2 ANOVA for EWC. This interaction existed between Presentation Rate and Modality. Because of this and because of the differences in both performance and individual preference for a specific mode of presentation, this study suggests firmly that comprehension of telegraphic materials is affected by and thus not independent of the presentation mode. This is contrary to the conclusion of Martin and Herndon's (1972) research.

Telegraphic Prose and Dawes' Set Relations Model

It was hypothesized that the total number of correct responses on the set relations test would decrease significantly for both the Listening and Listening/Reading modes for the 40 and 60 deletions at 275 wpm and for all versions at 400 wpm. This was only partially supported as significant differences among the mean scores were found only for the 40 and 60 deletion levels and were not affected by increasing the word per minute input rate.

On the basis of Dawes' (1964) model, fewer disjunctive or overgeneralization errors were predicted for the 40 and 60 versions than for the T version. Dawes found this in his research and he theorized that information overload would cause this in the longer and less condensed materials. Contrary to Dawes, significantly fewer disjunctive or overgeneralization errors existed for the T version than for the 40 and 60 materials for both the Listening and Listening/Reading modalities in this study. The postulate that the lack of detail in the highly reduced versions caused ambiguity of relationships and resulted in overgeneralization errors, which is opposite to Dawes' theory, is offered as an explanation for the results in this study.

Although the differences were not always significant, more disjunctive or overgeneralization errors than nested or pseudo-discrimination errors were found across all conditions. This finding agrees with Dawes but is contrary to the Martin (1967) and Sheffield (1973) studies which both found more nested than disjunctive errors. No significant differences were found for total set

relations items correct or between the nested and disjunctive scores for the four Reading treatment groups. In addition, none of the Reading treatment means which were T = 12.60, 20 = 12.05, 40 = 12.40, and 60 = 12.35 were significantly above the level of chance. As reading is the mode of learning used by Dawes (1964) as well as by Martin, Sheffield and others in the relatively small amount of research work that has been completed on telegraphic prose, it appears reasonable to argue that the set relations items are not a sound evaluation measure to discriminate the effects of telegraphic materials on comprehension. If so, the entire concept of using set relations as the basis of defining essential information in telegraphic prose may be challenged.

Time-Compressed Speech

Unlike telegraphic prose, the technical procedures for operationally defining and producing time-compressed speech pose no problem. The major difficulty exists in the expense of production equipment and creation of tapes which continues to make the availability and practical use of compressed speech materials minimal at the present time. Increased application of this valuable learning method depends on continued research work and dissemination of not only compressed speech material but knowledge of the concept itself. The results of this study support the use of time-compressed speech combined with telegraphic prose for didactic purposes.

Summary of Hypotheses

The main focus of this research was to study the effects of combining compressed speech and telegraphic prose upon comprehension. Although it was postulated that more efficient ways to process information are possible, it was assumed that individuals do have a limited capacity for input of information. The investigation of that capacity was one of the concerns of this study.

Because this research study used a unique combination of learning techniques, some of the hypotheses advanced were exploratory in nature.

Hypothesis one predicted a differential drop off rate in comprehension as a result of increasing the speech compression (Presentation Rate) and the word compaction (Deletion Level). Although a decrease in comprehension occurred, a differential drop off was not found as no significant interaction existed between these two main effects except for the EWC dependent variable. Previous research has established that comprehension does decrease at rates above 275 wpm. Thus, the speech compression technique was used also as a means of studying information density of telegraphic prose in this study. The lack of strong interaction effects are interpreted as not supporting the density aspect of telegraphic prose. Presentation Rate and Deletion Level main effects caused signficant decrements in comprehension which were additive rather than multiplicative.

Hypothesis two, which predicted that EWC would decrease at the high deletion levels and fast presentation rates, was rejected as

EWC increased at even the highest Presentation Rates and Deletion Levels (Table 4.4). Although there was a significant decrement in comprehension for the 40 and 60% Deletion Levels at the 275 and 400 wpm Presentation Rates, this decrease was offset by the faster presentation time. EWC increased progressively for each of the increased Presentation Rates and Deletion Levels. EWC increased a total of 204 wpm from the Traditional version at 175 wpm (EWC = 118) to the 60% reduced version at 400 wpm (EWC = 322) for the Listening Modality. For the combined Listening/Reading Modalities, EWC increased a total of 273 wpm from the Traditional version at 175 wpm (EWC = 138) to the 60% reduced version at 400 wpm (EWC = 411). The only decrease for EWC occurred in the control Reading treatments where it dropped from 235 wpm for the Traditional version to 191 wpm for the 60% telegraphic version. This decrement was a result of Ss voluntarily decreasing their actual wpm reading rate by 54% on the 60 version as compared with the Traditional prose story.

Hypothesis three stated that the most extreme experimental treatment conditions would input the material at too fast a rate and reduction level for Ss to adequately comprehend the material. This was confirmed on the basis of the multiple choice test as comprehension dropped well below acceptable limits. However, for the EWC variable where both task time and comprehension were considered, the 40 and 60% Deletion Levels at the 275 and 400 wpm Presentation Rates still appear too difficult for one exposure learning although not as unacceptable as was predicted.

Hypothesis four predicted that the combined Listening/Reading modalities would enhance comprehension compared with the Listening

modality alone. This hypothesis was confirmed. As shown in Tables 4.1 and 4.4, comprehension increased for each experimental treatment for Listening/Reading over Listening. Although the research literature remains controversial regarding the efficient use of two modalities simultaneously, the results of this study appear to confirm that Ss made efficient use of the combined modalities rather than relying on the selective use of only one (Tables 4.5 and 4.6).

Hypothesis five, which postulated that the majority of Ss would rely on the Reading modality alone for the 40 and 60% telegraphic versions at the 275 and 400 wpm rates for the combined Listening/Reading modalities, was rejected. This was surprising since it was predicted that the aural mode would be confusing and would tend to be ignored in these treatments. As illustrated in Tables 4.5 and 4.6, the majority of Ss continued to rely on both listening and reading for input of information.

The comparison of the experimental treatments to determine the most ideal combinations of Presentation Rate, Deletion Level, and Modality for increasing learning efficiency indicated that several of the treatment conditions enhanced information input and thus could be applied profitably to a variety of learning environments. For both Listening and the combined Listening/Reading modalities, the Traditional and 20% reduced versions at 275 wpm were the best and compared acceptably with the Reading control conditions for these versions. On a basis of time efficiency, however, Ss performed well enough on the Traditional and 20% reduced versions for both Listening and Listening/Reading at 400 wpm to indicate that

they could totally master the material by listening twice to these particular tapes which would require little additional time than for reading the material once. Listening to material under these conditions would be a boon to handicapped readers or to blind students. For the combined Listening/Reading modalities, the practical application of these experimental treatments should effect increased efficiency of information processing in normal learners at a variety of educational levels.

CHAPTER V

CONCLUSIONS

Reactions and Conclusions of Ss

Subjects' reaction to and attitude about any new mode of learning affects actual performance in mastering the material. Therefore reporting the Ss' major feedback and conclusions regarding telegraphic prose and compressed speech in this study is of import.

1. The majority of Ss believed the 60% deletion level was too high and resulted in confusion at any presentation speed.

2. Almost all Ss preferred increased speed over the 40 and 60% deletion levels. The preferred treatment conditions were the T and 20 versions at 275 wpm and the T version at 400 wpm. This was true both for the Listening and Listening/Reading conditions.

3. Many Ss reported having difficulty in maintaining concentration in listening to the T story at 175 wpm. Although this rate is slightly faster than that of the average professor or public speaker, it was not fast enough to command undivided attention. Some Ss who were assigned to Listening/Reading for this same treatment condition (L/RT_1) felt that the rate was too slow for ease in reading while simultaneously listening.

4. At least a third of the male Ss preferred to listen only. These Ss expressed great enthusiasm for the T version at the 400 wpm compressed speech tape as it was cited as: (1) commanding total concentration (2) being much more efficient and pleasurable than reading (3) making total retention of facts possible after listening to the tape twice. These Ss invariably classified themselves as poor readers and felt their learning rate would be enhanced if compressed speech tapes were available in place of some textbooks.

5. Almost all Ss assigned to the Listening/Reading mode for the 400 wpm treatment conditions believed this speed to be significantly faster than their own fastest reading rate. This is of significance in contrast to the claims made by commercial speed reading institutes which advertise that reading can be increased to as much as 4,000 to 10,000 words per minute in comparable S populations. University students are currently bombarded with such claims from the media and consequently believe themselves to be slow readers when in actuality their reading rate may be average or even above the norm.

6. Most of the graduate Ss assigned to listening treatment conditions were frustrated and concerned about their ability to comprehend aurally presented material. The graduate Ss not only expressed strong preference for the visual modality but even scored relatively low if assigned to a listening treatment condition. Although this observation is based on a small S sample, it provides the basis to speculate whether, all other contingencies being equal, admission to and success in graduate school is founded in high visual or reading skills. It is possible that individuals whose normal predilection for learning is the aural modality are penalized significantly at all levels of the educational system.

7. Subjects who rated themselves as having a fast rate of conversational speech liked the fastest (400 wpm) compressed speech tape better than Ss with a slow conversational speech rate. Most Ss who preferred the 400 wpm tape also classified themselves as relatively hyperactive as opposed to being slow and deliberate in their general behavior.

8. Subjects assigned to the 40 and 60 Deletion Levels at the 275 and 400 Presentation Rates usually commented at the end of the tape (or tape + written story) that they could recall nothing or very little of the material. After finishing the test, most of these students were amazed that when faced with objective questions they were able to remember many facts. Most of these Ss verbalized that their recall seemed to come in "waves" where they would be able to recall easily one segment of the story but have a complete lack of memory regarding another segment. These Ss further noted that the comprehension resulting from listening with the earphones at such accelerated speed and deletion levels seemed to be at a preconscious level where the S had little or no realization of having comprehended the material.

Implications for Further Research

Both telegraphic prose and compressed speech provide opportunities for use in a variety of learning environments which are as yet not being tapped. Research obviously needs to be continued for both concepts with more emphasis on practical implementation. The results of this study reveal the combination of telegraphic style and compressed speech to offer exciting practical application to learning and mandate additional research studies. Specific studies combining the two learning modes seem particularly pertinent in the following areas:

1. Application of compressed speech at rates through 400 wpm with 10 to 30% levels of deletion with Ss who are blind, visually handicapped, dyslexic, or poor readers is needed. Opportunities for more learning through the aural modality could be of great benefit to such populations at all levels of education.

2. Combining the Listening/Reading presentation mode with compressed speech tapes and telegraphic or traditional prose appears to be a meaningful technique for application to remedial reading programs. Only a few studies have been completed which relate to this. Forcing Ss to gradually increase reading rates through compressed speech tapes could become a useful means of increasing reading input rate.

3. Research studies with hyperkinetic, learning disabled children employing telegraphic prose/compressed speech materials should be undertaken to determine their effectiveness in promoting comprehension through both the aural and aural/visual modes.

4. Replicating the present study with the addition of intensive practice sessions in both listening and simultaneously listening and reading to compressed speech tapes would be worthwhile. Such a study should result in the enhancement of the experimental treatment conditions.

5. The results of this study indicate that the simultaneous presentation of the two listening and reading modalities increases learning efficiency. Since the auditory input was constant, the addition of the visual stimulus may have enhanced comprehension by allowing Ss to anticipate and briefly review the material as is normally done as an essential part of the learning process in reading or in listening and note taking. To further investigate the effects of the combined modalities, and the issue of compactness of information and input rate, a research study which controlled both the visual and auditory input at a constant rate would be of interest. The visual presentation of words in movie frames appearing at the same constant rate as the aural track would be an appropriate design for such a project.

General Conclusions

This investigation attempted to contribute to further theoretical and practical knowledge within the realm of information processing. As the results and specific conclusions were presented in detail in Chapters III and IV, this final section focuses on implications, conclusions, and recommendations relating to the broader based concerns which were introduced in Chapter I.

The results of this study are interpreted as supporting the implementation of the combined telegraphic prose/compressed speech techniques for a spectrum of learning environments. Modality was shown to be an important variable to be manipulated according to the needs and the conditions of the learner and the goals of learning. Listening to compressed speech/telegraphic prose materials has great potential for increasing the learning rate of the blind who must spend approximately three hours reading materials in braille for every one hour needed by a sighted reader. Much of the research work in compressed speech has advocated intensive use of speed reading by

listening for the blind and visually handicapped,but the all too familiar and prevalent lag in actual widespread application continues to exist. Visual texts, slides, or even movie frames using telegraphic prose could offer exciting means to increase learning efficiency for the deaf and hearing impaired but the same traditional methods for presenting information continue to prevail even in special education settings where innovations and modifications of learning methodologies are essential if efficient learning is to occur.

Despite the rightful concern for ways to increase learning efficiency for the handicapped, it eappears obvious that an even greater need, because it affects the majority of the population, exists for application of new techniques of information input and storage to normal learners. This study used a university level S population which would surely be ranked as significantly above average in general learning ability and aptitude. It was therefore shocking and distressing to discover how many of these Ss rated themselves as poor readers (see Table 4.5) and as generally inefficient learners. Although a major theme of education is individualization of programming and learning, the answer to what is in reality happening in education regarding individual learning efficiency looms ominously rather than beckoning brightly. The Ss' positive excitement for the telegraphic prose/compressed speech learning techniques used in this study was unexpected as was the majority of the Ss' preference for the simultaneous use of two modalities. In addition, comprehension and learning efficiency at the fastest 400 wpm presentation rate remained higher than on most of the reported research in compressed

speech and was within acceptable comprehension limits for the T story for both the listening and combined modalities. Thus, the major conclusion of this research is that telegraphic materials of 10 to 25% deletion combined with compressed speech of 400 wpm would benefit many university students by significantly increasing the efficiency of learning. A related conclusion is that the simultaneous use of the listening and reading modalities provides increased levels of information processing for most Ss and materials should be made available to take advantage of this knowledge. The availability of compressed speech tape recordings covering written text materials would make this possible to implement. While university specialists in a variety of discrete disciplines are devoted to seeking new insights into learning to be translated into classroom practice, many above average learners, as well as those who are handicapped, continue to spend prodigious amounts of time learning far too little.

The problem for all educational environments is to find better techniques to present information with speed and reliability. Despite the availability and knowledge of a number of feasible techniques such as those used in this study, information continues to be presented in all but a few settings in exactly the same ways that it has been for hundred of years. With the ever spiralling rise in today's knowledge explosion, man is bombarded and inundated with too much information to process and too little time in which to do so. If man is to become and remain as professionally and personally knowledgeable as he needs to, the development of better ways to share the proliferation of knowledge and man's time is essential.

Increased efficiency means less required time to complete a learning sequence. If speed is then the goal, what is the best use of the time gained? One answer is that more information can be presented in a given amount of time. Also, if learning time is halved by a 50% time-compression of the message, the same material could be presented twice in the same time required for the uncompressed material once. Since some of the compressed speech studies have found that by immediately repeating the same material comprehension is only slightly increased (Sticht, 1971), the savings of time could profitably be used for a variety of other learning purposes. Despite the fact that sociologists and others are currently concerned with how individuals will manage the increased leisure time that the latter part of this century is supposed to bring about, thousands of students and professionals believe that the opposite problem will continue to be the bane of their existence. The goal of increased speed of information processing and storage is concerned here basically with didactic and scientific text and journal materials. If the needed new techniques such as telegraphic prose and compressed speech were applied to making the plethora of essential professional and scientific information faster and more efficient to process, the savings of time might well be spent in creative thinking time or in more leisurely academic pursuit of other materials as suggested in the following classified advertisement which appeared in the July 19, 1973 issue of World Magazine. If it were meant to be facetious, it also has serious merit which is compatible with the plea for increasing the processing speed and efficiency of text and journal learning.

> WANTED: Refugees from speed reading. If you read books too rapidly and fail to savor the full richness of works with genuine literary merit, take our course in non-speed reading. Learn how to increase your comprehension of the author's intentions and get more out of your reading by spending more time on each page. Institute for Taking Reading Seriously. WM Box M.S.S.

The preceding paragraph mandates a summary of the flexibility of comprehension rates, of word redundancy and the compactness of telegraphic prose, and of the neurological limits on the rate of learning because all of those are essential components of information processing.

It has long been believed that the ability to be flexible in reading rate is a characteristic of the best readers. In the teaching of reading, students are told to alter reading speed according to the difficulty of the text to increase efficiency. The research studies regarding flexibility or change in reading rate, however, have found that only very small changes actually occur (Levin, 1968; Rankin, 1970; Rankin and Hess, 1970). These and other studies concluded that even those identified by tests as good readers are quite inflexible in their reading rate.

As found in this study as well as in the others which have investigated telegraphic prose, a significant decrease in reading rate has always been found for the highly reduced versions. The previous work has interpreted this as occurring because high telegraphic material is more difficult due to its informational density. However, if it is assumed that readers are basically inflexible in their rate of reading, the explanation that the 54% decrement in reading rate between the T and the 60 version for the Reading treatments in

this study was caused by the compaction of facts does not appear to be a valid one. In addition, the fact that comprehension was maintained acceptably when Ss were forced by the compressed speech tapes to increase their information processing rate also refutes this explanation. While telegraphic prose seems obviously more compact in its information than traditional prose, it is postulated here that it is not the increased compactness but the decreased redundancy which causes the severe voluntary reduction in rate of reading. Presumably, the fluent reader uses distinctive features of the printed stimulus to perceive meaning directly. If necessary, a reader can identify individual letters and words, but he does not in fact do so. Instead, he moves from the distinctive features to comprehension and is able to do this through knowledge of the redundancy in language. As emphasized by Frank Smith (1971) in his recent book on the analysis of reading: "The actual marks on the page are relatively less important than the knowledge of language that a skilled reader has before he even opens the book. A skilled reader will in fact be defined as one who makes the maximum use of redundancy in both identification and comprehension."

The fact of redundancy in language was used originally as a basic rationale for the feasibility of telegraphic materials. It is suggested here that when the redundancy is decreased too much through the deletion of words in telegraphic prose, the resulting loss of distinctive features and sequences confuses the reader who then chooses to proceed more slowly to comprehend the passage. The decreased redundancy rather than the increased difficulty through the compaction of information may well be the limiting factor of the degree to which

prose materials can be profitably reduced telegraphically. As discussed in Chapter I, redundancy is also extremely important in listening. The decrease in redundancy caused by the segment deletions of words in the compressed signal may also be the factor of limitation in the rates to which speech can be effectively compressed for efficient learning.

While research investigations continue to question whether there is a neurological limitation to information processing capacity, the majority of recent studies seem to concur that such a threshold does exist. The results of this study fully support the fact of a limit on central processing ability but the conclusion which requires emphasis is that this is an individual capacity or threshold. The basic problems in increasing learning efficiency are human rather than technological, but this study as well as others have demonstrated that the input rate of information can be significantly increased without loss of comprehension by learning techniques such as a combination of telegraphic prose, compressed speech, and modality. Although the upper limit on the rate at which units of information can be processed may be quite inflexible, it also is surely a highly individualized limit which may be significantly altered by the modality or modalities used or by the presentation rate and deletion level. The development of optimum libraries of resources in which the individual could select and control all of these essential contingent parts of efficient learning is a realistic and feasible need of the highest priority.

APPENDICES

APPENDIX A

San Francisco - Traditional Version

The popular Mayor St. John and his city councilmen were well aware of the two identities of the city of San Francisco. The rich, cultured layer overlaid the deeper problem ridden layer that contained hippies, prostitutes, junkies, con men, terrorizers of small merchants in Chinatown, union leaders of the dock laborers who lived high with their hands deep in the treasury. Perhaps there was a third layer, the level of the deep crust of earth beneath the city. Its identity was known only when it groaned or twitched, occasionally reminding the leaders of government in the city that it was there, and should be considered, too. But the other problems always seemed more pressing.

In June that year, the first earthquake came. More than halfway up the Richter scale, it was strong enough to cause a pretty solid loss of life in the old buildings those relics of rebuilding in 1906 that had somehow weathered urban renewal and freeway right-of-way acquisition. The Mayor hopped into his helicopter for the flight to Sacramento to seek state help. The Governor passed him in mid-air, a few miles apart, while flying to inspect the damaged city. It was a "disaster area" in the older sections, that was for sure. On return to the capital, the Governor found the Mayor already in conference with members of the Senate Committee on Urban Problems. The state government had set up this committee to deal with almost every ailment of modern day cities in the big state. But not really to "deal" with them, for there were no easy answers or quick solutions to most of the problems. "Be aware" of them would be more of a correct attitude.

"We need to know of your immediate plans, Mayor," stated a young senator who had been appointed to this committee for his freshman term, since it was the least prestigious of all. The older, wiser Chairman suggested, "Perhaps if we coordinate our efforts from the start we will avoid the fiscal waste of overlapping programs." Mayor St. John looked around the group, answering, "I hope we have enough time for plans to be made and carried out. Right now, I'm not worried about fiscal overlapping or finances, Honorable Chairman. Now, I'm worried that the next earthquake may be the big one instead of an aftershock. I am here to ask that you appoint some of your members to a joint committee--let's call it the 'Action Group'--that will also have members from my city council. When this group starts operating, we can have some plans made." "I'll volunteer," said Senator Salliman, the young man who asked the first question. Names of others of the Senate committee who wanted to help the Mayor were being jotted on the list when Governor Smedley burst into the room. "Just back from a look-see," he announced. "Glad you're here, St. John. Wanted to tell you I'm calling in State Civil Defense Chief Palmer. Mayor, you're to be in complete charge of the whole San Francisco operation, with Palmer acting as liaison between you and me. He'll be here for a briefing as soon as we get in touch with him down at the tracks in Santa Anita. Know he'll want to have a meeting with you boys right away."

Inwardly groaning, the Mayor accepted the inevitable. His new Action Group would be "hamstrung" at every turn by the inept Palmer. But there wasn't time to grieve. "Tell Palmer to come directly to the meeting room next to my office in City Hall, Governor. I'm

taking these senators who have volunteered to go back in the helicopter with me. We'll have our Action Group assembled by the time Palmer arrives. But tell him to get the hell up there fast, you hear?"

The Action Group met--all the hardest working members of the city council jumped at the chance to work with the state senators. Not surprising, the hardest working also turned out to be the youngest men. The Mayor looked around the group and guessed their average age was about thirty-six years at the most. The older fellows had said, "Call me if I can help," then left quietly to tend to their extensive business interests. But businesses and families, and even eating, was forgotten by this group as they met in session around the clock. State Director Palmer had arrived, but by the time he got there a great many plans had already been made and machinery already in operation to carry them out. The important plans were taken care of first, rapidly. For when Palmer and his two assistants arrived on the scene, sure enough, things began to slow down and finally just bogged down completely in quibbling by the three late comers over petty, unnecessary details. The youngest city councilman of the group, Will Atkins, coughed nervously, got up as inconspicuously as he could and walked past the Mayor as if he were going to the restroom. But he rested his hand on the table by the Mayor and a short memo was left behind as he went through the door. "Have heard by grapevine of serious trouble out at State Children's Mental Hospital in foothills. Am going to take a breather before I slug this SOB. Will see what's going on out there and be back in two hours."

One hour and thirty minutes later, doomsday arrived. In one sickening shudder, accompanied by a groan of metal that rose to a

shriek, with loud pops of glass shattering, City Hall was reduced to a dust-shrouded mound of rubble, all twelve floors of it. The Mayor's suite of rooms was on the second floor. He had moved down there from the top level because he would be right above the ground floor police rooms if he were ever needed. A police helicopter overhead was about to land on the roof when the earthquake hit. They told later that the whole surface level of the block on which City Hall was located and other blocks north of it seemed to drop suddenly about twenty feet. It was like the first three floors disappeared, then the top nine collapsed all at once.

Atkins had been elected by the youth of San Francisco. The charter had been revised the year before to allow citizens two years younger than the previous limit of thirty-two years to serve on the city government. He had pitched his campaign frankly at the young. The eighteen year olds had been delighted at finally getting to vote. Now they could show an approved legal voice to make know their disenchantment with the establishment. Using an unorthodox slogan, "You can just barely trust someone just barely over thirty," Atkins had been victorious on his first try. And he hadn't let the kids down either. From the first day in office, he was <u>their</u> spokesman to the city fathers. His office door was always open, and somehow he was always there to hand out the beer to whatever groups came, and listen to their ideas or their grievances. He announced, "Get together, decide, appoint a group. Then come to see me. There aren't enough minutes in the day for me to see individuals. So have your meetings at the grass roots, thresh out some of the problems and then bring me the rest." And it worked. Better than he had ever

hoped for. There was a noticeable lessening of riots, senseless vandalism, grudge fights and such throughout the city. He had their confidence on that day in June. He would need it more than he ever dreamed.

One of the police helicopters that was over the city when it happened found Atkins pretty quickly, thanks to citizen band radios that require no central transmitting stations, for none were left. While one of the policemen went behind the helicopter and vomited quietly because of what he had seen from above, the other ran to him, ashen faced, almost in hysterics. "Thank God, you are alive, Councilman. You are the man-on-the-spot now. You are the Mayor, the State Civil Defense Director, and the Police Chief all rolled together. What do we do first?"

Almost complete destruction...almost total disaster...what does anyone in authority do first? He forgets about his own loved ones; he does not even think of them one moment lest all resolve disintegrate completely.

Atkins left on the helicopter to see where he could establish some sort of temporary headquarters. They flew high to get a total picture at first; from low altitude the destruction seemed unreal, with unending blocks of rubble where buildings once stood. Atkins was surprised there was no smoke. The 1906 disaster had triggered fires almost from the start. But the laws had been rewritten since then and building codes enforced so that shut-off valves were standard on any equipment that might cause fires after an earthquake. He could see more water than he expected. The whole level of the peninsula must have dropped, with sinking still going on. Aftershocks would

probably make it worse, he guessed. The area from where Fisherman's Wharf should have been, down the whole dock area of the east side, was only water. In the distance he could see a vast lake spreading down the Santa Clara Valley. The Bay Bridge had dropped, the middle spans gone from view. Only a smudge in the ocean showed where the Naval Station Island once was. On around towards the Golden Gate--that bridge was gone, too, with tidal waves rushing into the bay from beyond the Presidio. The land seemed a little higher than he remembered on the Pacific side, like the peninsula had been tilted inland toward the bay. They turned down the west coast and he wondered what happened to the animals at the Zoo on the west side, making another mental note to find out and deal with that problem, too. The parks were the obvious gathering spots for survivors. Destruction seemed complete over the whole peninsula as far as he could see back past Daly City and from the Santa Cruz Mountains to the bay. The radio in the helicopter reported some university professor down at USC had measured the quake at almost nine on the scale.

Helda led the group, laden with their dishes and pans, down from the old buildings of the commune in the mountain valley. All the food they had was piled into the old farm wagon they pulled. They might have gone part of the way in the van, but the roadbed would soon have been impassable, so they loaded the wagon and pulled it down from the valley. They knew they would be needed. Helda had learned to boss a kitchen crew to turn out quantities of food for an unpredictable number of persons. She had learned to stretch inexpensive ground beef by adding rice or noodles until it would feed twice the expected number. The men in the commune had learned to use tools, to build

something out of almost nothing. They all believed they would be useful. It was now time to drop back into the world they had dropped out of a few years back. The skills they had learned the hard way were all they had to offer. Drugs and pot were left behind. Clear headed, the group--and dozens, hundreds even, of groups just like them--approached the wreckage of the city and made their way to the parks.

Governor Smedley had set up a disaster committee from among the remaining Senate members. Why is it always the first step of bureaucratic government to establish a committee, that strange entity that talks much but accomplishes little, wondered Atkins. He realized that the new committee must be utilized in the cooperative fashion, lest they become an obstacle to progress. Most of the operations, the actual work in the city ruins, was now being administered by the Armed Forces. Generals of Army, Air Force, Marines, Reserves and National Guard were in charge, along with an Admiral of the Navy. Rescue work was still the only operation a week after the earthquake. Aftershocks kept any other activity from occurring. Atkins had formed an interim city government of sorts. The surviving citizens of San Francisco seemed united in following Atkins' leadership, according to the few living councilmen, most of them the older men, who had come to his temporary headquarters in John McLaren Park. Here he coordinated the operations of a mass of volunteers, including the young people like Helda. They fed survivors who were uninjured or slightly so, then passed them back along the peninsula from park to park to evacuate them completely from this area of California. Most of the young people had heard they were needed on their transistor radios and had walked in from miles away, bringing simple things, sensible items,

and usable skills. Mayor Atkins had issued an order to the guard cordoning off the peninsula to take these young volunteers to an officer for questioning. If they checked out all right and seemed sincere in their wish to help, they were to be passed into the area. The young people became members of a group that worked, took instructions, worked some more, followed orders immediately, then continued to work more, seemingly inexhaustible. The name "Volunteers for Hope, came from among their ranks. No one would take individual credit. Arm bands appeared one day with the letters "V-HOPE" on them. No older person was given one except those directly in charge of the group. Those in charge were a few of the younger-minded senators from the Governor's disaster committee, those especially cooperative with the young mayor and willing to follow his leadership. Also in charge were a few young police officers who had been aloft in the helicopters and survived as the sole remaining law men. One of these men had been promoted quickly to Police Chief, with others becoming Captains and Lieutenants. All were part of the interim city government, where they came to respect their new young mayor who worked so hard and long. In turn, Atkins found these policemen to be calm and efficient and he decided to make some of them a part of the Volunteers for Hope group. The previous resentment between the "long hairs" and the pigs" disappeared as if it had never existed. The serious job before them made them all respect only one trait in a human--courage--which meant the ability to work until you were tired enough to drop and then keep on working, to take hold in whatever unpleasant situation and do the job without complaint. Respect and mutual admiration grew and blossomed and the

policemen swore that the Volunteers for Hope group would be a permanent part of whatever survived or grew new from the disaster.

The interim city government met and drew up plans of action. The Volunteers worked to carry out these plans. The only time there was even mild grumbling and dissention was when they heard a rumor the interim government was considering rebuilding the city in the same location. "Have they flipped completely?" asked the young people. "Don't they get the message after two earthquakes?" wondered Helda. But the work was for them to do, not the decision making, so they worked on. They knew that Atkins was their man and Atkins was in charge and would let them know when it was time to express their opinions.

On the seal of the city of San Francisco which existed between the years 1860 and 1974, there was pictured the Phoenix, the Egyptian symbol of immortality. The bird rises from ashes on the seal, commemorating the disastrous fires of the early 1850's. No one then foresaw the destruction by earthquake and fire, followed by rebuilding, followed by repeated destruction by earthquake, sinking of land and tidal wave. The Phoenix was eventually made the symbol of the Volunteers for Hope. Out of the ashes of the generation gap had arisen a reborn life: a new respect, understanding, acceptance, and love of old for young and young for old.

APPENDIX B

San Francisco - Twenty Percent Deletion

Mayor St. John and his city councilmen were aware of the two identities of city of San Francisco. Rich, cultured layer overlaid deeper problem-ridden layer contained hippies, prostitutes, junkies, con men, terrorizers merchants Chinatown, union leaders dock laborers who lived high with their hands deep in the treasury. There was third layer level of the deep crust of earth beneath the city. Its identity was known only when it groaned or twitched reminding leaders government city it was there and should be considered, too. Other problems always seemed more pressing.

June year, the first earthquake came. Halfway up Richter scale, it was strong enough to cause loss of life in old buildings, those relics of rebuilding in 1906 that had somehow weathered urban renewal, freeway right-of-way acquisition. The Mayor hopped into helicopter flight to Sacramento to seek state help. Governor passed him mid-air, few miles apart, while flying to inspect the damaged city. It was a "disaster area" in the older section sure. Return to capital, governor found the Mayor in conference with members of the Senate Committee on Urban Problems. State government set up this committee to deal with every ailment of modern-day cities in big state. Not "deal" with them, there were no easy answers or quick solutions to most of the problems. "Be aware" them would be more a correct attitude.

"We need to know your immediate plans, Mayor," stated a young senator who had been appointed to this committee his freshman term, it was

least prestigious. Older Chairman suggested, "If we coordinate our efforts from start, we will avoid fiscal waste of overlapping programs." Mayor St. John answering, "I hope we have enough time for plans to be made and carried out. Now, I'm not worried about fiscal overlapping or finances, Chairman. I'm worried that next earthquake may be the big one instead of aftershock. I am here to ask you appoint some your members to joint committee--call it the Action Group--will also have members from city council. When group starts operating, we can have plans made." "I'll volunteer," said Senator Salliman, man who asked first question. Names other of Senate committee who wanted to help Mayor were being jotted on list when Governor Smedley burst into room. "Back from look-see," he announced. "You're here, St. John. Wanted tell you, I'm calling State Civil Defense Chief Palmer. Mayor, you're in complete charge of whole San Francisco operation, with Palmer as liaison between you and me. He'll be here for briefing soon as we get in touch with him at tracks in Santa Anita. He'll want to have meeting with you boys right away."

Inwardly groaning, Mayor accepted the inevitable. His Action Group would be hamstrung every turn by inept Palmer. There wasn't time to grieve. "Tell Palmer to come to meeting room next to my office in City Hall. I'm taking these senators have volunteered go back in helicopter with me. We'll have Action Group assembled by time Palmer arrives. Tell him to get hell up there fast, you hear?"

Action group met, all hardest-working members of city council jumped at chance to work with state senators. Surprising, hardest-working men also turned out to be youngest ones. Mayor looked around group and guessed their average age was about thirty-six years most. Older

councilmen said, "Call me if I can help," then left to tend their extensive business interests. Businesses, families, even eating were forgotten by this group as they met in session around clock. State Director Palmer arrived, by the time he got there many plans had been made and machinery in operation to carry them out. Important plans were taken care of first. When Palmer and two assistants arrived scene, things began to slow down and finally just bogged down completely in quibbling by the three late comers over petty, unnecessary details. Youngest city councilman, Will Atkins, coughed, got up inconspicuously as he could, and walked past the Mayor as if he were going to the restroom. He rested his hand on table Mayor and a memo was left behind as he went through the door. "Have heard grapevine of serious trouble at State Children's Mental Hospital foothills. Going to take breather before I slug this SOB. Will see what's going on there, be back two hours."

Hour thirty minutes later, doomsday arrived. Sickening shudder accompanied by groan metal that rose to shriek with loud pops of glass shattering, City Hall was reduced to dust-shrouded mound of rubble, all twelve floors it. Mayor's suite rooms was on the second floor. He had moved there from top level because he would be above ground floor police rooms if he were needed. Police helicopter was about to land on roof when the earthquake hit. They told whole surface level of block on which City Hall was located, blocks north of it seemed to drop suddenly about twenty feet. Like first three floors disappeared then the top nine collapsed all at once.

Atkins been elected by youth of San Francisco. Charter been revised before to allow citizens two years young than previous limit

thirty-two years to serve on the city government. He pitched his campaign at the young. Eigteen year olds been delighted at finally getting to vote. They could show approved legal voice, make known their disenchantment with the establishment. Using slogan, "You can barely trust someone barely over thirty," Atkins had been victorious on his first try. He hadn't let the kids down. First day office, he was their spokesman to the city fathers. His door was open, he was always there to hand out beer whatever groups came, and listen to their ideas or their grievances. "Get together, decide, appoint a group. Then come see me. There aren't enough minutes day for me to see individuals. Have your meetings at grass roots, thresh out some the problems, and bring me the rest." It worked. Better than he had ever hoped. There was a noticeable lessening of riots, senseless vandalism, grudge fights throughout city. He had their confidence that day June. He would need it more than dreamed.

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Complete destruction--total disaster--what does anyone authority do first? He forgets his loved ones; he does not think of them one moment lest all resolve disintegrate.

Atkins left on helicopter to see where he could establish of temporary headquarters. Flew to get total picture first; from low altitude

destruction seemed unreal with unending blocks of rubble where buildings once stood. Atkins surprised there was no smoke. 1906 disaster triggered fires almost from the start. Laws been rewritten since then, building codes enforced so that shut-off valves were standard on equipment that might cause fires after earthquake. He see more water than expected. Level of peninsula must have dropped with sinking still going on. Aftershocks would make it worse, guessed. Area where Fisherman's Wharf should have been, down whole dock area of east side was only water. Distance he could see a vast lake spreading down Santa Clara Valley. Bay Bridge had dropped, middle spans gone from view. Smudge in water showed where the Naval Station Island once was. Towards Golden Gate--bridge was gone, too--with tidal waves rushing into the bay from beyond the Presidio. Land seemed higher than remembered on Pacific side, like the peninsula had been tilted inland toward the bay. They turned down west coast and he wondered what happened to animals at the zoo, west making another mental note to find out, deal with that problem. Parks were obvious gathering spots for survivors. Destruction seemed complete over whole peninsula far as he could see past Daly City and from Santa Cruz Mountains to bay. Radio in helicopter reported university professor at USC had measured the quake at almost nine on the scale.

Helda led group laden with dishes and pans down from the buildings of commune in the mountain valley. All food they had was piled into the wagon they pulled. They might have come part way in van, but roadbed would soon have been impassable so they loaded wagon and pulled it down from valley. Knew they would be needed. Helda learned to boss kitchen crew to turn out quantities food for unpredictable number of persons. She learned to stretch ground beef adding rice or noodles until it would

feed twice expected number. Men in commune had learned use tools to build something out of almost nothing. They believed they would be useful. It was time to drop back into world they had dropped out few years back. Skills they learned hard way were all they had to offer. Drugs, pot were left behind. Clear-headed group (dozens, hundred groups just like them) approached wreckage of the city and made their way to the parks.

Governor Smedley set up Disaster Committee from the remaining Senate members. Why is the first step of bureaucratic government to establish a committee entity that talks much, accomplishes little wondered Atkins. He realized new committee must be utilized in cooperative fashion lest they become an obstacle progress. Most operations, actual work in city ruins was now being administered by the Armed Forces. Generals of Army, Air Force, Marines, Reserves, National Guard were in charge along with Admiral Navy. Rescue work was still only operation week after the earthquake. Aftershocks kept other activity from occurring. Atkins had formed interim city government sorts. Surviving citizens of San Francisco united in following Atkins' leadership, according to living councilmen, most the older men, who had come to his temporary headquarters John McLaren Park. He coordinated operations of a mass of volunteers including young people like Helda. They fed survivors uninjured slightly then passed them along peninsula from park to park to evacuate them completely from this area of California. Young people had heard they were needed there and had walked in from miles away bringing simple things sensible items and usable skills. Mayor Atkins had issued order guard cordoning peninsula to take these young volunteers to an officer for questioning. They checked all, seemed

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APPENDIX C

San Francisco - Forty Percent Deletion

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City government met drew up plans action. Volunteers worked carry out plans. Grumbling, dissention when heard rumor the interim government was considering rebuilding the city in the same location. "They flipped?" asked young people. "They get message earthquakes?" wondered Helda. Work was for them do, not decision making they worked. Atkins man charge would let them know when it was time to express their opinions.

On seal of San Francisco 1860 and 1974 was pictured the Phoenix, Egyptian symbol of immortality. Bird rises from ashes on seal

commemorating disastrous fires 1850's. No one foresaw destruction earthquake, fire, rebuilding, destruction earthquake, sinking of land, and tidal wave. Phoenix was made symbol Volunteers for Hope. Ashes of generation gap arisen reborn life, respect, understanding, acceptance, love of for young, young for old.

APPENDIX D

San Francisco - Sixty Percent Deletion

Mayor St. John councilmen were aware identities San Francisco. Cultured layer overlaid problem layer men terrorizers, union leaders laborers lived high with hands in treasury. Third layer level crust earth beneath city. Identity known groaned, twitched, reminding it was there should be considered. Problems more pressing.

First earthquake came. Halfway up Richter scale was strong enough cause loss of life in buildings, relics weathered renewal. Mayor hopped helicopter Sacramento seek help. Governor passed him flying to inspect city. Disaster area in older sections. Governor found Mayor conference Senate Committee on Urban Problems. Government set up committee deal with ailment cities state. "Deal" no answers or quick solutions to problems. "Be aware" correct attitude.

"We need to know your immediate plans, Mayor," stated senator appointed committee term. Chairman suggested, "Coordinate efforts will avoid waste overlapping programs." Mayor, "Hope have time plans made carried out. Not worried fiscal overlapping finances. Worried next earthquake big instead aftershock. Here ask appoint members to committee--call Action Group--members city council. Group operating have plans." "I'll volunteer," Salliman man question. Names committee wanted help Mayor jotted list Smedley burst room. "Back from look. Here, St. John. Tell calling Defense Chief Palmer. Mayor, you're in charge San Francisco Operation, Palmer liaison. He'll be here briefing soon we get touch him. He'll want have meeting with."

Mayor accepted inevitable. Action Group be hamstrung by Palmer. Wasn't time. "Tell Palmer to come meeting room hall. I'm taking senators volunteered in helicopter. Group assembled Palmer arrives. Tell him get there fast."

Group met, working members council jumped chance work senators. Hardest-working men turned be youngest. Mayor looked group, guessed age thirty-six years. Said, "Call if I can help," left business. Businesses, families, eating forgotten group they met clock. Palmer arrived; by time got there plans made, machinery in operation carry. Plans taken care of. Palmer assistants arrived; things began slow down, finally bogged down completely comers over details. Will Atkins got up and walked past the Mayor going to restroom. He rested hand table and memo was left behind door. "Heard of trouble Children's Mental Hospital. Breather before slug SOB. See what's going, back hours."

Hour doomsday arrived. Shudder, groan metal, pops glass, shattering, City Hall was reduced to dust mound rubble floors. Suite rooms second floor. He moved because he would be above police if needed. Helicopter was land roof, earthquake hit. Level block City Hall, blocks north seemed to drop suddenly twenty feet. Three floors disappeared, top nine collapsed.

Atkins elected youth Francisco. Allow citizens two years younger two to serve on city government. Pitched campaign at young. Eighteen year olds delighted vote. They show legal voice, disenchantment establishment. "Trust someone over thirty," Atkins had victorious first try. Let kids down. He was their spokesman city

fathers. Door open, he there, hand out beer groups, listen to ideas, grievances. "Decide, appoint group. See me. Aren't minutes day see individuals. Have meetings, roots, thresh problems, bring me rest." It. Better he hoped. Lessing riots, vandalism, fights throughout city. Need more than dreamed.

Helicopters city found Atkins, thanks band radios require no transmitting stations, none left. Policeman vomited what he had seen, other ran to Atkins in hysterics. "Are alive. Man on spot. You Mayor, Defense Director, Police Chief. Do First?"

Destruction--disaster--anyone authority do? Forgets loved ones; not think them, resolve disintegrate. Atkins left, see where establish headquarters. Get picture, low altitude destruction unreal, blocks rubble buildings stood. Surprised no smoke. Disaster triggered fires start. Laws rewritten; codes enforced off valves standard equipment cause fires after earthquake. See water expected. Level peninsula dropped, sinking still going. Aftershocks make worse. Area Fisherman's Wharf, dock area east was water. He see lake spreading Clara Valley. Bridge dropped, spans gone. Smudge water showed Naval Island was. Golden Gate Bridge gone, waves rushing bay from Presidio. Land seemed higher remembered Pacific, peninsula tilted toward bay. Turned down coast, wondered what happened to animals zoo making mental note deal problem. Parks gather spots survivors. Destruction complete over peninsula Daly City, Santa Cruz Mountains, bay. Radio reported professor USC measured quake none on scale.

Helda led group, pans from buildings of commune valley. Food

was piled into wagon pulled. Gone in van, but roadbed been impassable, they loaded wagon pulled valley. Be needed. Helda learned boss turn out food number persons. She learned stretch beef, rice, noodles feed twice. Men commune learned use tools, build nothing. Believed be useful. Time drop into world they dropped out years. Skills learned were they had offer. Drugs left. Group, groups approached wreckage city made they way to parks.

Smedley set up committee Senate members. Why first step government establish committee accomplishes little wondered Atkins. Realized committee utilized in cooperative fashion become obstacle. Operations work ruins was administered by Armed Forces. Generals Marines, Reserves, Guard were in charge; Admiral. Rescue work operation after earthquake. Aftershocks activity occurring. Atkins formed city government. Surviving citizens Francisco united following Atkins' leadership according councilmen older had come temporary park. He coordinated operations volunteers including people. They fed survivors, passed along peninsula park to evacuate from area California. Young people heard were needed walked bringing things, items and usable skills. Atkins issued order guard to take volunteers officer questioning. They seemed sincere, they were be passed the area. People group worked, took instructions, worked, followed orders, work inexhaustible. "Volunteers for Hope" ranks. No credit. Bands appeared with "V-Hope." Person given one those in charge. In charge were senators cooperative with the young Mayor follow his leadership. In charge were police officers who helicopters and survived men. One had been promoted to Chief, Lieutenants. All were part government, came respect Mayor

worked hard. Atkins found policemen calm, efficient decided make part Volunteers for Hope. Resentment "long hairs," "pigs" disappeared never existed. Job made respect trait human, courage, ability work, tired, drop, keep working, hold whatever unpleasant situation, do job complaint. Respect, admiration grew; policemen swore volunteers be part whatever survived grew disaster.

Government met drew plans. Volunteers worked plans. Grumbling dissention interim government was considering rebuilding city in same location. "Flipped?" asked people. "Get message earthquake?" Helda. Work for them decision they worked. Charge would them know when was time to express opinions.

Seal of San Francisco 1860, 1974 pictured on the Phoenix, symbol immortality. Bird rises from ashes commemorating fires. No one foresaw destruction, earthquake, fire destruction, sinking land, wave. Phoenix symbol Volunteers for Hope. Generation gap arisen reborn life, understanding, acceptance, love for young, old.

APPENDIX E

Comprehension Test for "San Francisco"

Multiple Choice Test Items

1. In early June, San Francisco first experienced:

   1) a mud slide in the suburban hills because of excessive rain
   2) a tidal wave from the Pacific Ocean
   3) a moderately severe earthquake
   4) an extensive forest fire in the Santa Cruz Mountain area

2. As a result of this disaster:

   1) most homes built on the beaches were swept away
   2) a main north-south coastal freeway was swept away
   3) lives were lost in homes and camping areas in the fire's path
   4) lives were lost in older buildings that collapsed

3. The popular Mayor of San Francisco in early June was:

   1) Smedley
   2) St. John
   3) Palmer
   4) Salliman

4. The city had a form of government that was:

   1) a city manager with an elected city council and mayor
   2) an elected city council, with a mayor
   3) a city manager with an appointed city council and mayor
   4) an appointed city council, with a mayor

5. The Mayor and the city council were worried about:

   1) possibility of stronger future earthquake
   2) the need for U.S. Forest Service help in combating forest fires
   3) the need for State Highway Department funds to rebuild the coastal freeway
   4) possible erosion of coastal areas due to lack of a sea-wall

6. The Mayor went to seek help at:

   1) Washington
   2) Sacramento
   3) Los Angeles
   4) Santa Cruz

7. There was in existence a:

   1) Committee on Urban Growth and Development
   2) Committee on Urban Problems
   3) Committee on Urban and Rural Problems
   4) Committee on City Development

8. The Mayor asked for volunteers among the:

   1) Senators
   2) Representatives
   3) Congressmen
   4) State Officials

9. The volunteers were to serve on the Mayor's:

   1) Rehabilitation Group
   2) Restoration Group
   3) Activity Group
   4) Action Group

10. The Governor was:

   1) St. John
   2) Salliman
   3) Palmer
   4) Smedley

11. The Governor gave full authority over the San Francisco operation to the:

   1) Mayor
   2) Senate Committee
   3) State Highway Department
   4) State Forestry Service

12. The State Civil Defense Director would:

   1) have complete charge of planning activities
   2) direct the builders of the protective sea-wall
   3) have authority over the forest fire fighters
   4) act as liaison between the Governor and the Mayor

13. The Civil Defense Director was:

   1) Salliman
   2) Palmer
   3) Smedley
   4) St. John

14. The Civil Defense Director was known by the Mayor to be:

    1) a problem solver
    2) a publicity seeker
    3) a trouble maker
    4) a tireless worker

15. The city councilmen who volunteered to serve as members of the Mayor's group were:

    1) young and hard working
    2) older and experienced
    3) politically ambitious
    4) evading more demanding assignments

16. At first the Mayor's group:

    1) elected a chairman and a recorder
    2) called for a complete copy of existing disaster plans
    3) made some plans that were quickly carried out
    4) passed a resolution commending the Mayor for his action

17. The meetings of the Mayor's group were held:

    1) at the civic building located in John McLaren Park
    2) in a conference room at a state building in the foothills
    3) at City Hall in the Mayor's suite
    4) in the Senate Chambers at Sacramento

18. When Palmer finally joined the group:

    1) progress slowed
    2) new ideas were formulated
    3) the Mayor left the meeting
    4) he had a direct line telephone to the Governor brought in

19. Will Atkins was the:

    1) youngest police chief in the city's history
    2) most honest reporter from the largest newspaper
    3) youngest city councilman ever elected
    4) efficient public relations expert on the Mayor's staff

20. Atkins was about to:

    1) telephone the Governor's office with a press release
    2) walk out of the meeting because of the way the Mayor was conducting it
    3) ask for martial law to be set over the ruined city areas
    4) lose his temper with Palmer

21. Atkins left the group's meeting to go to:

    1) the men's restroom
    2) the bar across the street because he was a secret alcoholic
    3) a hospital in the foothills away from the city
    4) meet the Mayor's wife, with whom he was having an affair

22. Atkins planned to:

    1) return after Palmer had flown back to Sacramento
    2) take time out for lunch with the Mayor's wife
    3) make a report to the hospital board later in the day
    4) return to the meeting in two hours

23. Will Atkins had been:

    1) appointed to his office by his friend, the Mayor
    2) elected to his office by the youth of the city
    3) promoted after a long rise through the ranks
    4) elected to his office by the radical groups backing him

24. The position Atkins held:

    1) called for administering a force of over one thousand
    2) had been won on his very first try
    3) was bought with a large campaign contribution
    4) represented a victory after first suffering a defeat

25. City charter revisions allowed:

    1) city officials to be elected at age thirty
    2) the Mayor to have as many councilmen as he wanted
    3) the police to all wear plain clothes
    4) citizens age twenty-one or older to hold city offices

26. Unexpected changes in the city were:

    1) the dope traffic lessened because of the numerous plain-clothes policemen
    2) the riots and vandalism lessened because of conferences with youth groups
    3) graft and corruption grew in the Mayor's offices
    4) total honesty in city administration

27. One and one-half hours after Atkins left the meeting:

    1) Palmer shot the Mayor after an angry argument
    2) a great earthquake smashed City Hall
    3) an explosion from a bomb wrecked and burned police headquarters and the Mayor's suite on the floor above it
    4) a nuclear bomb from an unknown source had blasted the city

28. City Hall was:

    1) twelve floors, with the Mayor's suite on the second
    2) built with police headquarters underground
    3) two stories high but a city block large
    4) built in a hexagon, with Mayor's offices on sixth floor

29. All members of the Mayor's group:

    1) were killed in the explosion and resulting fire
    2) would be called as witnesses to testify against Palmer
    3) adjourned permanently out of respect for the Mayor
    4) were killed when the building collapsed

30. Some policemen survived who were:

    1) directing traffic at major league baseball game
    2) riding in patrol cars in residential areas
    3) working in after-hours jobs in suburban bank vaults
    4) flying in helicopters at the time of the disaster

31. Atkins received word of the disaster from:

    1) the policemen from the helicopter
    2) the Mayor's wife who received the news in a phone call
    3) a teletype release of a flash from the Civil Defense Headquarters
    4) the special police radio in the helicopter

32. The first action Atkins took was to:

    1) call on the radio to assemble all city councilmen
    2) go directly to the funeral home where the Mayor's body had been taken
    3) call Washington to give full information about the first nuclear blast
    4) fly by helicopter over the city to survey the damage

33. Building codes had been changed over the years with the result that:

    1) no buildings could be built higher than twelve floors
    2) fire would be less of a possibility in case of earthquake
    3) no major structure could be built near forested areas
    4) fireproof structures only could be built in the downtown areas

34. From his vantage point, Atkins noticed:

1) that the damage seemed to be worst towards the Chinatown area
2) traffic was piling up all along the damaged coastal highway
3) the whole peninsula seemed to be sinking
4) the fires were spreading outward more rapidly now that they had reached the city's edge

35. To further complicate the situation, Atkins saw:

1) both bridges had fallen into the bay
2) the blast had destroyed all water supplies
3) the firemen trying to control the fires were now cut off and surrounded
4) ambulances were not able to get through the piled-up traffic on the coast

36. Greater danger existed because:

1) no police were on hand to stop bay bridge traffic
2) the flimsy, flammable buildings in Chinatown lay in the path of the fire.
3) tidal waves could be seen rolling in from the Pacific
4) animals from the zoos were loose in all the parks

37. From above, Atkins could see that:

1) every single person would have to be evacuated from the area
2) there was no possibility that anyone in the city could have survived
3) parks would be the best gathering place for survivors
4) the people could be evacuated to the mountain valleys and foothills

38. The radio reported the true severity of the disaster, saying:

1) the earthquake measured almost nine on the Richter scale
2) the nuclear blast must have been from a 100 megaton bomb
3) the fires from the earthquake had destroyed 90 percent of the city
4) the tidal wave had swept clear down the Santa Clara Valley

39. The commune that Helda was a part of was located in:

1) Haight-Ashbury section of the city
2) a low field on old farm property in the Santa Clara Valley
3) a rather remote mountain valley
4) an abandoned rambling beachfront house

40. Members of the commune joined Helda in:

    1) walking into the city, carrying blanket and cots
    2) riding into the damaged area in the commune's van
    3) stealing pack horses to carry food, pans and tools for them
    4) pulling an old wagon by hand to bring supplies

41. Helda had acquired the ability to:

    1) sew simple garments for people who needed clothes
    2) keep homeless children in a small nursery
    3) boss a kitchen crew cooking large quantities of food
    4) organize a group to stage protests when needed

42. Men of the commune had learned to:

    1) plant and harvest crops of health foods
    2) make primitive and simple furniture
    3) tear down and rebuild the motor of their commune's van
    4) use tools with good ability

43. The commune Helda belonged to decided to go to the San Francisco area because they:

    1) were curious about the disaster
    2) believed they would be useful there
    3) would have an opportunity to gain converts to their religion
    4) needed to recruit new members for the commune

44. Helda's group and other groups like it:

    1) fled away from the area because they couldn't stand the sight of injured and suffering people
    2) left their drugs behind and went to the parks to go to work
    3) went into the worst part of the disaster area in spite of danger to themselves
    4) decided the time was right for taking over the city government

45. In John McLaren Park:

    1) headquarters for the interim city government were set up
    2) a major emergency hospital center was established
    3) a large amateur radio station was in operation to send messages in and out of the area
    4) the Salvation Army started a clearing house to locate missing people

46. Because of what had happened at City Hall, Will Atkins:

1) asked for federal troops to be sent in and martial law established
2) assumed the role of Mayor of the city
3) asked the Governor to come to the city for an extended stay
4) called for an immediate election to fill city vacancies

47. The older city council members and other citizens in the area:

1) demanded immediate elections be scheduled
2) united in following Atkins's leadership
3) were divided in their loyalty to Atkins
4) supported the Governor in his disagreement with Atkins

48. After the disaster, most of the rescue work was done by members of:

1) the Armed Forces
2) the young people from the communes
3) the city police force
4) the National Guard called out by the Governor

49. The Governor established:

1) a joint Senate-House Investigation Committee
2) an interim city government
3) a new city police force
4) a Senate Disaster Committee

50. To coordinate work on the volunteers, Atkins requested help from:

1) the Red Cross of the United States
2) the Western Division of the Salvation Army
3) the youth directors of the city's churches
4) some senators from the committee

51. Atkins issued an order to those guarding the area of the disaster that:

1) all young volunteer groups were to be allowed to come in
2) under no circumstances were the Governor or any senators to be admitted
3) only nurses and doctors should be given passes and allowed to enter
4) unauthorized persons should be shot on sight

52. The main job the volunteer groups did was to:

1) issue Army blankets and cots to survivors and erect tents
2) serve as deputized peace officers to help patrol the area
3) drive ambulances in the disaster area
4) help feed the survivors at the parks

53. The name, "Volunteers for Hope" was:

1) first thought of by an NBC commentator who was in the area
2) adopted by the young people themselves
3) originated by Will Atkins
4) an old World War II group name that was revived

54. The police force had a problem in:

1) the lack of a working radio transmitter
2) that there was little gasoline for the helicopters and patrol cars
3) the situation that their police chief, captains, and lieutenants were killed
4) the continuing confusion over whether they or the Armed Forces were in charge

55. Regarding the available policemen, Atkins was:

1) impressed with their calm efficiency
2) continually harrassed by their officers
3) sure they lacked the experience to be of much help
4) determined to keep them from taking away any of his powers

56. As a result of his opinion about the policemen, Atkins:

1) asked most of them to resign from the force
2) put some of them in charge of the young Volunteers
3) appointed them leaders, with the senators, of the Volunteers for Hope group
4) removed the new police chief and demoted the captains

57. The resentment between the young "long hairs" and the policemen they called "pigs":

1) grew stronger each day in the disaster area
2) erupted into open battles between them in the parks
3) disappeared in the face of a need for courage in the job facing them all
4) disappeared when all the young people were banned from the area

58. Policemen felt that the "Volunteers for Hope" were:

1) to be respected and admired and should be made permanent
2) members of a cover organization for the Young Nazi Party
3) a useless bunch of religious fanatics
4) a group of "draft-dodgers" worthy of no respect

59. Rumors that made the youth groups unhappy were about:

1) rebuilding City Hall first of all
2) moving the city to another location
3) rebuilding the city in the same location
4) moving all the minority groups to other locations in the city to break up the pattern of "de facto" segregation

60. Eventually, the Volunteers:

1) stopped supporting Atkins in his decisions
2) quit doing the hard work and left the area
3) made Atkins a honorary member of this group
4) adopted the Phoenix as their symbol

Set Relations Test Items

The following sentences describe relations of San Francisco city government and the state government before Mayor St. John was killed.

61. A) All of the Urban Problems Committee members belonged to the Action Group.

    B) Only some of the Urban Problems Committee members belonged to the Action Group.

62. A) All of the city councilmen were under the leadership of St. John.

    B) Only some of the city councilmen were under the leadership of St. John.

63. A) Only some of the Urban Problems Committee members were senators.

    B) All of the Urban Problems Committee members were senators.

64. A) Only some of those under the leadership of St. John were senators.

    B) All of those under the leadership of St. John were senators.

65. A) No Urban Problems Committee members were city councilmen.

    B) Only some of the Urban Problems Committee members were city councilmen.

66. A) All of the senators were in the Action Group.

    B) Only some of the senators were in the Action Group.

67. A) Only some of those under the leadership of St. John were Urban Problems Committee members.

    B) All of those under the leadership of St. John were Urban Problems Committee members.

68. A) Only some of the senators were city councilmen.

    B) No senators were city councilmen.

69. A) Only some of the Action Group were under the leadership of St. John.

    B) All of the Action Group were under the leadership of St. John.

70. A) All of the city councilmen were in the Action Group.

    B) Only some of the city councilmen were in the Action Group.

Set Relations Test Items (continued)

The following sentences describe relations of San Francisco city government and state government following the earthquake.

71. A) Only some of the senators were in charge of the Volunteers for Hope.

    B) All of the senators were in charge of the Volunteers for Hope.

72. A) All of the officials of the interim city government were followers of Atkins.

    B) Only some of the officials of the interim city government were followers of Atkins.

73. A) Only some of the disaster committee members were officials of the interim city government.

    B) No disaster committee members were officials of the interim city government.

74. A. Only some of the Volunteers for Hope were followers of Atkins.

    B. All of the Volunteers for Hope were followers of Atkins.

75. A) All of the officials of the interim city government were in charge of the Volunteers for Hope.

    B) Only some of the officials of the interim city government were in charge of the Volunteers for Hope.

76. A) All of the disaster committee members were senators.

    B) Only some of the disaster committee members were senators.

77. A) Only some of the followers of Atkins were disaster committee members.

    B) All of the followers of Atkins were disaster committee members.

78. A) All of the disaster committee members were in charge of the Volunteers for Hope.

    B) Only some of the disaster committee members were in charge of the Volunteers for Hope.

79. A) Only some of the senators were officials of the interim city government.

    B) No senators were officials of the interim city government.

80. A) Only some of the followers of Atkins were senators.

    B) All of the followers of Atkins were senators.

APPENDIX F

Pre-Test Form

NAME_____ BIRTHDAY_____ DATE_____

ADDRESS_____ TELEPHONE_____

COURSE NO._____ CLASS YEAR_____

Please list 4 hours when you could participate in this project:

	Day	Time
1.		
2.		
3.		
4.		

Note: One hour only of your time is needed. You will be given an option of two times to come next week in this class

1. Is English your first language: Yes____ No____
2. Fluency in languages in addition to English:_____
3. Handedness: Right____ Left____
4. Any significant hearing impairment: Yes____ No____
5. Any significant visual impairment: Yes____ No____
6. Do you think you learn most efficiently by:

   Listening_____

   Reading_____

   Combined Listening/Reading_____
7. How would you rate your conversational speech (word per minute basis):

   Slow_____

   Average_____

   Fast_____

8. How would you rate your own reading speed

   Slow ____

   Average ____

   Fast ____

APPENDIX G

Posttest Modality Checklist for the Listening/Reading Treatments

Please check the modality of modalities you relied upon most to comprehend the information in "San Francisco."

1. Auditory _____
2. Visual _____
3. Auditory and Visual Equally _____

Appendix H

ANOVAs for Reading Treatments

TABLE A-H1

Results of 1 x 4 ANOVA for Set Relations in the Reading Treatments

Source	df	MS	F	p
Groups	3	1.03	0.16	ns
Error	76	6.67	-	-
Total	79	646	-	-

TABLE A-H2

Results of 1 x 4 ANOVA for Nested in the Reading Treatments

Source	df	MS	F	p
Groups	3	1.03	0.38	ns
Error	76	2.71	-	-
Total	79	2.65	-	-

Results of 1 x 4 ANOVA for Disjunctive
in the Reading Treatments

Source	df	MS	F	p
Groups	3	0.68	0.35	ns
Error	76	1.97	-	-
Total	79	1.92	-	-

TABLE A-H4

Results of 1 x 4 ANOVA for EWC for Multiple Choice
in the Reading Treatments

Source	df	MS	F	p
Groups	3	7655.33	1.96	ns
Error	76	3903.70	-	-
Total	79	4046.16	-	-

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