RECALL AND COMPREHENSION AS A FUNCTION OF MODE OF PRESENTATION AND TRANSFORMATIONAL COMPLEXITY IN CONNECTED DISCOURSE

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Clessen J. Martin
Major professor

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By

Frederick Moses Okatcha

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ABSTRACT

REGALL AND COMPREHENSION AS A FUNCTION OF MODE OF PRESENTATION AND TRANSFORMATIONAL COMPLEXITY IN CONNECTED DISCOURSE

By

Frederick Moses Okatcha

The main objective of this study was to investigate variables which possibly influence recall and comprehension of prose material. More specifically, the effects of number of presentations and rate of presentation on recall and comprehension of low difficulty and high difficulty prose passages were examined.

Massed, distributed, and slow one-trial modes of presentation were employed in the study.

A total of one hundred and twenty Ss were assigned to 6 experimental conditions.

The results indicated that number of presentations was not a significant factor facilitating learning of prose material. Significantly poorer recall and comprehension was associated with prose material containing complex grammatical constructions. However, there was a significant interaction between mode of presentation and level of

grammatical complexity. The slow one-trial mode greatly facilitated the recall and comprehension of grammatically complex prose material.

The results were interpreted as supporting a transformational grammar model. It was assumed that complex grammatical transformations required transformational time to reduce them to their kernel sentences. The greater intra- and inter-sentence intervals in the slow one-trial condition allowed Ss the necessary transformation time.

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Dedicated to the late James Aggrey of Africa

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CHAPTER I

INTRODUCTION

One of the crucial issues in the psychology of learning today is the extent to which number of trials or repetitions actually influence learning. There are some learning theorists who maintain that learning is a gradual process, such that with increased number of trials or presentations there should be obtained a negatively accelerated learning curve. Learning theorists who hold this point of view are known as continuity theorists.

Opposed to the continuity theory are those learning theorists who adhere to the notion that learning is an all-or-none affair. These learning theorists are referred to as non-continuity theorists. They argue that in a learning situation, a S makes certain hypotheses such that the hypothesis that leads to the correct solution of a given problem is not necessarily dependent on prior irrelevant hypotheses. Thus, according to this view, number of trials or presentations is not a significant factor in learning.

Although there exist these diametrically opposed views on the role of repetition in learning, most learning psychologists and progressive educators inherently accept the notion that learning is a gradual process and that with more

repetitions or presentations of a given stimulus material, a negatively accelerated learning curve should be obtained.

However, most of the studies which show a negatively accelerated learning curve to be a function of number of trials or presentations are based on relatively simple learning tasks (e.g., nonsense syllable learning, serial learning, and paired-associate learning). Consequently, the extent to which the findings of these studies can be generalized to other kinds of learning such as prose learning requires examination.

In prose learning, unlike the learning of simple tasks, there are complex variables known as invisible strings (Flesch, 1946). According to Flesch, these invisible strings influence how well a prose passage is understood. He points out that in a simple short sentence pattern, there are invisible strings, such that if a sentence goes beyond the subject-predicate-object type, it is more than likely to have a net of criss-crossing strings that must be untangled before the message it conveys is understood. For example, in a simple sentence like "Robinson likes Florence" there is one string between "Robinson" and "likes" and another between "likes" and "Florence." But in a sentence that goes beyond the subject-predicate-object there are many more such criss-crossing strings. An example of such a sentence is given below:

> Here is Edmund Burke, the eminent British Liberal, than whom no European statesman was more horrified by the outrages of the French Revolution (Flesch, 1946, p. 32).

According to Flesch, the above sentence is a tangle because the clause is tied to the main sentence by "whom" from which an invisible string leads to "Burke." But to reach "whom" the word "than," which is tied to "more horrified," must be jumped over. Flesch, therefore, recommends that the sentence should be revised to read as follows:

> No other European statesman was more horrified by the outrages of the French Revolution than Edmund Burke, the eminent British Liberal (Flesch, 1946, p. 32).

While Flesch's theoretical position has received support from some empirical studies (Coleman, 1962), it should be pointed out that other studies examining the effects of grammatical transformations clearly indicate that there are more refined techniques for manipulating grammatical complexity. For example, there is some empirical evidence (e.g., Coleman, 1965) that active sentences are learned better than their transformed passive versions, that non-embedded sentences (e.g., The cat killed the rat that ate the malt) are learned better than embedded sentences (e.g., The rat that the cat killed ate the malt), and that nominalized sentences (e.g., The policeman's investigation of the incident involved hours of tracing down suspects) are harder to learn than their de-transformed active versions (e.g., When the policeman investigated the incident, it involved hours of tracing down suspects).

Although these grammatical transformations indicate the importance of certain transformational variables, the full implications of this have not been thoroughly examined.

Moreover, in some studies, recall and comprehension are confounded (e.g., Coleman, 1962). From a conceptual point of view, recall and comprehension are not necessarily the same. Recall of verbal materials may involve identification of certain previously stated facts or statements without necessarily understanding what these facts or statements mean or imply. Thus, recall of factual information may be regarded as verbatim learning (Cofer, 1941). Comprehension, on the other hand, involves more complicated cognitive processes, such as the derivation of some meanings that are not explicitly stated, the drawing of some implications from the given information, and also applying these derived meanings and implications to other similar situations. Thus, comprehension may be regarded as logical learning (Cofer, 1941).

The above distinction between recall and comprehension implies that recall of factual information is a necessary condition for comprehension to occur, but the availability of this factual information does not necessarily imply the presence of comprehension. Thus, with exception of a few cases (Wiener and Cromer, 1967, p. 622) there cannot be comprehension without recall, although there may be recall without comprehension.

In conclusion, perhaps, it would be appropriate to state that recall of factual information is to the statement "we learn by doing" what comprehension is to the statement "we learn by thinking about what we are doing."

Although recall is related to comprehension, the extent

of the relationship is not known. In addition, little is known about the factors which influence each or both of these processes. More specifically, little research is available which has examined the effects of mode of presentation and grammatical complexity upon the recall and comprehension of prose material.

Statement of the Problem:

The present problem is, therefore, concerned with the kinds of manipulations which possibly influence the recall and comprehension of a prose passage. This study will examine how number of presentations and rate of presentation influence recall and comprehension of low difficulty and high difficulty tape-recorded prose messages.

The Significance of the Study:

The significance of this study lies in the fact that the results may provide some additional data on the factors involved in the recall and comprehension of connected discourse of varying grammatical complexity. A knowledge of the role of repetitions and transformational time on recall and comprehension of prose materials may be of significance for prose learning theory development, and may also contribute to the facilitation of school learning.

Theoretical Framework:

Some theoretical positions have been advanced to explain memorization of sentences of varying grammatical transformations.

For example, one position (Savin and Perchonock, 1965) assumes that sentences with several grammatical transformations occupy more space in immediate memory than do others (the ones with fewer grammatical transformations). Since each of these grammatical transformations is encoded separately and also occupies a characteristic amount of space in immediate memory, it should be easier to encode sentences with fewer grammatical transformations than sentences with more grammatical transformations. This being the case, it should be expected that sentences with fewer grammatical transformations will be easier to remember than sentences with more grammatical transformations.

Another theoretical position (Miller, 1962) assumes that when Ss are asked to learn sentences in an experimental situation, they usually remember complex sentences in their kernel forms. However, when the Ss are asked to recite the original sentence exactly, they supplement their memory of the kernel with a footnote about the syntactic structure.

Although these two theories would explain why recall of low difficulty prose material should be easier than recall of high difficulty prose material, it should be made quite clear that the dependent variables measured in sentence learning and in prose learning, though similar, are usually not the same. In sentence learning the S is usually required to memorize the sentences and recite them exactly, but in prose learning the S is usually required to remember specific facts. However, granted that the transformational processes postulated by Miller occur in prose learning, it should be expected that

Ss given prose material with more grammatical transformations would have considerable difficulty in recall of certain factual information. This is simply because the Ss' involvement in the transformation of complex sentences into their kernel forms while at the same time encoding them may interfere with the Ss' immediate recall of factual information. This line of reasoning is based on the results of a study by Miller (1962). The basic assumption in this particular study was that Ss would require a longer time to learn a more complicated grammatical transformation than they would require to learn a less complicated grammatical transformation. The test consisted of eighteen kernel sentences, plus corresponding sets of eighteen sentences which were produced from these kernels by negative, passive, and passive-negative transformations. The Ss were required to pair two of these four sets of eighteen sentences (e.g., matching passive sentences with their corresponding passive-negative forms).

The obtained results indicated that the passive transformation or its inverse, the negative, and the passive transformations took more time than the negative transformation or its inverse.

Since recall and comprehension are not necessarily dichotomous, it would be necessary to examine some two similar theoretical positions dealing with sentence comprehension. One of these theoretical positions explains why nominalized sentences are harder to comprehend than their active-verb transformations. It postulates that nominalized sentences do

not have many specific references that exist in their active-verb transformations although these references are implied within the nominalized sentences. On the other hand, the active-verb transformations express these specific references explicitly. Thus, since knowing these specific references is important in understanding the sentence, and since it is difficult to deduce these specific references from the given nominalized sentence, it should be expected that nominalized sentences will be more difficult to comprehend than their active-verb transformations (Jasperson, 1924; Coleman, 1964).

The other theoretical position of sentence comprehension states that in a simple short sentence pattern there are invisible strings, such that if a sentence goes beyond the subject-predicate-object type, it is likely to have a net of crisscrossing strings that must be untangled before the sentence is understood. Consequently, for effective communication, short sentences should be used. This emphasis on the use of short sentences is based on the assumption that the use of short sentences gives the reader or the listener ample opportunities "for breathing spells and does not get caught in invisible strings between words" (Flesch, 1946). Since comprehension of a complicated sentence involves, first of all, the untangling of these invisible strings, it logically follows that the reader or listener who is not caught in invisible strings between words should comprehend the given information better than the reader or the listener who is caught in these invisible strings.

A careful examination of the two theories of sentence comprehension clearly shows that the theory about nominalized sentences, though quite relevant, would be inadequate in explaining comprehension of prose material of various grammatical transformations, because it is practically impossible to find a prose passage that consists of nominalized sentences only. However, the theory would make a good supplementary theory of prose learning only and only if the prose material in question consists of some nominalized sentences.

Flesch's theory too is quite relevant, but it is confined to sentence length, and therefore would not explain comprehension of prose material that consists of other grammatical transformations (e.g., passives, etc.). Perhaps, a grammatical transformation theoretical model that integrates Miller's transformational model, nominalized sentence learning theoretical model, and Flesch's theoretical model would constitute a good theoretical model of prose comprehension. Consequently, such an integrated grammatical transformational theoretical model of prose comprehension will be assumed here.

Since the mode of presenting low difficulty and high difficulty messages is more than likely to have some considerable effect on recall and comprehension of these messages, it should be appropriate to examine how the suggested three modes of presentation (massed, distributed, and slow one-trial) are likely to influence recall and comprehension of low difficulty and high difficulty tape-recorded messages. Before

doing so, however, it should be pointed out that there is some empirical evidence showing that prose materials can be presented at fairly rapid rates without loss of comprehension. For example, in one study by Foulke, a passage was read at three different rates (149, 164.6, and 195.7 wpm). This passage was compressed to 275 and presented to one of the three comparable groups of listeners. The results showed that the groups did not differ significantly on a comprehension test (Foulke, 1966, p. 6).

An examination of the suggested three modes of presentation shows that only massed and distributed conditions have been intensively employed in simple learning studies. These studies show that learning is better under distributed practice condition than under massed practice condition (Lorge, 1930; Kientzle, 1946; Duncan, 1951; Deese, 1958, pp. 187-194; Keppel, 1964; Hall, 1966, pp. 377-385; Underwood, 1966, pp. 569-570).

Two theoretical positions have been advanced to account for this finding (Deese, 1958, pp. 194-197). One of these theoretical positions assumes that in a distributed learning condition, the Ss rehearse the stimulus material during the rest periods, while in a massed learning condition, the Ss do not rehearse. Consequently, the superior performance obtained under distributed practice condition is attributed to rehearsal during the rest periods. The other theoretical position assumes that in a learning task, reactive inhibition builds up, such that the organism or the S learns not to

respond. This reactive inhibition is assumed to dissipate during rest periods, and it is this dissipation of inhibition that accounts for the fact that performance is better under distributed practice condition than under massed practice condition.

However, neither of these two theoretical positions are readily applicable to recall and comprehension of prose material, under massed and distributed conditions. There are some obvious weaknesses in both theoretical positions. In the first place, rehearsal has been controlled in some more basic studies in verbal learning, and learning is still found to be better under distributed condition than under massed condition (Deese, 1958). Moreover, this phenomenon has been shown to occur in animal learning where chances for rehearsal are very slender (Bunch and Magdick, 1933; Holland, 1953; Deese, 1958). The second theoretical position is also weak on the ground that the assumption concerning conditioned inhibition and dissipation of inhibition has not been empirically substantiated with complex stimulus materials.

Perhaps, the best theoretical model that could explain the better performance under distributed condition is the grammatical transformational model. The application of this theoretical model would necessarily assume that distributed condition offers ample opportunities or time during the rest periods (inter-sentence interval) for transforming complex sentences into their kernel forms, whereas such opportunities are lacking in a massed condition. In short, encoding of

high difficulty material should be better in a distributed condition than in a massed condition. Since encoding of high difficulty material is poorer in a massed condition, it should be expected that this will lead to production deficiencies. These production deficiencies should lead to poorer recall and comprehension. This line of theorizing is supported by the findings of the already cited Miller's sentence matching study which showed that Ss required a longer time to recognize a more complicated transformation than they would require to recognize a less complicated grammatical transformation (Miller, 1962).

Since no transformations are required in the low difficulty material, it should be expected that recall of low difficulty material should be better than recall of high difficulty material, under a massed condition. High difficulty material requires transformation time (inter-sentence interval), but this transformation time is not available in the massed condition. It should also be expected that recall of high difficulty material under distributed condition, which allows transformation time (inter-sentence interval), will be better than recall of high difficulty material under a massed condition. Since in the slow one-trial condition there exist two types of transformational times (i.e., inter-sentence interval and intra-sentence interval) it should be expected that recall of high difficulty material will be better under a slow one-trial condition. Lastly, recall of low difficulty material should be better under a massed condition than

under a slow one-trial condition. This is because the low difficulty material does not require transformation time; hence hearing prose material twice should lead to better recall of factual information in the low difficulty material.

With regard to comprehension, it should be expected that comprehension of low difficulty material will be better under a massed than under a slow one-trial condition. And comprehension of low difficulty material should be better than comprehension of high difficulty material, under a massed condition. A slow one-trial condition should lead to better comprehension of high difficulty material. Lastly, comprehension of high difficulty material under distributed condition should be expected to be better than comprehension of high difficulty material under a massed condition.

Thus, operating within the transformational theoretical framework, the following formal hypotheses are presented:

Statement of Hypotheses

A. Recall:

Hypothesis 1. Modes of presentation and grammatical complexity will interact.

Hypothesis 2. Recall of low difficulty material will be better than recall of high difficulty material, under a massed condition.

Hypothesis 3. Recall of low difficulty material will be better under a massed condition.

B. Comprehension:

Hypothesis 1. Modes of presentation and grammatical complexity will interact.

Hypothesis 2. Comprehension of high difficulty material will be better under a slow one-trial condition than under either a distributed or a massed condition.

Hypothesis 3. Comprehension of high difficulty material will be better under a distributed condition than under a massed condition.

Hypothesis 4. Comprehension of low difficulty material will be better than comprehension of high difficulty material, under a massed condition.

Hypothesis 5. Comprehension of low difficulty material will be better under a massed condition.

CHAPTER II

REVIEW OF RELATED STUDIES

The related research will be reviewed under the following three headings: Number of Presentations, Grammatical Transformations, and Compressed Speech.

1. Number of Presentations:

The major study examining the role of repetition in the learning of prose material was conducted by Slamecka (1959). The main objective of Slamecka's study was to determine whether or not the recall of a passage of prose would increase as the degree of its original learning was increased. Secondly, the study also aimed at finding out whether or not the curve of trial-by-trial acquisition would be negatively accelerated, as is the usual case in simpler learning tasks.

There were six groups of Ss. Each group was given a different number of presentations of the original passage and three presentations of an interpolated passage. This interpolated passage was used to control the experience of all Ss during the interval between original learning (OL) and delayed recall (DR). Degree of original learning was varied by the number of presentations of the passage (1, 3, 5, 7 and 9).

The passages were presented on a tape-recorder as follows: original presentation, a single original recall, three

interpolated presentations, a single interpolated recall, and a delayed recall of the original passage.

The Ss were told that they would be presented with passages and that they would be required to memorize them. There was a 5-second interval between successive readings.

At the end of the listening period, the Ss were asked to write down as much as they could recall of the first passage.

Results showed that the mean scores among the groups on OL differed significantly. This showed that the number of presentations influenced the level of acquisition. Plotting of these acquisition means as a function of the number of presentations generated a very smooth negatively accelerated curve, consistent with the usual findings obtained with unconnected material.

In another experiment, Slamecka (1959) tested the hypothesis that recall of a prose passage would decrease as the degree of learning of an interpolated passage increased.

The Ss for the experiment were divided into 5 groups, every group being given a different number of presentations of an interpolated passage, and three presentations of the original passage.

The results showed that forgetting is directly related to the degree of interpolated learning.

In a subsequent study, Slamecka (1960) was interested in investigating whether varying degrees of practice would have the same effect on the recall of connected discourse as on unconnected material. It was hypothesized that the rote

of retention of a prose passage is subject to retroactive inhibition (RI) and that its recall is a direct function of amount of practice in original learning (OL) and an inverse function of amount of practice in interpolated learning (IL).

Subjects learned passages of connected discourse. Three levels of OL practice (2, 4, and 8 trials) and three levels of IL practice (0, 4, and 8 trials) were given.

Results showed that OL and IL were a function of number of practice trials. Recall of prose was subject to significant RI and also varied directly with OL practice and inversely with IL practice.

2. Grammatical Transformations:

Recently, there has been an increasing number of studies on grammatical transformations. However, only a few of these studies are closely related to the present study. Consequently, only these related studies will be reviewed.

To begin with, it would be necessary, perhaps, to point out that although Flesch (1946, p. 33) emphasizes that for effective communication we should write short sentences, he does not clearly specify how much we improve comprehensibility by shortening sentences. Consequently, this has been one of the major problems to be investigated empirically. For example, Coleman (1962) selected three difficult passages from The Human Senses of Geldard and performed the following procedures: First, each passage was adjusted to contain 232 words, 405 syllables, 32 prepositions, 45 "direct words," and 10

sentences; second, each passage was written into other versions such that one version contained 6 sentences, and one contained 15 sentences, and the original one had 10 sentences. And lastly, in each passage the first version had 15.4 words to a sentence, and in the second they averaged 23.2, and in the third they averaged 38.8.

Readability was measured by cloze tests given immediately after the S had finished reading each passage. Mean number of words correctly inserted per subject were 22.4, 21.4, 20.9 for the words for passages of 15.4, 23.2 and 38.6 words to a sentence respectively. These differences are statistically significant and a good indication that technical passages divided into short sentences were significantly more comprehensible than their long counterparts. The magnitude of the improvement in comprehensibility due to shortening sentences was found to be about 6 per cent.

In a subsequent study, Coleman and Blumenfeld (1963) investigated the relative comprehensibility of different grammatical transformations of a single sentence. The transformations compared in this particular study were nominalizations derived from verbs (e.g., John's description of it) and their grammatical transformations using the active verb (John described it).

Each sentence was written in two versions (nominalized and active verb), and for each S half of his sentences were in the active-verb version and the other half were in the nominalized version. The results showed that the performance

on the active verb version was better than the performance on the nominalized version.

In another similar study, Coleman (1964) carried out four experiments. In the first experiment three transformations were applied simultaneously to difficult technical prose (nominalizations, passives and adjectivalizations were transformed to their active-verb counterparts, and the original versions were compared to the transformed versions for readability). The simplified versions were comprehended better than the original versions.

In the second experiment, each subject read four passages in the original version and four in the simplified version. He was then asked to write each of these passages exactly, immediately after reading each of them. The passages were simplified by applying the same three transformations used in the first experiment. The results showed that the simplified versions were recalled better than the originals.

In the third experiment, 20 nominalized sentences were compared with their active-verb transformations. The measure of learning was the same as in the second experiment. The results again showed the active-verb transformations were recalled better than the nominalized versions.

In the last experiment, 10 nominalized sentences were compared with their active-verb transformations in terms of the amount of time required to learn each version. Sentences were presented to Ss on a memory drum at the rate of one second. The measure of learning was in terms of trials to

perfect recall. As it was expected, active-verb transformations took less time to be learned than the original nominalized sentences.

Coleman (1965) further examined different categories of grammatical transformations. Four experiments were carried out. The first experiment contained the examination of nominalizations, and the second compared actives to passives. In the third experiment, adjectivalizations (e.g., the urgency of immediate demands is allowed to usurp attention) were compared to their detransformed adjective versions (e.g., Immediate demands are so urgent that they are allowed to usurp attention). And lastly, a comparison of embedded sentences (e.g., The rat that the cat killed ate the malt) with non-embedded sentences (e.g., The cat killed the rat that ate the malt) was made.

The results of the four experiments showed that the detransformed active-verb versions, measured by a cloze test, were easier to learn, actives were better retained than passives, and that performance on nonembedded versions was better than performance on embedded versions. There was no indication that detransforming any and all adjectivalizations will have significant effect in making prose easier to comprehend.

Mehler (1963) also carried out a similar study to those by Coleman. He presented a set of eight short sentences to the S who was instructed that he would be tested for recall. The sentences differed in their grammatical forms (e.g., active

or passive, affirmative or negative, declarative or interrogative).

The eight kernel sentences and their transformations gave 64 sentences which were divided into 8 groups of 8 sentences in such a way that in each group no sentence and no transformation was represented more than once. The results showed that kernel sentences were learned with greater facility.

The relative effects of these grammatical transformations on speed of understanding has also been investigated in a study by Gough (1965). In this particular study, 8 descriptive kernel sentences, plus the negative, passive and negative-passive transformations were used. There were, thus, 32 sentences; and each of these 32 sentences could be paired with any of the 16 experimental events which confirmed or falsified the sentences.

The obtained results indicated that active sentences were verified faster than passive sentences, affirmative sentences faster than negative sentences. The results also showed that true sentences were verified faster than false, and truth value interacted with the affirmative-negative variable.

Slobin (1966) in a similar study tried to examine the degree to which children and adults were able to verify kernel, passive, negative, and passive-negative sentences. The method employed in this study was as follows: a sentence was read and then a picture was exposed. The S was required to say whether the sentence was true or false in relation to the exposed picture.

The results showed that female Ss of all ages tended to respond more rapidly than males. The main effect of grammar was found to be significant, and consistent with the previous findings, kernel sentences required less time to verify than passive sentences, and passive sentences required less time than negative sentences, and negative sentences less time than passive-negative sentences. This was true at all age levels (kindergarten, second, fourth and sixth grades, and adults).

The results also showed that true negatives (e.g., The cat is not chasing the dog) were more difficult to verify than false negatives (e.g., The dog is not chasing the cat). There was also some good evidence to show that reversible sentences (e.g., The dog is chasing the cat) were harder to verify than non-reversible sentences (e.g., The girl is watering the flowers). This finding held true at all age levels.

Age was also found to be a significant variable in that both reaction time and errors in verification of the sentences tended to diminish with age.

In a similar study, Smith (1965) attempted to examine whether the time involved in making passive or negative transformations (or their inverse) is independent of their effect on the meaning of the transformed sentence.

Four tasks, each requiring the conversion of a list of 16 sentences according to rules involving either a negative or passive transformation (or their inverse) and resulting in the reversal or nonreversal of sentence meaning were employed in the study. The task rules also involved the

changing of words within each sentence to opposite or synonymous form. A single negative transformation or word change to the opposite reversed the meaning of a sentence, while a single passive transformation or word change to synonymous form left the meaning unchanged. Two meaning reversals within the same sentence cancelled each other and left the total meaning unchanged.

Group I Ss performed tasks involving the following transformations: 1) one transformation and one word change, the conjunction of negative transformation and one word change to the opposite form; 2) the conjunction of negative transformation and word change to opposite or of passive transformations and word change to synonymous form.

Group II Ss performed similar tasks, each involving one transformation and two word changes. Thus, for each group of Ss, the tasks resulted in a reversal of sentence meaning and two did not.

The results showed that change of sentence meaning resulted in longer performance times in tasks involving passive transformations, but not in tasks involving negative transformations.

In a somewhat related study, but performing different kinds of transformations in a prose passage, Martin and Alonso (1967) examined whether or not high informational, condensed verbal materials can be comprehended as well as, if not better than, full length text verbal materials.

The Ss for the study were blind children. One-third of the Ss read a traditional passage, one-third read a medium length version, and the remaining one-third read a short telegraphic version. All three versions contained the same essential information.

The following three conditions were employed to obtain information acquired under each of these three versions: set relations questions, which were designed to measure Ss' retention and distortion of the set relations; multiple-choice questions, which tested the retention of factual type information; and reconstruction, in which Ss were required to reconstruct the story from memory.

The obtained results showed that the Ss who read the medium and short versions required significantly less time than Ss who read the traditional version.

Some studies in this general area have also attempted to develop theoretical models to account for the learning of sentences of various grammatical transformations. For example, a study by Savin and Perchonock (1965) attempted to examine why some of these grammatical transformations are easier to remember than others. More specifically, the purpose of the study was to measure the amount of immediate memory that is occupied by several grammatical features. The grammatical features of interest were the negative, passive, question, negative-question, emphatic, and wh-transformations.

The investigators presumed that each of these features is encoded separately and therefore each occupies a

characteristic amount of space in immediate memory. It was postulated that the sentences with several transformations occupy more space in immediate memory than others (the ones with fewer transformations). The problem was, therefore, to measure the amount of space remaining in memory after a sentence had already been encoded. Consequently, this additional space was measured by seeing how much additional material could be remembered along with the sentence. The rationale here was that if a sentence filled most of the memory, little or nothing extra can be remembered along with it. On the other hand, if another sentence was encoded compactly, then there would be space for several other items in addition to it.

The S was therefore given a sentence followed by a string of words and was required to recall as many as possible of the extra words. The number of extra words recalled was taken as a measure of the memory capacity remaining after the sentence had been encoded.

The results supported the assumption that sentences with more transformations occupy more space in immediate memory than do sentences with fewer transformations. However, it is also possible that during the recall the S was still altering the syntactic form of the sentences with more transformations. This process of alteration should interfere with the number of extra words that can be recalled. This line of argument is based on Miller's (1962) theoretical position that what Ss remember is the kernel sentence, but when asked to recite

the original sentence exactly, they supplement their memory of the kernel sentence with a footnote about the syntactic structure.

Although most of the experimental and theoretical studies on grammatical transformations have primarily been by psychologists, the work of the linguist Chomsky (1968) has also contributed to our theoretical understanding in this area. According to Chomsky, people are born with predispositions to use a language in a certain way, such that if a sentence whose surface structure does not correspond to its deep structure (the way people are predisposed to use a sentence), certain grammatical transformations must be made for the sentence to be understood. Chomsky's theorizing has influenced the work of psychologists such as Miller (1962) and Savin and Perchonock (1965).

3. Compressed Speech:

There is an increasing amount of research being conducted on time compressed speech. Time compressed speech essentially means that if a speech has been delivered at a normal word rate (175 wpm) the same speech can be accelerated by increasing word rate (Foulke, 1966).

The dependent variables studied in time compressed speech are usually intelligibility and comprehension. In one study (Garvey, 1953) 95 per cent or greater intelligibility was obtained when the original speed had been accelerated 1.5, 1.75, and 2.0 times. Accelerating original speed 1.67 and

2.5 times gave mean intelligibility scores above 90 per cent.

Accelerating the original speed 3.0 times produced a mean intelligibility score of 78 per cent. When the acceleration of the original speed reached 3.5 times, intelligibility dropped to 50 per cent, and the mean intelligibility score did not drop below the 50 per cent level until the original speed had been accelerated 4.0 times.

These findings were supported by the findings of a subsequent study by Foulke and Sticht (Foulke, 1966, p. 26) which showed that there was a 9 per cent loss in intelligibility at 425 wpm. Compressing speech to approximately twice the normal rate (175 wpm) led to only six per cent loss in intelligibility.

However, comprehension was affected much more than intelligibility. Comprehension begins to decline at 275 wpm. This is well substantiated by the finding of a study (Foulke, 1966) in which a passage was read at three different rates (149, 164.6, and 195.7 wpm) and then compressed to 275 wpm. The compressed passage was presented to one of the three comparable groups of listeners. The results showed that the groups did not differ significantly on a comprehension test.

In a similar study (Orr, Friedman and Williams, 1965) Ss were given systematic practice in listening comprehension of prose material tape-recorded at progressively increasing rates of 325 wpm to 475 wpm. Again the results showed that increasing speed of presentation in words per minute up to double the normal 175 wpm rate did not produce a significant loss in

comprehension.

The findings of the studies cited here are consistent with the findings of other studies in this general area of time compressed speech (Fairbanks, Guttman and Myron, 1957; Foulke, Amster, Nolan and Bixler, 1962) which indicated that there is very little loss in comprehension until the rates approach or exceed 300 wpm.

Summary:

Studies cited here clearly indicate that the role of repetitions in prose learning has not been thoroughly examined. Although Slamecka (1959 and 1960) has attempted to do this, the relative effects of number of presentations on prose learning when time is held constant are not known.

Also the effects of availability of transformational time on recall and comprehension of prose material has not been empirically examined.

Thus, this study is designed to examine the effects of repetitions on recall and comprehension of prose materials of varying grammatical complexity when time is held constant. Secondly, it is necessary to examine the effects of providing transformation time (inter-sentence interval and intra-sentence interval) on recall and comprehension of low difficulty and high difficulty prose passages.

Operating within the grammatical transformational theoretical framework discussed in Chapter I, it is predicted that number of presentations will be a significant factor in the

recall and comprehension of the low difficulty material, while transformational time (inter-sentence interval and intra-sentence interval) will be a significant factor in the recall and comprehension of high difficulty material.

Details concerning the development of the stimulus material, modes of presentations and other related experimental procedures are described in the next chapter.

CHAPTER III

METHOD

Stimulus Materials:

A 354-word standardized reading passage for grade nine was selected from "Tests of Academic Progress: Form 1" (p. 54). The average sentence length of this passage was 16.8 words.

A second standardized reading passage (655 words) was selected from "Iowa Tests of Basic Skills: Form 3" (p. 22). The average length of this passage was 13.9 words. The two passages, in their standardized forms, constituted the Low Difficulty Versions.

The following procedures were employed in transforming these Low Difficulty Versions (LDV) into High Difficulty Versions (HDV): Wherever possible, sentences in the LDV were changed into passives, noun clauses, embedded versions, nominalized versions, and wherever possible, combining these transformed versions into long complex sentences. This procedure is justified on the ground that sentence learning research literature reviewed in Chapter II clearly indicates that these grammatical transformations are difficult to recall or comprehend.

An example of LDV and its transformed HDV are given below:

Low Difficulty Version	High Difficulty Version
The paintings of ancient peoples tell us of their problems and their heroes. From their art we can learn about their government and their religion. For example, we know that the Egyptians had powerful and glorified rulers and their religion included included a belief that there was life after death.	By the paintings and art of ancient peoples we are told of their problems and heroes, their government and religion. That the Egyptians had powerful and glorified rulers, for example, and that included in their religion was a belief that there was life after death, we know.

Table 1. Number of words, sentences, and average sentence length in the Low Difficulty Versions and in the Corresponding transformed High Difficulty Versions.

	Words	Sentences	Average Words/Sentence
Passage 1.			
LDV	354	21	16.8
HDV	376	13	28.9
Passage 2.			
LDV	655	47	13.9
HDV	754	22	34.2

Ten recall and ten comprehension questions were obtained for each of the two passages. Recall questions were designed to test the S's ability to recall factual information, while comprehension questions were designed to test the S's ability to organize and understand given or implied information.

Some examples of recall and comprehension questions are given below.

Recall

A complex set of written symbols developed by the Egyptians were known as

1) Braille
2) Microscopics
3) Hieroglyphics
4) Cuineform
5) None of these

What is the Little Bighorn?

1) An Indian reservation
2) One of the Black Hills
3) A river
4) A pass between two hills

Comprehension

Which of the following would make the best title for this selection?

1) Custer the Great
2) The Yellow Hair
3) The military career of George Armstrong Custer
4) The death of Custer

According to the selection, what is the principal advantage of water color over other art mediums?

1) A wider variety of colors is possible
2) Cheaper materials are available
3) Larger surfaces can be covered more easily
4) All the above are advantages
5) The selection gives no clue

Modes of Presentation:

There were three modes of presentation: massed, distributed, and slow one-trial.

Massed Condition: The LD and HD passages were presented twice at approximately 208 wpm. The second presentation occurred immediately upon completion of the first presentation.

Distributed Condition: As in the massed condition, both the LD and HD passages were presented twice at approximately 222 wpm. However, in this condition there was a 5 second pause at the completion of each sentence.

Slow One-trial Condition: The LD and HD passages were presented only once at approximately 117 wpm.

Thus, there were six experimental conditions: LD-Massed, LD-Distributed, LD-Slow One-trial, HD-Massed, HD-Distributed, and HD-Slow One-trial.

Table 2 shows the amount of time it took to tape-record each of these conditions.

Table 2. Amount of time taken to tape-record each version.

	Number of words	minutes	seconds
Passage 1:			
LD-Massed	354	3	36
LD-Distributed	354	6	30
LD-Slow One-trial	354	4	45
HD-Massed	376	3	40
HD-Distributed	376	5	30
HD-Slow One-trial	376	4	20
Passage 2:			
LD-Massed	655	6	40
LD-Distributed	655	13	40
LD-Slow One-trial	655	9	30

Table 2: (Continued)

	Number of words	minutes	seconds
Passage 2:			
HD-Massed	754	6	30
HD-Distributed	754	10	00
HD-Slow One-trial	754	7	50

The rate at which each of these conditions was tape-recorded was calculated as follows: the total time taken to record massed condition was halved and the total number of words in that condition was then divided by this quotient. In the distributed condition, the number of pauses in each version was multiplied by five (i.e., the 5-second pause at the end of each sentence). The resulting figure was subtracted from the total amount of time in that condition. The remaining amount of time was halved, and the total number of words in that condition was divided by this quotient. Since in the slow one-trial condition, five seconds elapsed before the next sentence could be read, this had to be accounted for when calculating the reading speed. Consequently, the number of pauses in each version was multiplied by five. The obtained product was subtracted from the total amount of time for this condition, and then the total number of words in this condition was divided by the remaining amount of time. Table 3 shows the rate at which the passages and their transformed high difficulty versions were read on the tape-recorder:

Table 3. The rate at which the passages and their transformed high difficulty versions were read on the tape-recorder.

Passage 1: Version	Words per Minute
LD-Massed	196.7
LD-Distributed	223.5
LD-Slow One-trial	118
HD-Massed	205.9
HD-Distributed	214.9
HD-Slow One-trial	112.8
Passage 2:	
LD-Massed	196.5
LD-Distributed	218.3
LD-Slow One-trial	115
HD-Massed	232
HD-Distributed	232
HD-Slow One-trial	124

Subjects:

One hundred and twenty Ss were obtained from six classes of grade nine students at Okemos High School. It was not possible to randomly assign these Ss into six experimental groups because the authorities felt that the students had been initially randomly assigned to these classes. Secondly, it was felt that random assignment of these Ss into six experimental groups would have seriously interfered with class schedules.

Procedure:

Since it was not possible to randomly assign the Ss into six experimental groups, it was necessary to administer a pretest to determine whether or not the six groups were similar in prose learning ability. Consequently, a short passage was selected from "Tests of Academic Progress: Form 1" (p. 47) for this purpose. This passage was read on a tape-recorder at the normal speed. The Ss listened to the tape and then took a short quiz.

Each of the six groups was assigned to one of the six experimental treatments (LD-Massed, LD-Distributed, LD-Slow One-trial, HD-Massed, HD-Distributed, HD-Slow one-trial), after the pretest.

At the beginning of each experiment, the Ss were told, on the tape, that some passages were going to be read to them on the tape, and that at the end of each passage, they would be given a quiz.

After the Ss had finished taking the quiz on the first passage, they were told to take a short break (5 minutes) and then be prepared for another passage.

Performance on recall and comprehension was scored in terms of items answered correctly.

Individual Difference Measures:

I.Q. (Lorge Thorndike) scores and Verbal Reasoning Ability (Differential Aptitude Test) scores were available for some of the Ss. It was necessary to obtain this

incidental information to facilitate correlational analyses between individual difference measures and the dependent variables (recall and comprehension). Table 4 shows the number of Ss, in each of the six groups, whose individual difference measures were available.

Table 4. Number of subjects whose I.Q. and Verbal Reasoning Ability scores were available.

Group	Number
LD-Massed	10
LD-Distributed	12
LD-Slow One-trial	17
HD-Massed	19
HD-Distributed	18
HD-Slow One-trial	16

CHAPTER IV

RESULTS

Pretest

The rationale for the pretest was to establish the comparability of the groups to recall and comprehend prose material. The number of correct items on the pretest was recorded for each S. Table 5 presents means and standard deviations on the pretest.

Table 5. Means and standard deviations on the pretest.

Group	Mean	SD
HD-Massed	2.85	1.49
HD-Distributed	3.15	1.49
HD-Slow One-trial	3.15	1.15
LD-Massed	3.10	1.84
LD-Distributed	3.15	1.88
LD-Slow One-trial	2.90	1.22

Table 6 presents the summary of a simple 1 x K analysis of variance which showed that the six groups were similar.

Table 6. Analysis of variance summary table of performance of the six groups on the pretest.

Source	SS	df	MS	F
Between	1.90	5	.38	.15
Within	283.80	114	2.48	
Total	285.70	119		

Thus, it could be assumed that the groups were comparable in their ability to learn from prose material. On the basis of these results it can, thus, be assumed that differences in the performance of these six groups in the six different experimental conditions were due to the experimental treatments rather than initial differences among the groups.

Statistical analysis of performance on recall and comprehension were performed separately for each passage.

Passage 1:

A. Recall:-

The total number of correct recall items was recorded for each S. Table 7 presents the means and standard deviations for the six groups.

Table 7. Mean number of correct recall items and standard deviations for each group on Passage 1

Group	Mean	SD
HD-Massed	3.45	1.36
HD-Distributed	4.80	1.72
HD-Slow One-trial	6.20	2.40
LD-Massed	6.30	2.05
LD-Distributed	5.70	1.65
LD-Slow One-trial	6.15	1.46

Table 8 presents an analysis of variance which shows that both level of difficulty and mode of presentation had significant effects on recall. A test for homogeneity of variances showed that the variances were similar (F-max = 3.11, $p > .05$).

Table 8. Analysis of variance summary table of recall on Passage 1.

Source	SS	df	MS	F	P
Difficulty	45.63	1	45.63	13.26	.0005
Mode	35.82	2	17.91	5.20	.007
Interaction	43.72	2	21.86	6.35	.002
Error	392.30	114	3.44		
Total	517.47	119			

Since there was a significant mode x difficulty interaction, a test for simple main effects (Bruning and Kintz, 1968, pp. 117-123) of mode within each difficulty level was performed. The null hypothesis of mode main effects within the low difficulty material was not rejected. This indicated that mode of presentation is not an important variable when difficulty is low. The null hypothesis of mode main effects within high difficulty level was rejected. Thus, mode of presentation contributes to variability in recall of prose material under high difficulty conditions. The locus of the significant main effect showed that recall of high difficulty material under the distributed condition was significantly better than recall of high difficulty material under the massed condition; recall of high difficulty material under the slow one-trial condition was significantly better than recall of the high difficulty material under either the distributed condition or the massed condition. Also, recall of high difficulty material was significantly poorer than recall of low difficulty material under the massed condition. Table 9 presents the results of the individual comparisons.

Table 9. Differences between some specific pairs of means of recall in Passage 1.

Conditions		HD-M	HD-D	LD-D	LD-S	HD-S	LD-M
	Means	3.45	4.80	5.70	6.15	6.20	6.30
HD-M	3.45	---	1.35**			2.75**	2.85**
HD-D	4.80	1.35**	----	.90		1.40**	
LD-D	5.70		.90	----	.45		.60
LD-S	6.15			.45	----	.05	.15
HD-S	6.20					----	
LD-M	6.30						----

**Significant differences beyond .05 level

Key to abbreviations in Table 9:

HD-M = High Difficulty Massed
HD-D = High Difficulty Distributed
LD-D = Low Difficulty Distributed
LD-S = Low Difficulty Slow One-trial
HD-S = High Difficulty Slow One-trial
LD-M = Low Difficulty Massed

All these hypotheses, except one, were confirmed by these results. Only the hypothesis which had predicted recall of low difficulty material to be better than recall of high difficulty material, under the distributed condition, was not supported. However, there was a trend in the predicted direction.

Figure 1 presents the interaction between levels of difficulty and modes of presentation.

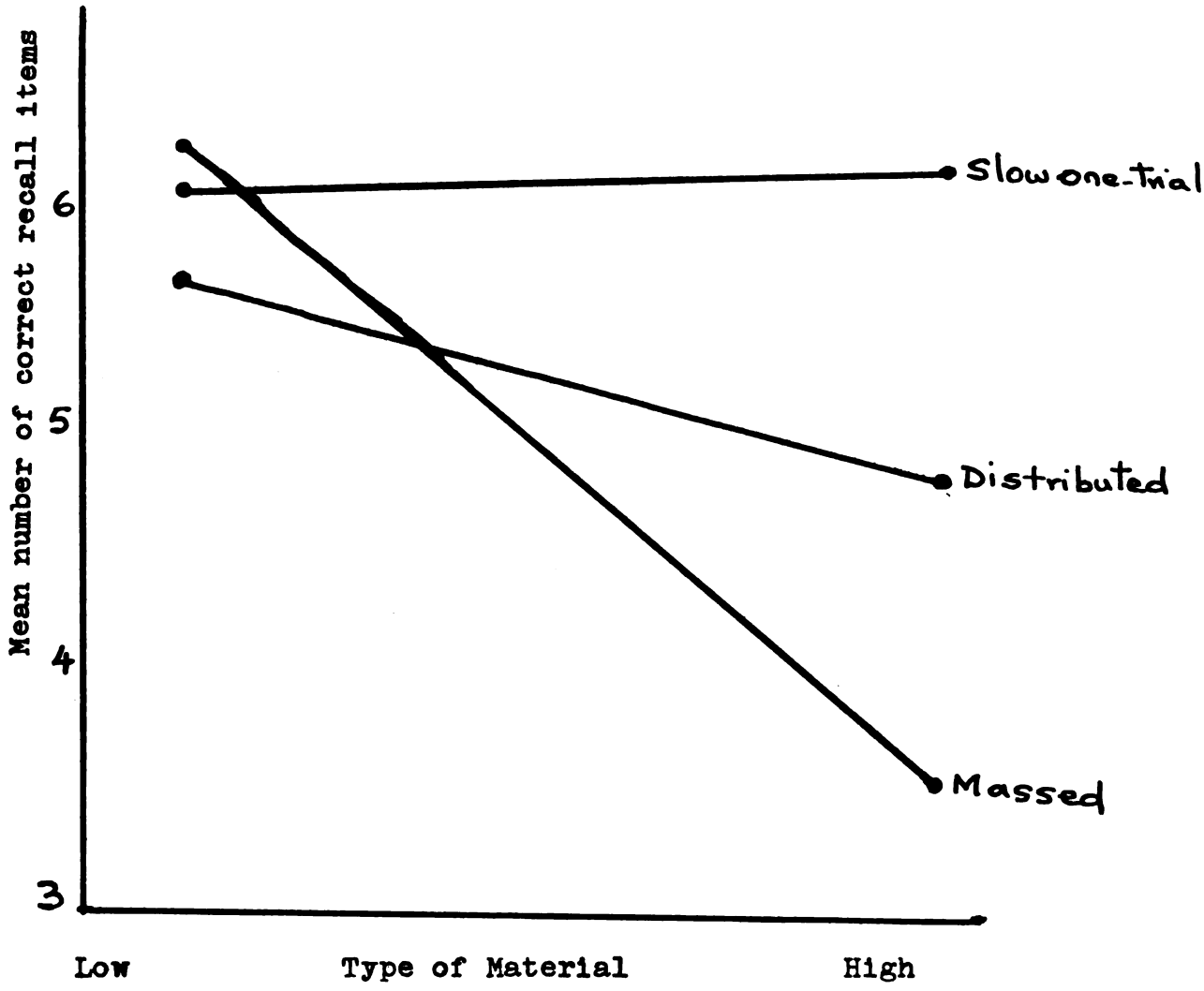

Fig. 1. Interactions between grammatical complexity and modes of presentation in recall of Passage 1.

B. Comprehension:-

The total number of correct comprehension items was recorded for each S. Table 10 presents the means and standard deviations for each of the six groups on Passage 1.

Table 10. Mean number of correct comprehension items and standard deviation for each group on Passage 1.

Group	Mean	SD
HD-Massed	3.20	1.69
HD-Distributed	4.00	1.70
HD-Slow One-trial	5.10	1.37
LD-Massed	5.45	2.06
LD-Distributed	5.40	1.83
LD-Slow One-trial	5.55	2.36

Table 11 presents an analysis of variance which showed a significant main effect due to difficulty. Mode of presentation was not significant, but again there was a trend in the predicted direction. A test for homogeneity of variances showed that variances were similar (F-max = 2.96, $p. > .05$).

Table 11. Analysis of variance summary table of comprehension.

Source	SS	df	MS	F	P
Difficulty	56.03	1	56.03	15.37	.0005
Mode	20.42	2	10.21	2.80	.065
Interaction	16.22	2	8.11	2.22	.113
Error	415.70	114	3.65		
Total	508.37	119			

Individual means were compared to determine which ones differed significantly from each other. Tukey's significant gap of 1.19 showed that comprehension of low difficulty material was significantly better than comprehension of high difficulty material, under massed condition and distributed condition; and comprehension of high difficulty material under slow one-trial condition was significantly better than comprehension of high difficulty material under massed condition (Table 12).

Table 12. Differences between some specific pairs of means of comprehension of Passage 1.

Conditions		HD-M	HD-D	HD-S	LD-D	LD-M	LD-S
	Means	3.20	4.00	5.10	5.40	5.45	5.55
HD-M	3.20	----		1.90**		2.25**	
HD-D	4.00	.80	----	1.10	1.40**		
HD-S	5.10			----			
LD-D	5.40				----		
LD-M	5.45					----	
LD-S	5.55						----

**Significant differences beyond .05 level.

Thus, the results confirmed three hypotheses and not two. The two hypotheses that were not supported had predicted comprehension of high difficulty material under distributed condition to be better than comprehension of high difficulty

material under massed condition, and an interaction between levels of difficulty and modes of presentation.

Figure 2 shows these interactions between levels of difficulty and modes of presentation.

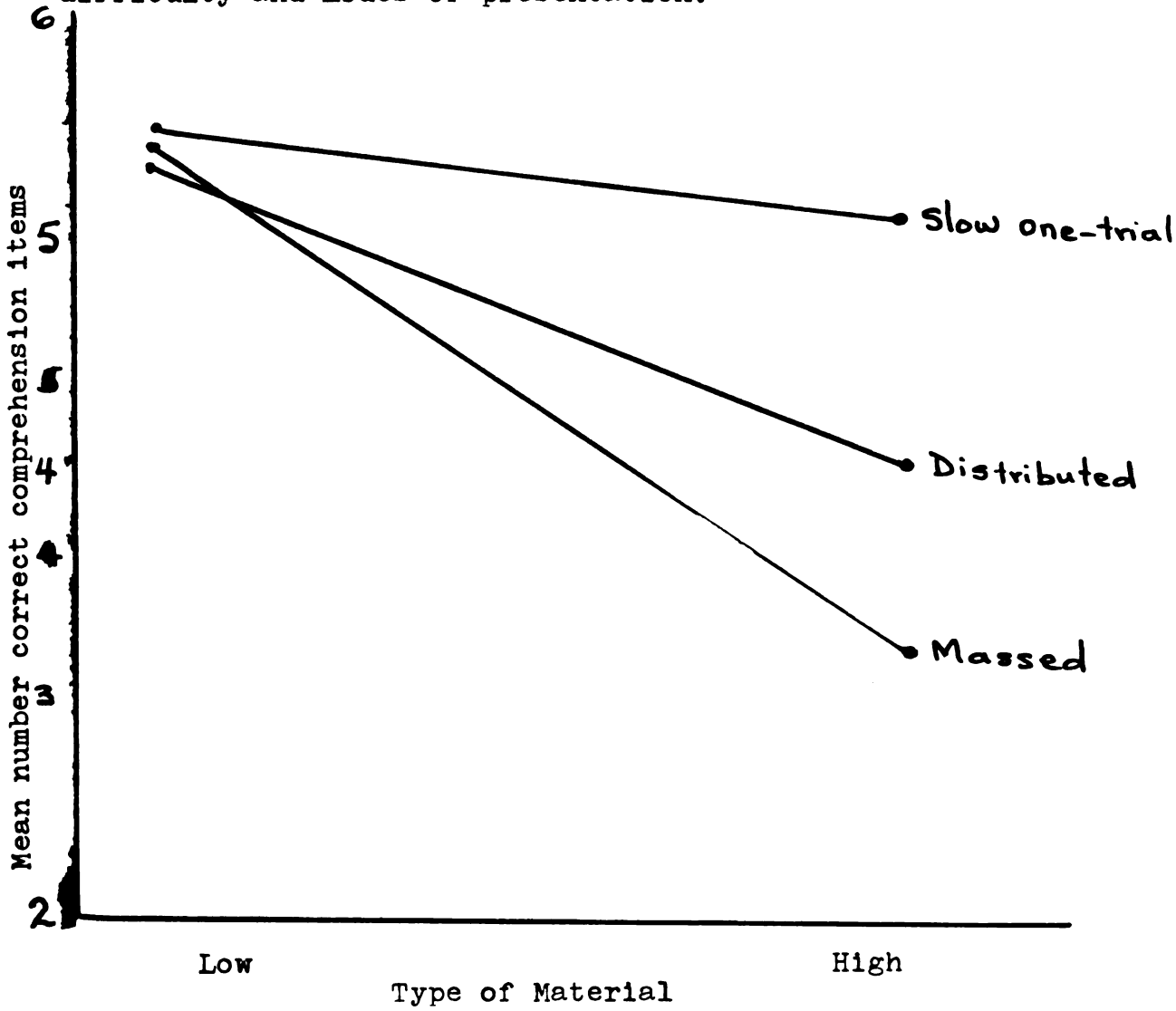

Fig. 2. Interactions between grammatical complexity and modes of presentation in comprehension of Passage 1.

Passage 2

A. Recall:

The total number of correct recall items was recorded for each S. Table 13 presents the means and standard deviations for the six groups.

Table 13. Mean number of correct recall items and standard deviation for each group on Passage 2.

Group	Mean	SD
HD-Massed	4.55	1.69
HD-Distributed	5.25	1.67
HD-Slow One-trial	5.80	1.50
LD-Massed	6.40	1.83
LD-Distributed	6.40	1.69
LD-Slow One-trial	6.00	1.14

Table 14 presents an analysis of variance which showed that levels of difficulty had a significant effect on recall.

Table 14. Analysis of variance summary table of recall.

Source	SS	df	MS	F	P
Difficulty	34.13	1	34.13	12.65	.001
Mode	4.12	2	2.06	0.76	.469
Interaction	13.72	2	6.86	2.54	.083
Error	307.50	114	2.70		
Total	359.47	119			

Tukey's significant gap of 1.02 indicated that recall of low difficulty material was significantly better than recall of high difficulty material, under the massed condition, and the distributed condition. Recall of high difficulty material under the slow one-trial condition was significantly better than recall of the high difficulty material under the massed condition. Table 15 presents the differences between specific pairs of means of recall of Passage 2. The predicted interaction between levels of difficulty and mode of presentation was not significant. However, there was a trend in the predicted direction. Variances were found to be similar (F-max = 2.58, $p > .05$).

Table 15. Differences between some specific pairs of means of recall of Passage 2.

Conditions		HD-M	HD-D	HD-S	LD-S	LD-M	LD-D
	Means	4.55	5.25	5.80	6.00	6.40	6.40
HD-M	4.55	----		1.25**		1.85**	
HD-D	5.25	.70	----	.55			1.15**
HD-S	5.80			----			
LD-S	6.00				----		
LD-M	6.40					----	
LD-D	6.40						----

**Significant differences beyond .05 level

Figure 3 shows these interactions between levels of difficulty and modes of presentation.

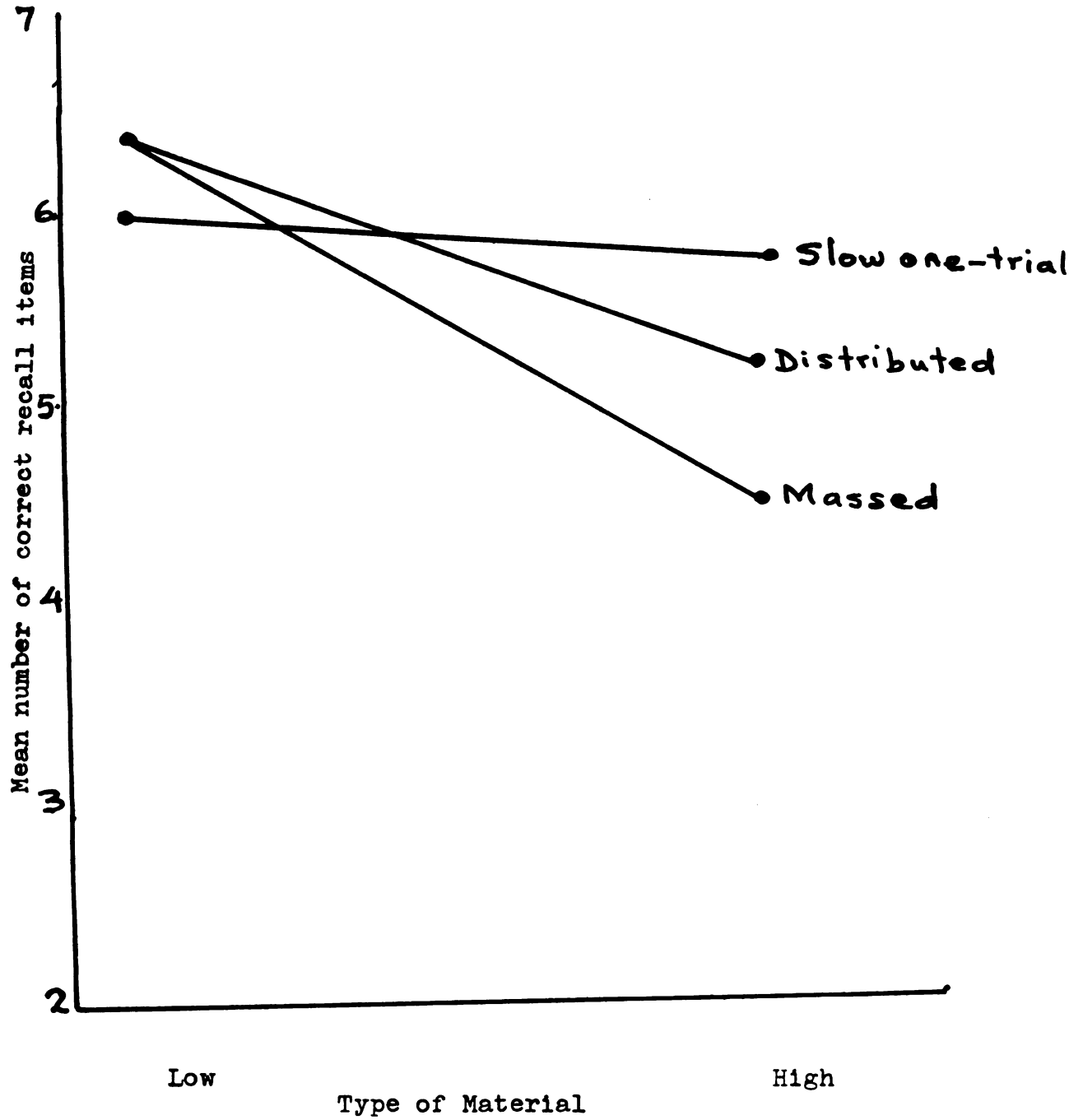

Fig. 3. Interactions between grammatical complexity and mode of presentation in recall of Passage 2.

B. Comprehension

The total number of correct comprehension items was recorded for each S. Table 16 presents the means and standard deviations for the six groups.

Table 16. Mean number of correct comprehension items and standard deviation for each group on Passage 2.

Group	Mean	SD
HD-Massed	4.45	1.88
HD-Distributed	4.70	1.68
HD-Slow One-trial	5.70	1.23
LD-Massed	5.55	1.75
LD-Distributed	5.75	1.64
LD-Slow One-trial	6.10	1.61

Table 17 presents an analysis of variance which showed that both levels of difficulty and modes of presentation had significant effects on comprehension. A test for homogeneity of variances showed that the variances were homogeneous (F-max = 2.34, $p > .05$).

Table 17. Analysis of variance summary table of comprehension.

Source	SS	df	MS	F	P
Difficulty	21.67	1	21.67	7.63	.007
Modes	17.55	2	8.77	3.09	.049
Interaction	3.05	2	1.52	0.54	.586
Error	323.85	114	2.84		
Total	366.12				

Tukey's significant gap of 1.04 showed that comprehension of low difficulty material was significantly better than

comprehension of high difficulty material, under the massed condition and the distributed condition; and comprehension of high difficulty material under the slow one-trial condition was significantly better than comprehension of high difficulty material under the massed condition. Table 18 presents the results of the Tukey test for individual comparisons.

Table 18. Differences between some specific pairs of means of comprehension of Passage 2

Conditions		HD-M	HD-D	LD-M	HD-S	LD-D	LD-S
	Means	4.45	4.70	5.55	5.70	5.75	6.10
HD-M	4.45	----		1.10**	1.25**		
HD-D	4.70	.25	----		1.00	1.05**	
LD-M	5.55			----			
HD-S	5.70				----		
LD-D	5.75					----	
LD-S	6.10						----

**Significant beyond .05 level

Figure 4 shows the interactions between grammatical complexity and modes of presentation in comprehension of Passage 2.

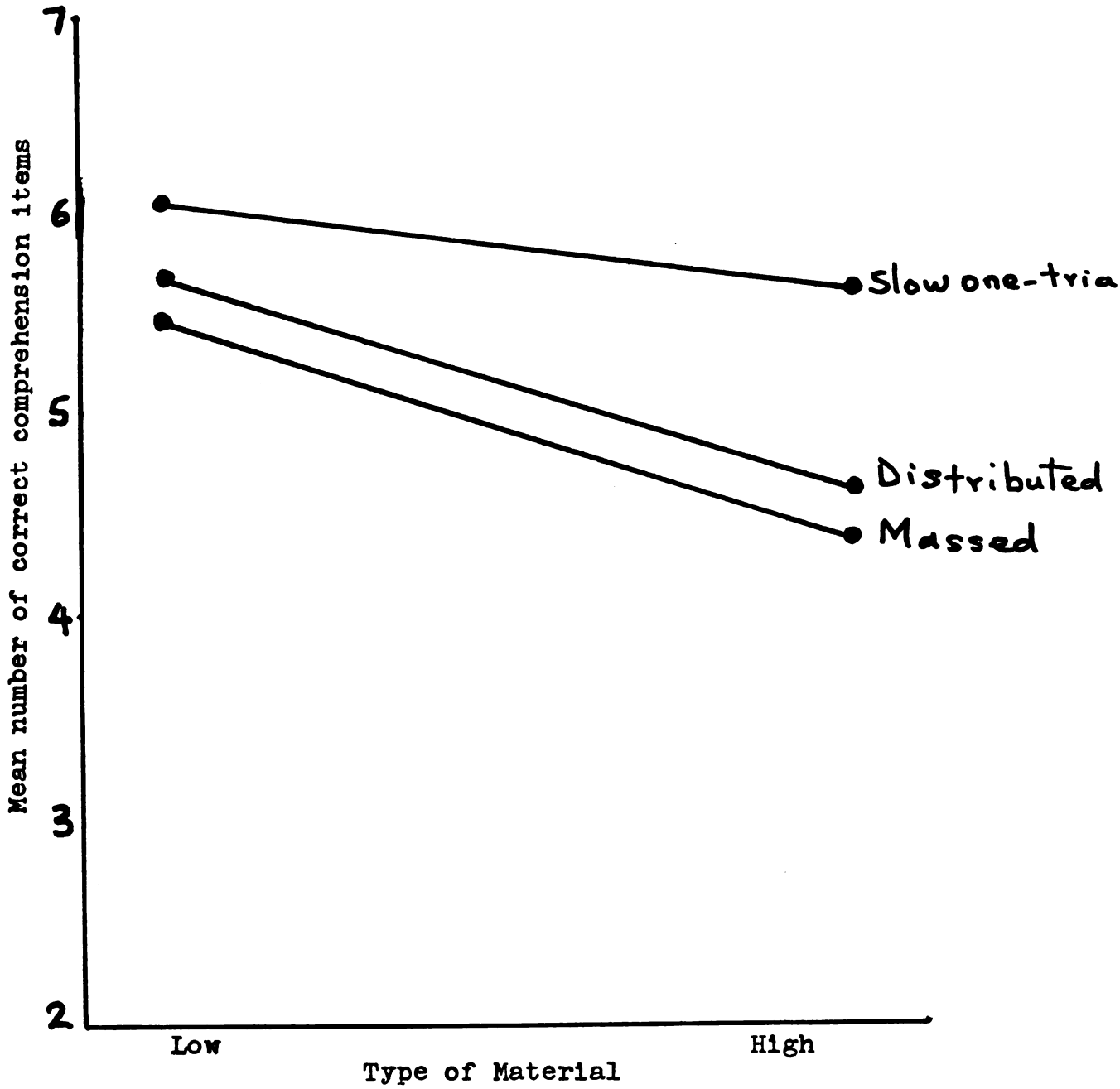

Fig. 4. Interactions between grammatical complexity and modes of presentation in comprehension of Passage 2.

Analyses of correlations between recall and comprehension, under the six conditions

Correlational analyses between recall and comprehension were done to find out to what extent recall and comprehension are related, under each of the six conditions (Table 19).

Table 19. Correlations between recall and comprehension.

Group	r	P
Passage 1:		
HD-Massed	.09	n.s.
HD-Distributed	.07	n.s.
HD-Slow One-trial	.21	n.s.
LD-Massed	.67	.01
LD-Distributed	.51	.02
LD-Slow One-trial	.53	.02
Passage 2		
HD-Massed	.27	n.s.
HD-Distributed	.49	.05
HD-Slow One-trial	.21	n.s.
LD-Massed	.39	n.s.
LD-Distributed	.62	.01
LD-Slow One-trial	.54	.02

These correlations show that recall and comprehension of high difficulty material were not significantly correlated, under the massed condition, distributed condition, and slow one-trial condition. On the other hand, recall and comprehension of low difficulty material were significantly correlated under these same conditions.

Analysis of Individual Differences:

Although the analysis of the individual difference variables was not central to this study, such information may have value in determining the extent to which these variables were correlated in the various presentation conditions. This information may be of value in specifying the extent to which individual difference variables predict recall and comprehension of prose material under various modes of presentation.

Table 20 presents the correlations between I.Q. and recall of passage 1 and 2, under all six experimental conditions.

Table 20. Correlations between I.Q. and recall of passages 1 and 2.

Group	N	r	P
Passage 1			
HD-Massed	19	.41	n.s.
HD-Distributed	18	.21	n.s.
HD-Slow One-trial	16	.75	.01
LD-Massed	10	.72	.02
LD-Distributed	12	.56	.05
LD-Slow One-trial	17	.46	n.s.
Passage 2			
HD-Massed	19	.28	n.s.
HD-Distributed	18	.38	n.s.
HD-Slow One-trial	16	.53	.05
LD-Massed	10	.17	n.s.
LD-Distributed	12	.79	.01
LD-Slow One-trial	17	.17	n.s.

These correlation coefficients indicate that I.Q. and recall are significantly correlated under HD-Slow One-trial,

LD-Massed (except in Passage 2), and LD-Distributed conditions. Table 21 presents the correlations between I.Q. and comprehension of passage 1 and passage 2, under all six experimental conditions.

Table 21. Correlations between I.Q. and Comprehension.

Group	N	r	P
Passage 1			
HD-Massed	19	.20	n.s.
HD-Distributed	18	.09	n.s.
HD-Slow One-trial	16	.10	n.s.
LD-Massed	10	.82	.01
LD-Distributed	12	.44	n.s.
LD-Slow One-trial	17	.28	n.s.
Passage 2			
HD-Massed	19	.66	.01
HD-Distributed	18	.50	.05
HD-Slow One-trial	16	.09	n.s.
LD-Massed	10	.42	n.s.
LD-Distributed	12	.82	.01
LD-Slow One-trial	17	.38	n.s.

These correlation coefficients show that I.Q. and comprehension are significantly correlated under LD-Massed (in Passage 1 only), LD-Distributed (in Passage 2 only), HD-Massed (in Passage 2 only), HD-Distributed (in Passage 2 only), and LD-Distributed (in Passage 2 only) conditions.

Table 22 presents correlations between verbal reasoning ability and recall of Passage 1 and Passage 2.

Table 22. Correlations between verbal reasoning ability and recall.

Group	N	r	P
Passage 1			
HD-Massed	19	.32	n.s.
HD-Distributed	18	.28	n.s.
HD-Slow One-trial	16	.76	.01
LD-Massed	10	.65	.05
LD-Distributed	12	.46	n.s.
LD-Slow One-trial	17	.55	.02
Passage 2			
HD-Massed	19	.19	n.s.
HD-Distributed	18	.31	n.s.
HD-Slow One-trial	16	.16	n.s.
LD-Massed	10	.20	n.s.
LD-Distributed	12	.48	n.s.
LD-Slow One-trial	17	-.04	n.s.

With the exception of a few significant correlations between verbal reasoning ability and recall, obtained in Passage 1, it would appear that there is not a significant correlation between verbal reasoning ability and recall.

Table 23 presents correlations between verbal reasoning ability and comprehension.

Table 23. Correlations between verbal reasoning ability and comprehension.

Group	N	r	P
Passage 1			
HD-Massed	19	.27	n.s.
HD-Distributed	18	.20	n.s.
HD-Slow One-trial	16	-.11	n.s.

Table 23 (Continued)

Group	N	r	P
Passage 1			
LD-Massed	10	.81	.01
LD-Distributed	12	.29	n.s.
LD-Slow One-trial	17	.52	.05
Passage 2			
HD-Massed	19	.55	.02
HD-Distributed	18	.50	.05
HD-Slow One-trial	16	.02	n.s.
LD-Massed	10	.28	n.s.
LD-Distributed	12	.59	.05
LD-Slow One-trial	17	.12	n.s.

Again, as with recall, verbal reasoning ability does not seem to be significantly correlated with comprehension.

A comprehensive discussion of all the results presented in Chapter IV is presented in the next chapter.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Analysis of the items from Passage 1 showed that, as predicted, recall of high difficulty material under the distributed condition was significantly better than recall of high difficulty material under the massed condition. Further, recall of high difficulty material under the slow one-trial condition was significantly better than recall of high difficulty material under either the distributed condition or massed condition. Recall of low difficulty material was significantly better than recall of high difficulty material in the massed condition.

Analysis of the comprehension items from Passage 1 showed, with the exception of the interaction between mode of presentation and grammatical complexity, that the locus of comprehension was as predicted. Comprehension of low difficulty material was significantly better than comprehension of high difficulty material, under either the distributed or massed conditions. Comprehension of high difficulty material under the slow one-trial condition was significantly better than comprehension of high difficulty material under the massed condition.

The presence of interaction between mode of presentation and grammatical complexity, in recall of Passage 1 indicated,

as expected, that the differences between the means of high difficulty material were significantly greater than the differences between the means of low difficulty material. And the lack of predicted interaction between mode of presentation and grammatical complexity in comprehension of Passage 1 was consistent with the theoretical assumption that the presence of a certain amount of recall does not necessarily mean that there is a corresponding amount of comprehension. Thus, although there was a significant interaction between mode of presentation and grammatical complexity in recall, there was not a corresponding significant interaction between mode of presentation and grammatical complexity in comprehension.

Examination of number of words in the low difficulty version and the high difficulty version of Passage 1 showed that the low difficulty version had 354 words and the high difficulty version had 376 words. There is also a similar situation in Passage 2. Consequently, a competing hypothesis could be advanced that those obtained predicted significant differences due to level of difficulty were not due to level of difficulty but due to the fact that there were more words in the high difficulty version than there were in the low difficulty version (Savin and Perchonock, 1965). Another competing hypothesis could also be advanced that the obtained predicted differences due to level of difficulty were not entirely due to level of difficulty alone, but also partly due to the fact that the high difficulty version had more

words than the low difficulty version.

However, since the amount of information in the two versions is the same, and since the difference between the number of words in the high difficulty version is very small, it is unlikely that any of the above hypotheses are tenable. Moreover, length of a prose passage does not seem to be a significant factor in how well the passage is comprehended.

Analysis of performance on recall in Passage 2 also showed, as expected, that there was a significant main effect due to difficulty. The recall of low difficulty material was significantly better than recall of high difficulty material, under the massed condition and the distributed condition.

The unexpected lack of significant main effect due to mode of presentation in recall of Passage 2 was probably due to the fact that the Ss heard the second passage read to them on the tape-recorder after they had already listened to the first passage read at the same speed. The Ss had, therefore, practiced under a given mode of presentation and the generalization of this prior practice may account for the lack of a main effect due to mode of presentation. This is consistent with the fact that Ss can be trained to listen and comprehend speeded discourse. This interpretation is supported by some empirical data. For example, in one study (Orr, Friedman & Williams, 1965) Ss were given a systematic practice in listening comprehension of prose material tape-recorded at progressively increasing rates of 325 wpm to

475 wpm. The results showed that increasing speed of presentation in words per minute up to double the normal rate (175 wpm) did not produce a significant loss in comprehension.

An analysis of performance on comprehension of Passage 2 also showed, as expected, that there were significant main effects due to levels of difficulty and modes of presentation. Comprehension of low difficulty material was significantly better than comprehension of high difficulty material, under the massed condition and the distributed condition. Comprehension of high difficulty material under the slow one-trial condition was significantly better than comprehension of high difficulty material under massed condition.

The lack of a significant effect due to mode of presentation in recall of Passage 2 and the presence of such a significant effect in comprehension of Passage 2 indicates that while generalization of prior practice effects led to comparable performance on recall of factual information, this phenomenon was not found in comprehension. Again, this finding is consistent with the theoretical assumption that comprehension involves more complicated cognitive processes than recall. Thus, although mode of presentation was not important in recall of factual information, after prior practice, it was important in the organization and understanding (comprehension) of the material.

Analysis of correlations between recall and comprehension generally revealed that recall and comprehension of high difficulty material were not significantly correlated. On

the other hand, recall and comprehension of low difficulty material were generally found to be significantly correlated. Examination of the significant correlation coefficients showed that only a small percentage of the variance in comprehension can be accounted for by the variation in recall.

These results seem to suggest that trials or number of presentations per se is not the major factor facilitating recall and comprehension of low difficulty and high difficulty prose material. This disproves the original prediction that trials or number of presentations would facilitate the acquisition of factual material in the low difficulty passages. These results also seem to indicate that difficult transformations require inter-sentence and intra-sentence intervals long enough so that the transformations can be made. This is consistent with the original prediction that recall and comprehension of high difficulty material would be better under a distributed condition (in which there were 5-second pauses between sentences or inter-sentence intervals) and also under a slow one-trial condition (in which there were 5-second pauses between sentences and some short pauses between words in the sentence).

Analysis of correlations between I.Q. and recall revealed some interesting results. There was a significant correlation between I.Q. and recall of high difficulty material under a slow one-trial condition. There was also a significant correlation between I.Q. and recall of low difficulty material under the massed (in Passage 1 only) and

distributed conditions. These findings are interpreted to mean that high I.Q. Ss under the HD-Slow One-trial condition, LD-Massed condition, and LD-Distributed condition are processing information faster and more efficiently than the low Ss. The lack of significant correlations between I.Q. and recall under the HD-Massed and HD-Distributed conditions means that the material was so difficult and was presented so fast that even the high I.Q. Ss were performing as poorly as the low I.Q. Ss. Similarly, the lack of significant correlations between I.Q. and recall under the LD-Slow One-trial condition means that the material was so easy and was presented at such a slow rate that even the low I.Q. Ss were performing as well as the high I.Q. Ss.

Analyses of correlations between I.Q. and comprehension generally showed that I.Q. and comprehension were significantly correlated under the LD-Massed, (in Passage 1 only), HD-Massed (in Passage 2 only), HD-Distributed (in Passage 2 only), and LD-Distributed (in Passage 2 only) conditions. This is interpreted to mean that high I.Q. Ss were organizing the acquired information better than low I.Q. Ss, under these conditions.

Examination of correlations between verbal reasoning ability and recall generally indicated that verbal reasoning ability is neither correlated with recall nor comprehension. This essentially means that verbal reasoning ability is not a good predictor of how well a S will recall and comprehend a prose passage.

At any rate, the correlations between individual difference measures and the dependent variables should be regarded as tentative findings since individual difference measures were not available for all 120 Ss. However, these tentative findings should precipitate great interest in the nature of the interaction of individual differences with modes of presentation in recall and comprehension of low and high difficulty materials. An investigation in this area may enable one to specify certain educational prescriptions which permit better learning for some individuals than others.

In general, the results indicated that some of the findings of the sentence studies on grammatical transformations could be generalized to prose learning.

Number of trials or presentations per se does not seem to be the major factor facilitating learning of low difficulty and high difficulty prose materials.

Difficult grammatical transformations require inter-sentence and intra-sentence intervals long enough to that the transformations can be made.

On the whole, the results support the grammatical transformational model discussed in Chapter I.

Any conclusions regarding the relation between the individual difference measures and the dependent variables should be regarded as tentative until further information is obtained. The only conclusion that can be made on the basis of the available information is that for low I.Q. children both low and high difficulty prose materials should be

presented at a very slow rate. But for high I.Q. children slow presentation should be necessary only for high difficulty prose materials.

Lastly, mode of presentation does not seem to be an important factor in presenting material to children of high reasoning ability and low reasoning ability.

CHAPTER VI

SUMMARY

The main objective of this study was to examine the kind of manipulations which possibly influence recall and comprehension of prose materials.

A 354-word standardized reading passage for grade nine was selected from "Tests of Academic Progress: Form 1." The average sentence length of this passage was 16.8 words. Another standardized reading passage (655 words) was selected from "Iowa Tests of Basic Skills: Form 3." The average length of this passage was 13.9 words. These two passages constituted low difficulty versions.

The following procedures were employed in transforming these Low Difficulty Versions (LDV) into High Difficulty Versions (HDV): Wherever possible, some sentences in the LDV were changed into passives, noun clauses, embedded versions, nominalized versions, and then, wherever possible, combining these transformed versions into long complex sentences.

Three different presentation modes were employed: 1) Both the LDV and HDV were read twice on a tape-recorder, at a fast rate (Massed condition). 2) The LDV and HDV were read twice at a fast rate (as in massed condition) but there were 5-second pauses at the end of each sentence (Distributed condition). 3) The LDV and HDV versions were read once at a very slow rate (Slow One-trial condition). There were,

thus, six experimental conditions: High Difficulty -Massed (HD-Massed), High Difficulty-Distributed (HD-Distributed), High Difficulty-Slow One-trial (HD-Slow One-trial), Low Difficulty-Massed (LD-Massed), Low Difficulty-Distributed (LD-Distributed), and Low Difficulty Slow One-trial (LD-Slow One-trial).

One hundred and twenty Ss were assigned equally to six experimental conditions.

Some incidental information regarding individual difference measures (I.Q. and verbal reasoning ability scores) were available for some of the Ss. This incidental information was useful in the examination of whether or not any of these individual difference measures is significantly correlated with any of the dependent variables under any of the six experimental conditions.

It was hypothesized that:

A. Recall:

1. Mode of presentation and grammatical complexity will interact.
2. Recall of low difficulty material will be better than recall of high difficulty material, under the massed condition.
3. Recall of high difficulty material will be better under the distributed condition than under the massed condition.

4. Recall of high difficulty material will be better under the slow one-trial condition.
5. Recall of low difficulty material will be better under a massed condition.

B. Comprehension:

1. Mode of presentation and grammatical complexity will interact.
2. Comprehension of low difficulty material will be better than comprehension of high difficulty material, under a massed condition.
3. Comprehension of high difficulty material will be better under a distributed condition than under a massed condition.
4. Comprehension of high difficulty material will be better under a slow one-trial condition.
5. Comprehension of low difficulty material will be better under a massed condition.

The results indicated that number of presentations was not a significant factor facilitating learning of prose material. Thus, the hypotheses that had predicted better recall

and comprehension of low difficulty materials, under a massed condition, were not confirmed. On the whole, all the other predictions were confirmed. These results were interpreted as supporting a transformational grammar model.

The analysis of the correlations between individual difference measures and the dependent variables indicated that I.Q. and recall were significantly correlated under HD-Slow one-trial, LD-Massed (except in Passage 2), and LD-Distributed conditions. There were also significant correlations between I.Q. and comprehension under LD-Massed (in passage 1 only), LD-Distributed (in Passage 2 only), HD-Massed (in Passage 2 only), HD-Distributed (in Passage 2 only), and LD-Distributed (in Passage 2 only) conditions.

With the exception of a few significant correlations between verbal reasoning ability and recall, it appeared that verbal reasoning ability and recall were not significantly correlated. Similarly, verbal reasoning ability did not seem to be significantly correlated with comprehension.

In conclusion, it can be said that number of presentations is not a significant factor facilitating learning of prose material. Recall and comprehension of prose material containing complex grammatical constructions tend to be significantly poorer. However, there was a significant interaction between mode of presentation and level of grammatical complexity. The slow one-trial mode greatly facilitated the recall and comprehension of grammatically complex prose material. These results suggest that complex grammatical transformations require

transformational time to reduce them to their kernel sentences. Thus, the greater intra- and inter-sentence intervals in the slow one-trial condition allow Ss the necessary transformation time.

APPENDIX A

PRETEST PASSAGE

Rio de Janeiro often is called Rio. It was once the capital and is still the largest city in Brazil. It lies on a bay near the Atlantic Ocean. Its outstanding landmarks are a 1,200-foot peak at the entrance to the bay and a huge concrete statue of Christ atop 2,300-foot Corcovado Mountain.

The green islands in its bay, its white beaches, its blue harbor, and its gray hills provide Rio with a most beautiful setting. Among man-made additions to its charm are its mosaic sidewalks, its plazas, and its tree-lined boulevards.

Rio is located in Southeast Brazil. It extends from the bay, along the coast, and into the valleys of nearby mountains. Granite hills, many of which have been tunneled, divide the city into sections. Natives as well as tourists are attracted to its botanical gardens, its opera house, its national library, its lavishly ornate public buildings and churches. One of the most awe-inspiring of its sights is its Municipal Stadium packed with 150,000 spectators at a musical event, sports contest, or political rally.

The Portugues colonized Brazil and they ruled it for centuries. They gave Brazil its Catholic religion and its national language. The rights of Portugal to Brazil became established through a treaty with Spain in 1494, and Brazil did not achieve an independent government until 1822. Even with independence, Brazil's government retained a Portuguese flavor through a monarchy that remained in power until 1889. Brazil became a republic under a constitution in 1891.

Passage 1

Low Difficulty Version

Man's paintings give us a record of his culture and his problems from a time long before he acquired the ability to prepare a written history. The walls of European caves have paintings that have survived from the early Stone Age.

Although many of primitive man's drawings consisted of "stick figures," some of the best cave paintings show form and movement that are amazingly accurate and realistic.

The paintings of ancient peoples tell us of their problems and their heroes. From their art we can learn about their government and their religion. For example, we know that the Egyptians had powerful and glorified rulers and their religion included a belief that there was life after death.

From their early, crude recordings of specific events, the Egyptians developed a complex set of written symbols, hieroglyphics.

Much of our present knowledge concerning the early civilization of China and Greece comes from information recorded in various art forms. From pictures, we know of the Greek gods and of the Greeks' reverence for athletic prowess.

The Babylonians early developed the art of making pictures with glazed tile. These extremely colorful and permanent pictures contained symbolic designs and patterns. As a development from tile art came mosaic pictures formed from bits of colored glass and marble. Many of these

featuring religious subjects, are preserved on the walls of early churches.

During the period of medieval art, from approximately 500 A.D. to 1500, frescoes and the "illumination" of manuscripts became established as mature art forms. Fresco painting is done on Fresh (hence the name) plaster. The design is first sketched and then the pigment is combined with the plaster. Fresco painting is well suited to large surfaces. Illumination was developed by the monks and resulted in beautiful and intricate letters and pictures on their scrolls. Modern day artists find difficulty in improving upon or even matching the quality of the art of this period.

Shortly after 1400 A.D., artists began to paint with oil, first on wood and then on canvas. The use of slow-drying oil allowed for great detail and the many possible colors encouraged brilliance, shading, and depth.

Passage 1

High Difficulty Version

A record of man's culture and his problems from a long time before he acquired the ability to prepare a written history is given us by his paintings. Paintings on the walls of European caves have survived from the early Stone Age.

Form and movement that are amazingly accurate and realistic are shown by some of the best cave paintings, although many of primitive man's drawings consisted of stick figures.

By the paintings and art of Ancient peoples we are told of their problems and heroes, their government and religion. That the Egyptians had powerful and glorified rulers, for example, and that included in their religion was a belief that there was life after death, we know.

A complex set of written symbols, hieroglyphics, was developed by the Egyptians from early, crude recordings of specific events that they had made.

Coming from information recorded in various art forms, is much of our present knowledge concerning the early civilization of China and Greece, and the Greek gods and the Greeks' reverence for athletic prowess are known by us, from pictures.

The art of making pictures with glazed tile was early developed by the Babylonians, and symbolic designs and patterns were contained in these extremely colorful and permanent pictures. Mosaic pictures that were a development from tile art were formed from bits of colored glass and marble, and

many of these, featuring religious subjects, are preserved on the walls of early churches.

The establishment of frescoes and the "illumination" of manuscripts as mature art forms took place from approximately 500 A.D. to 1500, during the period of medieval art. On fresh (hence the name) plaster, is done Fresco painting which is well suited to large surfaces, and combination of the pigment with the plaster takes place after the design is first sketched. Illumination which was developed by the monks resulted in beautiful and intricate letters on their scrolls and difficulty is found by modern-day artists in improving upon or even matching the quality of the art of this period.

Painting with oil, first on wood and then on canvas, was begun by artists shortly after 1400 A.D., great detail being allowed through use of slow-drying oil, and brilliance, shading and depth were encouraged by many possible colors.

Passage 2

Low Difficulty Version

The Indians called him "Yellow Hair." Most people of his day considered George Armstrong Custer a dashing figure. The youthful cavalry officer was impetuous and daring in action, romantic in appearance. He fancied embroidered buckskins, leather gauntlets, and big-rimmed hats. His curly, red-gold hair swept his shoulders. He has been called conceited, headstrong, and foolish - and also one of the finest horsemen the Army ever had.

Custer was born in Ohio in 1839. From boyhood he wanted to be a soldier, and yet he graduated from West Point at the foot of his class. His teachers described him as intelligent but careless. A few days after graduation, he was ordered to duty in the Civil War. During the next two years his record for bravery was so outstanding that by 1863 he had risen to the wartime rank of brigadier general, the youngest man of that rank in the Army at the time. His youth, his fearlessness, and his conspicuous dress made him a great favorite.

When the war ended, Custer was given a lower rank and sent West to fight the Indians. Bored and impatient, he was often in trouble with his superiors. After fighting the Cheyennes in Kansas, he was sent north to protect the buildinf of the Northern Pacific Railroad. In 1874 he helped a group of scientists explore the Black Hills of South Dakota,

the territory of the fierce Sioux tribes.

When gold was discovered there, the Sioux grew restless. They did not like miners poking around their reservations. Furthermore, the railroad was creeping toward their territory. White settlers were moving onto land over which the Indians had hunted for generations. The Sioux foresaw the end of the buffalo herds on which they depended for meat and clothing. Embittered young warriors quietly slipped away from the reservations and joined war camps. There were sudden attacks on settlers. Alarmed, the government in Washington ordered all Indians to return to their reservations, but this order was contrary to certain treaties that allowed the Sioux to hunt on the northern plains. Two of the strongest chiefs, Sitting Bull and Crazy Horse, refused to obey and prepared to fight.

Early in the spring of 1876, General Alfred Terry was sent out from Bismarck, North Dakota, to bring the two chiefs in. His troops included the Seventh Cavalry Regiment, which Custer commanded. When Terry's men reached Montana, advance scouts located Sitting Bull's camp on the Little Bighorn River. Custer and 600 men were sent ahead to bar the chief's escape until the rest of the troops could join them.

At the bank of the river, Custer pondered his next move. Though clouds of smoke and dust rose beyond the hills on the other side, he could not judge the size of the Indian camp. Nor did he know whether the Indians guessed how small his own forces were. Should he wait for General Terry, or should he

attack at once? If he waited for General Terry, the Indians might break camp and flee, or they might attack him. Perhaps, Custer wanted the glory of capturing Sitting Bull himself. At any rate, he decided not to wait for Terry.

He dispatched part of his troops to attack the Sioux camps to the South. The remaining 265 he led across the Little Bighorn toward the center of the Sioux line. Immediately, between 2500 and 4000 whooping Indians poured out from the hills. Somehow Custer's men managed to fight their way to a higher hill. There a thousand Cheyennes suddenly appeared, and it was all over. Only one member of Custer's band, a Crow scout, escaped. "Yellow Hair" and two younger brothers died with the rest. All were scalped except the commander.

Not until General Terry arrived was the extent of the disaster known. The news stunned the nation. Custer became a popular but controversial hero. The battlefield near Hardin, Montana, where he made his "last stand," is now a national monument.

Passage 2

High Difficulty Version

Impetuous and daring in action, and romantic in appearance, the youthful cavalry officer, George Armstrong Custer, whose shoulders were swept by his curly red-gold hair, was called "Yellow Hair" by the Indians, and a dashing figure by most people of his day. Embroidered buckskins, leather gauntlets, and big-rimmed hats were fancied by him, and although he has been called conceited, headstrong and foolish, he was one of the finest horsemen ever had by the Army.

Born in Ohio in 1839, and described as intelligent but careless by his teachers, Custer wanted to be a soldier from boyhood even though he graduated from West Point at the foot of his class. That his record for bravery was so outstanding was shown by the fact that when he was ordered to duty in the Civil War a few days after graduation, his performance during the next two years led to his rising to the wartime rank of brigadier general, the youngest man of that rank in the Army at the time, by 1863. His being a great favorite was made by his youth, his fearlessness, and his conspicuous dress.

Bored and impatient, Custer was often in trouble with his superiors after he had been given a lower rank and was sent west to fight the Indians when the war ended. A group of scientists was helped by him to explore the Black Hills of South Dakota, the territory of the fierce Sioux tribes, in 1874, after the Cheyennes in Kansas had been fought by him

and he having been sent north to protect the building of the Northern Pacific Railroad.

The Sioux, who did not like miners poking around their reservations, and, furthermore, whose territory the railroad was moving toward, grew restless when gold was discovered there. That the Sioux foresaw the end of the buffalo herds on which they had depended for meat and clothing was the result of the moving onto land over which the Indians had hunted for generations, by White settlers. Sudden attacks on settlers were made by embittered young warriors who quietly slipped away from the reservations and joined war camps. Two of the strongest chiefs, Sitting Bull and Crazy Horse, who refused to obey an order by the alarmed government in Washington that all Indians return to their reservations in that this order was contrary to certain treaties that allowed the Sioux to hunt on the northern plains, prepared to fight.

General Alfred Terry, whose troops included the Seventh Cavalry Regiment, which Custer commanded, was sent out from Bismarck, North Dakota, to bring the two chiefs in, early in the spring of 1876. Sitting Bull's camp on the Little Bighorn River was located by advance scouts when Montana was reached by Terry's men, and the chief's escape was barred by Custer and 600 men who had been sent ahead until the rest of the troops could join them.

Pondering his next move, whether to wait for General Terry or attack at once, at the bank of the river, and though clouds of smoke and dust rose beyond the hills on the other

side, the size of the Indian camp could not be judged by him, nor was it known by him whether it had been guessed by the Indians how small his own forces were. Although Custer may have wanted the glory of capturing Sitting Bull himself, perhaps, the fact is he decided not to wait for Terry because if he had waited, the camp might have been broken by the Indians and they would have fled or he might have been attacked by them.

Part of his troops were dispatched by him to attack the Sioux camps to the south, and the remaining 265 were led by him across the Little Bighorn toward the center of the Sioux line. Somehow Custer's men managed to fight their way to a higher hill when between 2500 and 4000 wildly whooping Indians poured out from the hills, immediately. Only one member of Custer's band, a Crow scout, escaped when it was all over as a result of a sudden appearance of a thousand Cheyennes. Dying with the rest were "Yellow Hair" and two younger brothers, and all, except the commander, were scalped.

Not until General Terry arrived was the extent of the disaster made known by him. The nation was stunned by the news. That Custer became a popular but controversial hero is evident from the fact that the battlefield near Hardin, Montana, where he made his "last stand" is now a national monument.

APPENDIX B

Questions for Pretest

1. What is the national language of Brazil?

   1) Spanish

   2) Portuguese

   3) Brazilian

   4) English

   5) The selection gives no clue

2. Which of the following divides Rio into sections?

   1) Bays

   2) Valleys

   3) Tunnels

   4) Hills

   5) Tree-lined boulevards

3. What are the principal attractions for tourists of Rio?

   1) Its musical events

   2) Its sports contests

   3) Its religious shrines

   4) Its climate and beautiful beaches

   5) Its gardens and public buildings

4. According to the selection, which of the following terms best describes Brazil's churches?

   1) Lavish

   2) Huge

   3) Catholic

   4) Charming

   5) Ornate

5. The author of this selection refers to Rio's gray hills. From clues given in the selection, what factor seems most responsible for this appearance?

   1) Lack of moisture

   2) Hot climate

   3) Exposed rock

   4) Low-hanging clouds

   5) Industrial smoke

6. According to the selection, what are the most outstanding landmarks in Rio?

   1) A small mountain and a statue

   2) Its magnificent old churches

   3) Its stadium and other public buildings

   4) Its mosaic sidewalks and its parks

   5) Its beautiful bays and beaches

7. What form of government does Brazil have today?

   1) Limited monarchy

   2) Monarchy

   3) Republic

   4) Democracy

   5) The selection does not discuss today's government

8. What is Rio's relationship to Brazil?

   1) Capital city

   2) Largest city

   3) Most beautiful city

   4) An independent city

   5) Most religious city

Response Sheet for Pretest

1. 1) Spanish
   2) Portuguese
   3) Brazilian
   4) English
   5) The selection gives no clue

2. 1) Bays
   2) Valleys
   3) Tunnels
   4) Hills
   5) Tree-lined boulevards

3. 1) Its musical events
   2) Its sports contests
   3) Its religious shrines
   4) Its climate and beautiful beaches
   5) Its gardens and public buildings

4. 1) Lavish
   2) Huge
   3) Catholic
   4) Charming
   5) Ornate

5. 1) Lack of moisture
   2) Hot climate
   3) Exposed rock

4) Low-hanging clouds

5) Industrial smoke

6. 1) A small mountain and a statue

2) Its magnificent old churches

3) Its stadium and other public buildings

4) Its mosaic sidewalks and its parks

7. 1) Limited monarchy

2) Monarchy

3) Republic

4) Democracy

5) The selection doesnot discuss today's government

8. 1) Capital city

2) Largest city

3) Most beautiful city

4) An independent city

5) Most religious city

Questions for Passage 1

1. When were Frescoes and the illumination of manuscripts become established as mature art forms?

   1) During the Stone Age

   2) During the period of Medieval art

   3) After 1500 A.D.

   4) Before man acquired the ability to prepare a written history

   5) None of these

2. According to the selection, what is manuscript "illumination"?

   1) Explaining what the writer means

   2) Furnishing sufficient light to read

   3) Providing charts and graphs

   4) Decorating the manuscript with color and design

   5) Making the manuscript easier to read

3. From the selection it can be concluded that Egyptian rulers were

   1) Immoral

   2) Autocratic

   3) Religious

   4) Democratic

   5) None of these

4. Many of primitive man's drawings consisted of

   1) Complex symbols

   2) Scrolls

   3) Stick figures

   4) Symbolic designs

5) None of these

5. The walls of European caves have paintings that have survived from

1) The medieval period

2) The Early Stone Age

3) The mosaic period

4) Shortly after 1400 A.D.

5) None of these

6. Frescoes and illumination of manuscripts became established as a mature art form during

1) The Stone Age

2) The period of medieval art

3) The Babylonian period

4) The mosaic period

5) None of these

7. Mosaic pictures were a development from

1) Medieval art

2) Fresco painting

3) Tile art

4) Stick figures

5) None of these

8. The illumination of manuscripts was developed by

1) The Egyptians

2) The Babylonians

3) The nuns

4) The Chinese

5) The monks

9. Of the materials discussed in the selection, which of the following, if any, was most recently introduced as a work surface?

   1) Scrolls

   2) Canvas

   3) Wood

   4) Stone

   5) The selection gives no clue

10. According to the selection, what is the principla advantage of water color over other art mediums?

   1) A wider variety of colors is possible

   2) Cheaper materials are available

   3) Larger surfaces can be covered more easily

   4) All the above are advantages

   5) The selection gives no clue

11. According to the selection, to which of the following, if any, can the origin of mosaic art be traced?

   1) Primitive art

   2) Egyptian

   3) Babylonian

   4) Medieval

   5) The selection gives no clue

12. What does the term "fresco" mean?

   1) Plaster

   2) Fresh

   3) Wet

   4) Colored

   5) The selection gives no clue

13. Who among the following developed the art of making pictures with glazed tile?

    1) The Egyptians

    2) The Chinese

    3) The Babylonians

    4) The Greeks

    5) None of these

14. According to the selection, which period, if any, produced an art form most difficult for modern-day artists to duplicate?

    1) Primitive

    2) Babylonian

    3) Egyptian

    4) Medieval

    5) The selection gives no clue

15. On which of the following is Fresco painting done?

    1) On the wall

    2) On fresh plaster

    3) On stones

    4) On wood

    5) On canvas

16. The walls of European caves have paintings that have survived from

    1) The mosaic period

    2) The Medieval Age

    3) Early Stone Age

    4) Babylonian period

    5) None of these

17. According to the selection, for what were hieroglyphics used?

1) Decorating walls

2) Recording religious events

3) Recording information

4) Illuminating manuscripts

5) The selection does not say

18. According to the selection, what art form is well suited to covering the wall of a large room?

1) Mosaic

2) Oil on canvas

3) Water color

4) Fresco

5) The selection gives no clue

19. A complex set of written symbols developed by the Eygptians were known as

1) Braille

2) Microscopics

3) Hieroglyphics

4) Cuineform

5) None of these

20. According to the selection, what can be said about the Ancient man?

1) The Ancient man had no culture before a written history

2) The Ancient man lived in European caves

3) The government and religion of the Ancient man can be learned from the paintings of ancient peoples

4) The Ancient man was a cannibal

5) None of these

Response Sheet for Passage 1

1. 1) During the Stone Age
   2) During the period of Medieval art
   3) After 1500 A.D.
   4) Before men acquired the ability to prepare a written history
   5) None of these

2. 1) Explaining what the writer means
   2) Furnishing sufficient light to read
   3) Providing charts and graphs
   4) Decorating the manuscripts with color and design
   5) Making the manuscripts easier to read

3. 1) Immoral
   2) Autocratic
   3) Religious
   4) Democratic
   5) None of these

4. 1) Complex symbols
   2) Scrolls
   3) Stick figures
   4) Symbolic designs
   5) None of these

5. 1) The medieval period
   2) The Early Stone Age

3) The mosaic period

4) Shortly after 1400 A.D.

5) None of these

6. 1) The Stone Age

2) The period of medieval art

3) The Babylonian period

4) The mosaic period

5) None of these

7. 1) Medieval art

2) Fresco painting

3) Tile art

4) Stick figures

5) None of these

8. 1) The Egyptians

2) The Babylonians

3) The nuns

4) The Chinese

5) The monks

9. 1) Scrolls

2) Canvas

3) Wood

4) Stone

5) The selection gives no clue

10. 1) A wider variety of colors is possible
    2) Cheaper materials are available
    3) Larger surfaces can be covered more easily
    4) All the above are advantages
    5) The selection gives no clue

11. 1) Primitive art
    2) Egyptian
    3) Babylonian
    4) Medieval
    5) The selection gives no clue

12. 1) Plaster
    2) Fresh
    3) Wet
    4) Colored
    5) The selection gives no clue

13. 1) The Egyptians
    2) The Chinese
    3) The Babylonians
    4) The Greeks
    5) None of these

14. 1) Primitive
    2) Babylonian
    3) Egyptian
    4) Medieval
    5) The selection gives no clue

15. 1) On the wall
    2) On fresh plaster
    3) On stones
    4) On wood
    5) On canvas

16. 1) The mosaic period
    2) The medieval age
    3) Babylonian period
    4) Early Stone Age
    5) None of these

17. 1) Decorating walls
    2) Recording religious events
    3) Recording information
    4) Illuminating manuscripts
    5) The selection does not say

18. 1) Mosaic
    2) Oil on canvas
    3) Water color
    4) Fresco
    5) The selection gives no clue

19. 1) Braille
    2) Microscopics
    3) Hieroglyphics
    4) Cuineform
    5) None of these

20. 1) The Ancient man had no culture before a written history

2) The Ancient man lived in European caves

3) The government and religion of the Ancient man can be learned from the paintings of ancient peoples

4) The Ancient man was a cannibal

5) None of these

Questions for Passage 2

1. Which of the following would make the best title for this selection?

   1) Custer the Great

   2) The Yellow Hair

   3) The military career of George Armstrong Custer

   4) The death of Custer

2. What effect did Custer's Civil War experience have on his personality?

   1) It made him cautious

   2) It caused him to have a very high opinion of himself

   3) It killed his ambition

   4) It made him disagreeable and unfriendly

3. In terms of the size of the opposing forces, what were the odds against Custer and his men?

   1) About 2 to 1

   2) About 15 to 1

   3) Amost 100 to 1

   4) Better than 1000 to 1

4. In which state did Custer make his "last stand"?

   1) Kansas

   2) North Dakota

   3) Montana

   4) South Dakota

5. Why did the Indians resent the coming of the white men?

   1) They wanted to mine the gold for their own use

   2) They were afraid of railroad trains

   3) They feared the loss of their food and clothing supply

6. What respect did the Indians show for the held Custer?

   1) They took him prisoner instead of killing him

   2) They gave him a military funeral

   3) They built a monument in his honor

   4) They did not scalp him

7. What is the Little Bighorn?

   1) An Indian reservation

   2) A river

   3) One of the Black Hills

   4) A pass between two high hills

8. Which phase of Custer's career is treated in the greatest detail in this article?

   1) His training at West Point

   2) His Civil War experience

   3) His postwar assignments in Kansas and South Dakota

   4) The part played in the campaign against the Sioux

9. How many men died with Custer?

   1) 200

   2) 264

   3) 600

   4) No one knows for sure

10. What error in judgement did Custer make at the Little Bighorn?

    1) He underestimated the size of the enemy forces

    2) He delayed his attack too long

    3) He attacked across a river

    4) He tried to fight from a hill

11. Who among Custer's forces escaped the massacre?

    1) Custer himself

    2) A younger brother of Custer

    3) An Indian scout

    4) No one escaped

12. Custer commanded a regiment of

    1) Foot soldiers

    2) Horsemen

    3) Engineers

    4) Indian scouts

13. Why did General Terry send Custer to the Little Bighorn?

    1) To capture Sitting Bull

    2) To chase the Indians back to their reservations

    3) To round up some Indians who could be trained as scouts

    4) To hold the Indians in Sitting Bull's camp

14. Why were the Indians ordered to return to their reservations?

    1) To save the buffalo herds from being wiped out

    2) To keep them away from the newly discovered gold

3) Because the treaties they had signed required them to stay on their reservations

4) To help prevent further attacks on white settlers

15. What attitude to Custer does the author take in this article?

1) He believes Custer was a selfish glory hunter, and tries to prove it

2) He believes Custer was not to blame for the disaster at the Little Bighorn

3) He believes Custer was one of the finest officers in the Army

4) He tries to give all the facts and let the reader decide

16. Where did Custer receive his formal military training?

1) On the frontier

2) On Civil War battles

3) At the U.S. Military Academy

4) At a military school in Ohio

17. Why was Custer unhappy in the years following the Civil War?

1) He missed the excitement and honor that had been his during the war

2) He was disappointed because the South did not win the war

3) He was heavily in debt because his army pay was too low for him to meet his bills

4) He did not like being moved around the country

18. Which of these things happened <u>last</u>?

1) Custer was promoted to the rank of general

2) Gold was discovered on the Black Hills

3) Custer helped protect the building of the Northern Pacific

4) Treaties were signed which allowed the Sioux to hunt on the plains

19. How old was Custer when he was made a brigadier general?

1) 24

2) 27

3) 30

4) 33

20. The Indians called George Armstrong Custer

1) Blond Hair

2) Red Hair

3) Black Prince

4) Yellow Hair

5) None of these

Response Sheet for Passage 2

1. 1) Custer the Great
   2) The Yellow Hair
   3) The military career of George Armstrong Custer
   4) The death of Custer

2. 1) It made him cautious
   2) It caused him to have a very high opinion of himself
   3) It killed his ambition
   4) It made him disagreeable and unfriendly

3. 1) About 2 to 1
   2) About 15 to 1
   3) Almost 100 to 1
   4) Better than 1000 to 1

4. 1) Kansas
   2) North Dakota
   3) Montana
   4) South Dakota

5. 1) They wanted to mine the gold for their own use
   2) They feared railroads
   3) They feared the loss of their food and clothing supply

6. 1) They took him prisoner instead of killing him
   2) They gave him a military funeral
   3) They built a monument in his honor
   4) They did not scalp him

7. 1) An Indian reservation
   2) A river
   3) One of the Black Hills
   4) A pass between two high hills

8. 1) His training at West Point
   2) His Civil War experience
   3) His postwar assignments in Kansas and South Dakota
   4) The part played in the campaign against the Sioux

9. 1) 200
   2) 264
   3) 600
   4) No one knows for sure

10. 1) He underestimated the size of the enemy forces
    2) He delayed his attack too long
    3) He attacked across a river
    4) He tried to fight from a hill

11. 1) Custer himself
    2) A younger brother
    3) An Indian scout
    4) No one escaped

12. 1) Foot soldiers
    2) Horsemen
    3) Engineers
    4) Indian scouts

13. 1) To capture Sitting Bull

    2) To chase the Indians back to their reservations

    3) To round up some Indians who could be trained as scouts

    4) To hold the Indians in Sitting Bull's camp

14. 1) To save the buffalo herds from being wiped out

    2) To keep them away from the newly discovered gold

    3) Because the treaties they had signed required them to stay on their reservations

    4) To help prevent further attacks on white settlers

15. 1) He believes Custer was a selfish glory hunter, and tries to prove it

    2) He believes Custer was not to blame for the disaster at the Little Bighorn

    3) He believes Custer was one of the finest officers in the army

    4) He tries to give all the facts and let the reader decide

16. 1) On the frontier

    2) On Civil War battles

    3) At the U.S, Military Academy

    4) At a military school in Ohio

17. 1) He missed the excitement and honor that had been his during the war

    2) He was disappointed because the South did not win the war

    3) He was heavily in debt because his army pay was too low for him to meet his bills

    4) He did not like being moved around the country

18. 1) Custer was promoted to the rank of general

    2) Gold was discovered in the Black Hills

    3) Custer helped protect the building of the Northern Pacific

    4) Treaties were signed which allowed the Sioux to hunt on the plains

19. 1) 24

    2) 27

    3) 30

    4) 33

20. 1) Blond Hair

    2) Red Hair

    3) Black Prince

    4) Yellow Hair

    5) None of these

APPENDIX C

RAW DATA

High Difficulty - Massed Group

		Passage 1		Passage 2	
S #	Pretest	Recall	Comprehension	Recall	Comprehension
1	2	4	0	3	2
2	3	3	4	4	5
3	2	5	2	2	4
4	5	4	4	3	1
5	4	1	2	5	2
6	4	7	4	6	7
7	1	2	3	4	0
8	5	2	6	3	6
9	2	3	1	6	8
10	5	3	1	5	5
11	1	1	3	3	4
12	4	4	3	4	6
13	3	4	4	1	6
14	3	5	6	6	4
15	2	3	6	6	4
16	2	3	3	6	4
17	0	3	3	6	3
18	1	4	1	8	6
19	3	4	3	4	3
20	5	4	5	6	7

High Difficulty - Distributed Group

		Passage 1		Passage 2	
S #	Pretest	Recall	Comprehension	Recall	Comprehension
1	3	2	3	2	3
2	4	5	2	4	4
3	3	5	1	5	3
4	1	3	5	4	5
5	4	9	6	8	5
6	2	6	3	7	8
7	2	5	6	5	5
8	3	3	6	5	4
9	4	4	7	8	4
10	1	3	2	5	6
11	5	2	4	5	5
12	3	4	5	6	6
13	5	7	4	5	6
14	4	4	4	4	7
15	5	5	1	7	6
16	2	7	5	8	5
17	2	4	4	3	2
18	5	6	3	6	6
19	5	5	6	5	3
20	0	6	3	3	1

High Difficulty - Slow One-trial Group

		Passage 1		Passage 2	
S #	Pretest	Recall	Comprehension	Recall	Comprehension
1	2	1	3	6	4
2	4	6	7	5	6
3	2	3	3	4	7
4	2	5	6	5	7
5	4	7	4	4	6
6	3	6	6	6	6
7	4	9	7	8	5
8	3	6	4	5	4
9	2	5	5	6	5
10	3	8	4	5	5
11	1	3	7	4	4
12	4	9	5	9	7
13	6	8	5	7	6
14	3	9	7	3	6
15	3	6	7	6	7
16	3	7	5	6	7
17	4	7	5	5	4
18	2	2	4	8	8
19	5	1	3	7	4
20	3	7	5	7	6

Low Difficulty - Massed Group

		Passage 1		Passage 2	
S #	Pretest	Recall	Comprehension	Recall	Comprehension
1	2	6	6	3	5
2	3	8	9	5	7
3	4	7	7	7	6
4	5	6	6	5	5
5	1	4	2	3	3
6	1	2	5	6	3
7	3	5	5	6	3
8	2	4	3	5	6
9	1	6	3	5	7
10	2	7	5	8	5
11	1	5	4	6	3
12	5	5	7	7	7
13	6	9	5	8	5
14	0	5	3	8	4
15	4	4	4	6	5
16	3	9	8	6	8
17	3	8	6	9	9
18	4	7	4	9	6
19	7	10	10	10	8
20	5	9	7	6	6

Low Difficulty - Distributed Group

		Passage 1		Passage 2	
S #	Pretest	Recall	Comprehension	Recall	Comprehension
1	3	4	5	6	5
2	5	6	5	8	7
3	3	6	5	5	3
4	4	3	5	7	7
5	7	8	9	7	6
6	2	6	9	8	7
7	3	6	5	6	6
8	2	4	4	3	3
9	4	3	6	6	7
10	4	8	4	5	8
11	2	8	7	9	8
12	2	5	4	5	6
13	1	5	5	8	6
14	2	4	2	7	5
15	2	4	4	6	2
16	1	7	6	7	6
17	7	8	9	9	7
18	6	7	6	8	7
19	0	5	4	3	4
20	3	7	4	5	5

Low Difficulty - Slow one-trial Group

		Passage 1		Passage 2	
S #	Pretest	Recall	Comprehension	Recall	Comprehension
1	3	6	5	5	5
2	2	7	10	5	5
3	2	8	5	6	9
4	4	7	6	5	7
5	4	3	2	7	7
6	3	8	9	6	6
7	1	6	6	5	6
8	4	8	5	6	8
9	5	7	7	8	8
10	4	7	6	4	4
11	2	4	2	8	8
12	4	7	5	6	8
13	1	6	3	4	3
14	2	6	3	6	3
15	3	3	6	6	5
16	5	7	11	6	6
17	3	5	5	6	6
18	1	5	4	7	6
19	3	6	4	8	6
20	2	7	7	6	6

APPENDIX D

INDIVIDUAL DIFFERENCE MEASURES

High Difficulty - Massed Group

Passage 1		Passage 2		I.Q.	Verbal Reasoning Ability
Recall	Comprehension	Recall	Comprehension		
4	0	3	2	107	21
3	4	4	5	114	26
5	2	2	4	102	19
4	4	3	1	88	15
1	2	5	2	94	24
7	4	6	7	124	38
2	3	4	2	96	14
2	6	3	6	126	41
3	1	6	8	108	25
3	1	5	5	100	14
1	3	3	4	92	19
4	3	4	6	126	40
4	4	1	6	99	22
5	6	6	4	114	40
3	6	6	4	106	16
3	3	6	4	93	9
3	3	6	3	101	19
4	1	8	6	121	36
4	3	4	3	98	12

High Difficulty - Distributed Group

Passage 1		Passage 2		I.Q.	Verbal Reasoning Ability
Recall	Comprehension	Recall	Comprehension		
2	3	2	3	94	16
5	2	4	4	120	31
5	1	5	3	104	16
3	5	4	5	124	28
6	3	7	8	120	24
5	6	5	5	100	18
3	6	5	4	97	14
4	7	8	4	124	37
3	2	5	6	103	14
2	4	5	5	125	37
4	5	6	6	118	40
7	4	5	6	120	46
5	4	4	7	124	45
7	5	8	5	111	28
4	4	3	2	108	19
6	3	6	6	122	36
5	6	5	3	110	24
6	3	3	1	106	19

High Difficulty - Slow One-trial Group

Passage 1		Passage 2		I.Q.	Verbal Reasoning Ability
Recall	Comprehension	Recall	Comprehension		
1	3	6	4	114	24
6	7	5	6	114	38
3	3	4	7	107	30
7	4	4	6	128	38
6	6	6	6	123	24
9	7	8	5	144	41
6	4	5	4	122	36
5	5	6	5	108	23
8	4	5	5	127	39
3	7	4	4	106	18
9	5	9	7	134	41
8	5	7	6	132	41
9	7	3	6	118	29
6	7	6	7	117	27
7	5	5	7	128	36
2	4	8	8	116	17

Low Difficulty - Massed Group

Passage 1		Passage 2		I.Q.	Verbal Reasoning Ability
Recall	Comprehension	Recall	Comprehension		
6	6	3	5	127	35
8	9	5	7	120	35
6	6	5	5	108	33
5	5	6	3	116	28
6	3	5	7	103	19
5	4	6	3	116	32
5	3	8	4	103	21
9	8	6	8	125	29
10	10	10	8	134	44
9	7	6	6	124	39

Low Difficulty - Distributed Group

Passage 1		Passage 2		I.Q.	Verbal Reasoning Ability
Recall	Comprehension	Recall	Comprehension		
4	5	6	5	100	20
6	5	8	7	113	21
3	5	7	7	112	17
6	9	8	7	112	28
6	5	6	6	108	13
4	4	3	3	82	11
8	4	5	8	112	28
5	4	5	6	106	26
4	2	7	5	109	26
8	9	9	7	122	27
5	4	3	4	98	19
7	4	5	5	112	20

Low Difficulty - Slow One-trial Group

Passage 1		Passage 2		I.Q.	Verbal Reasoning Ability
Recall	Comprehension	Recall	Comprehension		
7	10	5	5	105	34
8	5	6	9	122	29
7	6	5	7	114	26
3	2	7	7	119	29
8	9	6	6	122	33
6	6	5	6	105	16
8	5	6	8	112	28
7	7	8	8	111	36
7	6	4	4	118	28
4	2	8	8	110	18
7	5	6	8	114	17
6	3	4	3	90	16
6	3	6	3	115	30
3	6	6	5	90	9
7	11	6	6	128	36
5	4	7	6	100	17
6	4	8	6	113	17

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