

## ABSTRACT

### RETROACTIVE INTERFERENCE IN PROSE LEARNING AS A FUNCTION OF SIMILARITY, DEGREE OF LEARNING, AND INSTRUCTIONS

By

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A number of studies have investigated retroactive interference in prose learning but there has been little agreement in their findings. Two common problems have confronted researchers in this area. One has to do with the distinction between rote and meaningful learning and the other involves developing a means of operationally defining what is meant by similarity between original and interpolated learning tasks. A methodology was tested in this study which attempted to deal with both of these problems.

This methodology was based upon a system of constructing prose which used Venn diagrams to represent the structure of passages (Dawes, 1964). This type of prose construction had some definite advantages for a study investigating RI: (1) essential information could be held constant for all passages; (2) degree of similarity could be operationally defined by systematically varying the

structure of original and interpolated passages; and (3) the logical structure of passages made it possible to write test questions that measured retention of information acquired by making an inference. It was a major concern of this study to determine if RI operates in the same way for retention of information based upon inference as it does for information stated directly in a passage.

Two separate experiments were performed. The first experiment, set up as a 3x2x2 factorial design, was conducted to determine if RI would vary as a function of the degree of organizational similarity between the original and interpolated passages, the amount of practice given on the interpolated passage, and the type of instructions used. In the original learning phase all subjects read a passage on anthropology twice and took a retention test. The interpolated learning phase consisted of three levels of similarity: (1) one group of subjects read an interfering passage on anthropology having a logical structure similar to the original passage; (2) a second group read an interfering passage having a dissimilar structure; and (3) a third group worked a set of arithmetic problems as a filler task (control). Degree of interpolated learning was defined in terms of one or two exposures to the interfering passage. Instructions preceding the learning tasks were either general or

specific. During the retention phase, five dependent measures of original learning were obtained for each subject. Immediate and delayed tests were used to measure the forgetting of information stated explicitly in the original passage and that which could be acquired only by making an inference. An additional retention measure required subjects to label sets and subsets in the Venn diagram used to construct the original learning passage. A multivariate analysis of covariance revealed no significant main effects or interactions for any of the five measures.

A second experiment was performed to assess the influence of the original learning test upon final retention measures. A test- no test variable was incorporated into a 2x2 design along with two levels of organizational similarity. Only the similar and dissimilar passages were used in the interpolated phase. Passages and retention measures were identical to those used in the first experiment. Including the original learning test was found to have a significant effect upon retention. Within the no-test condition, subjects exposed to a highly similar interpolated passage had significantly lower scores on the immediate test of information stated directly in the original learning passage, but this difference was not found on the delayed retention test.

Retention was significantly higher for the same subjects on the test which required labeling the Venn diagram.

The facilitating effect of providing a test immediately after original learning was described in relation to retroactive interference as well as other theoretical notions. Significant findings obtained under the no-test condition were discussed in terms of paired-associate and subjective organization models. Possible directions for future research were suggested.

#### REFERENCE

Dawes, R. M. Cognitive distortion. Psychological Reports, 1964, 14, 443-459.



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## CHAPTER I

### THE PROBLEM

A basic concern in education, in addition to the acquisition of knowledge gained in classroom learning situations, is the retention of this knowledge over a period of time. Since students rely to a great extent upon prose materials in the process of learning, it seems reasonable to consider how the construction of these materials affects the retention of knowledge gained from them. Educational researchers who have been concerned with the problem of what contributes to the forgetting of information acquired by reading instructional prose have often searched for solutions in the psychological literature dealing with retroactive interference. With a certain degree of consistency this literature has identified variables which appear to lend support to the interference theory of forgetting. However, there has been a notable lack of consistency between the findings of the studies done in the psychological laboratory using nonsense syllables and paired-associate and serial learning tasks and the findings of studies done in classroom settings using prose materials.

Education is often criticized for failing to incorporate the findings of laboratory studies into the procedures of classroom learning. For this reason the contribution to school learning would be substantial if the variables found to affect retroactive interference in laboratory studies were found to operate in a similar manner when the stimulus materials consisted of connected discourse. If the forgetting of one segment of instructional prose is found to be dependent upon its similarity to a following passage, as the classical verbal learning literature seems to suggest, the implications of such a finding would seem to have an important effect upon how segments of prose are arranged in textbooks and how learning experiences involving written instructional materials are sequenced over an entire day.

Although numerous attempts have been made to replicate the findings of laboratory studies by using prose materials in place of nonsense syllables and single words, few have succeeded in demonstrating the presence of retroactive interference. Not only have these studies failed to manipulate connected discourse so as to systematically produce varying degrees of retroactive interference but the result has often been to produce retroactive facilitation instead (Ausubel, Stager, & Gaite, 1968). It seems reasonable to suspect that this inconsistency may be due to the difficulty of achieving the same degree

of control using prose materials as is possible when laboratory-type tasks are used. Even though it may still not be possible to achieve the same degree of control as in the laboratory, recent methodological innovations used in the course of studying other problems in prose learning appear to be applicable to the study of retroactive interference and facilitation. These new techniques are concerned with a means of quantifying the essential information in a prose passage and in so doing arriving at a more precise way of operationally defining the variable of organizational similarity between two passages. In addition to this, support is growing in the literature which indicates that manipulation of test-like events may have an important effect upon attentional responses, or mathemagenic behaviors (Rothkopf, 1965) of students as they are reading a prose passage. Because test-like events may affect retention, their relationship to retroactive interference should be investigated.

It is the purpose of this study to investigate the role of retroactive interference or facilitation in learning from connected discourse by systematically varying the degree of acquisition, the degree of organizational similarity between prose passages, and the type of instructions preceding each passage. Although previous prose studies that have manipulated some of the same variables within the framework of the basic retroactive

interference paradigm have produced equivocal results, it was expected that some basic changes in the design of this study, in addition to a refinement of operational definitions for crucial variables, would make it possible to demonstrate reliably an interfering or facilitating effect.

Ausubel (Ausubel et al., 1968) has stated that "there is much doubt as to whether retroactive interference occurs when connected material is meaningfully learned (i.e., when it interacts on a nonarbitrary, substantive basis with established ideas in cognitive structure) [p. 250]." Given the situation where two highly similar prose passages are read one after the other, he contends that similarity is a factor in forgetting original passage material only when it has been learned in a rote manner. Ausubel has predicted that for meaningful verbal learning a highly similar interpolated passage will facilitate what has been learned in the original passage. His research has supported this contention (Ausubel, Robbins, & Black, 1957; Ausubel et al., 1968). At issue here is what is meant by similarity and meaningful verbal learning when prose materials are used in an experiment dealing with retroaction. Similarity has often been defined in terms of judged similarity and no effort has been made to determine how interference affects different types of learning by obtaining separate measures of retroactive interference for the same subject.

This study differed from previous connected discourse studies based on the retroactive interference paradigm by operationally defining the variable of similarity in terms of set relations. This approach also made it possible to establish that the amount of essential information was basically the same in the original and interpolated passages. In addition to operationally defining similarity, the set relations technique provided a means of distinguishing between rote and meaningful learning. Rote learning applied to that information which was presented explicitly in the passage. Learning which required making a deduction or inferring something on the basis of what was stated directly was considered to be a form of meaningful learning. Separate measures were developed for assessing each type of learning before and after an interpolated task.

Retroactive interference studies dealing with connected discourse have often used existing prose passages as the original and interpolated tasks. Not only did this practice make it difficult to determine in an operational sense whether or not passages were similar or dissimilar and whether or not they contained equivalent amounts of content, but there was always the possibility that familiarity with the passage content would be a confounding factor. In order to control for familiarity in this study, all materials were written as

fiction although they could be identified with subject matter areas. Further, the passages were composed only after a basic organizational structure had been adopted.

Degree of learning on the interpolated task was also operationally defined and manipulated as one of the main variables in the study. This variable has not been included in prose learning experiments to the extent that it has in studies employing more traditional verbal learning tasks. Also, no previous prose study has attempted to manipulate the attentional responses of subjects by varying instructions in order to determine their effect upon retroactive interference or facilitation.

The interference theory of forgetting states that it is the learning of a similar interpolated task following the learning of an original task that causes a decrement in performance when the retention of the original task is measured at a later time. In the basic experiment two groups are given the same original learning task but one group is given an interpolated task and the other, which is a control, engages in some filler activity. The greater amount of retention shown by the control group defines the extent of retroactive interference. Greater retention for the group receiving the interpolated task defines the degree of retroactive facilitation. Traditional paired-associate studies have made use of the paradigm: learn AB, learn AC, recall and relearn AB.

The explanation of the interference phenomenon up until 1940 was one of competition between responses B and C, a position advanced by McGeoch (1942). At that time Melton and Irwin (1940) postulated a two-factor theory, stating that in addition to response competition there was an unlearning of the original responses.

Predictions of interference and facilitation in prose learning studies have often been based upon the findings of verbal learning experiments employing paired-associate learning tasks. Since similarity was an important variable in paired-associate studies, it also became prominent in studies using prose materials. A major problem exists, however, in determining what the stimulus and response elements are in learning from connected discourse. In the study reported here, stimulus and response elements were defined in terms of multiple-choice questions based on passage content. A question stem was considered to be the stimulus and the answer the response. Where the original and interpolated passages were highly similar, the question stems (stimuli) were identical but the correct answers (responses) were different. Where the interpolated passage was highly dissimilar both question stems and answers were different.

In addition to paired-associate learning studies, predictions of retroactive interference or facilitation can be based on research which has been done on subjective



organization using the method of free recall. According to the theoretical model underlying subjective organization, the subject learns a list of words by organizing these words into higher-order memory units. The recall of one word within this memory unit serves to facilitate the recall of others. This position on free recall was set forth by Tulving (1962, 1964, 1966) in his statement regarding the interdependence hypothesis. Using the notion of subjective organization as a basis for the explanation of interference in a study using prose materials, it is hypothesized that the higher-order memory units developed for remembering the content of the original passage are reorganized to a greater extent when the second passage is similar in organization than when it is highly dissimilar. This would result in a highly similar interpolated passage being more interfering.

Since it cannot be stated at this point whether learning from prose material is more like a paired-associate task or one of free recall, Chapter II will review research in both of these areas as well as other areas which include studies based upon the retroactive interference paradigm. The predictions made regarding retroactive interference in this experiment are consistent with research that has been done using both paired-associate and free recall tasks.

On the basis of research which is to be reviewed later, it is expected that the application of the retroactive interference paradigm to prose materials will yield results similar to those obtained in studies employing paired-associate, serial learning, and free recall methods. Given that subjects attain a criterion level of 65-70% on the original learning task, it is predicted that retroactive interference will be greater when there is a high degree of similarity between original and interpolated tasks. Further, retroactive interference should increase with additional practice on the interpolated task. It is also hypothesized that under specific instructions to learn the information in each passage, what is learned in the original passage will be more resistant to the effects of retroactive interference.

## CHAPTER II

### REVIEW OF THE LITERATURE

Verbal learning studies dealing with retroactive interference and facilitation have employed a variety of experimental materials and procedures. Despite the fact that many different approaches have been used, retroaction studies have used the basic paradigm: learn task A, learn task B, then test for retention of task A.

A large part of the research to be reviewed in this chapter deals with variables which have been found to affect retroactive interference and facilitation in paired-associate, serial learning, and free recall experiments. Although these studies have typically involved learning nonsense syllables and lists of words, their findings, especially in relation to degree of learning and the effect of similarity, have been used as a basis for making predictions about retroactive interference and facilitation in studies of connected discourse. In addition to experiments based upon more traditional verbal learning procedures, this review will include studies which have employed learning tasks consisting of prose materials. Studies which have dealt with attentional

factors in prose learning and ways of quantifying prose will also be reviewed.

Degree of Acquisition as a Variable in  
Paired Associate and Serial  
Learning Studies

Degree of interpolated learning was first studied by Thune and Underwood (1943) by having subjects learn lists of 10 paired adjectives using the anticipation method. Original learning of five trials was constant while interpolated learning was varied by 2, 5, 10, and 20 trials. RI was found to be a function of interpolated learning up to 10 trials. Underwood (1945), varying the number of interpolated lists instead of practice on a single list, had subjects learn 2, 4, and 6 different lists after achieving a criterion of six or more responses on the original learning task. There was a direct increase in RI in relation to the number of interpolated lists.

Barnes and Underwood (1959) manipulated degree of interpolated learning by providing 1, 5, 10, and 20 trials on list two. A criterion of one perfect trial was established for list one learning. The method of MMFR was used in this experiment, which meant that subjects had sufficient time to attempt the recall of both first and second list responses during interpolated learning. As additional practice was provided on list two, the availability of first list responses diminished. This

evidence supported the contention that first list responses become extinguished during interpolated learning. Briggs (1957) varied degree of acquisition for both original and interpolated learning, using 2, 5, 10, and 20 trials on the first list and 0, 2, 5, 10, and 20 trials on the second. There was an interaction between degree of original learning and degree of interpolated learning. With increasing trials, first list responses became more available at recall, whereas increasing amounts of practice on the second list resulted in greater extinction of first list responses.

The findings of serial learning studies parallel those using paired associates. In two separate experiments McGeoch (1929, 1936) found decreasing RI with increased practice on the first serial list and increasing RI with increased practice on the second list. The same relationship was found between amount of RI and degree of interpolated learning in a study by Melton and Irwin (1940), except that when a large amount of practice was given on the interpolated list RI actually decreased somewhat. Using nonsense syllables, Postman and Riley (1959) varied the levels of original and interpolated learning, having subjects practice the first list for 5, 10, 20, and 40 trials and the second list for 0, 5, 10, 20 and 40 trials. Again RI was found to increase with

practice on the interpolated list and decrease with practice on the original list.

There appears to be considerable agreement in the findings of paired-associate and serial learning studies, indicating that retroactive interference decreases with practice on the original learning task and increases with practice on the interpolated task. In both types of studies there is some evidence of a leveling off effect with increasing amounts of interpolated learning.

#### Similarity as a Variable in Paired-Associate and Serial Learning Studies

The variable of similarity between original and interpolated learning has also been studied by using serial and paired-associate learning tasks, but there appears to be less agreement in the findings. In studies of serial learning, similarity appears to increase the amount of retroactive interference. This was demonstrated in a study by Melton and von Lackum (1941) in which subjects learned nonsense syllables by the anticipation method. Using words to vary similarity in the interpolated task, Kingsley (1946) found that synonyms interfered with retention more than antonyms, and that both were more effective in creating interference than high and low association words.

It is less clear how similarity affects retroactive interference when paired-associate tasks are used.

As part of his conclusions regarding the transfer and retroaction surface, Osgood (1949) stated that retroactive interference would be found when stimuli are identical and responses are varied; he also concluded that retroactive interference would decrease as response terms became more similar. This finding was challenged by Bugelski and Cadwallader (1956) who stated that as response terms became more alike there would first be an increase in retroactive interference and then a decrease. Wimer (1964) also failed to support Osgood on this point in a transfer study which tested responses that were opposed, antonymous, identical and similar. Positive transfer was found for all four. Barnes and Underwood (1959) found a facilitation effect for similar responses.

Unlike degree of first and second list acquisition, investigations manipulating similarity have revealed a lack of consistency in their findings. In this way paired-associate and serial learning studies have paralleled studies employing prose materials.

#### Prose Studies Manipulating Degree of Acquisition and Similarity

Degree of acquisition and similarity were investigated by Slamecka in a series of studies using prose materials. In one experiment Slamecka (1959) had subjects commit to memory a passage that was presented three times for both original and interpolated learning. Conditions of

high, intermediate, and low similarity were used along with a control. Forgetting (RI) was inversely related to the degree of original learning and directly related to the degree of interpolated learning. Recall of first passage was found to be a negative function of degree of similarity. In two later studies Slamecka (1960, 1962) used the serial anticipation method in having subjects learn passages of connected discourse. In the first (Slamecka, 1960) 2, 4, and 8 trials were used for original learning and 0, 4, and 8 trials for interpolated learning. Significant RI was found, increasing with practice on interpolated learning and decreasing with practice on original learning. In the second study (Slamecka, 1962), one experiment was performed which manipulated interpolated learning by varying trials on only one passage while in another experiment interpolated learning was varied by using different passages. Retroactive interference was evident in both conditions. These studies helped to demonstrate that with prose materials RI may be influenced by degree of acquisition and similarity in the same way as it is in experiments using paired associates and serial learning.

Hall (1955) investigated the effect of varying similarity in an experiment where the original and interpolated tasks consisted of 30 sentences, each presented separately by a slide projector for five seconds. A condition of high similarity was created by using 20 sentences in the interpolated task that were identical to



those in the original and by changing only one word in the remaining 10 sentences. Manipulating similarity had no effect on subsequent recall measures. In another experiment Hall (1956) manipulated similarity in the interpolated task by using synonyms of key words omitted in the sentences of the original learning task. Again, even without the context of whole sentences being used in the interpolated learning task, retroactive interference was not evident.

Peairs (1958) also used lists of sentences in original and interpolated learning, manipulating subjects as stimuli and predicates as responses. Levels of interference were created by reversing subjects and predicates in one condition and learning new responses to original stimuli in another. A criterion of one perfect test was achieved for each subject on both original and interpolated tasks. Using a recognition type test, retroactive interference was found for the two experimental conditions as measured by wrong-response intrusions. The results, suggesting unlearning in one condition and competition of response terms in the other were interpreted as support for the two-factor theory of RI.

It was suggested in a paper by Mehler and Miller (1964) that RI in prose materials may depend upon whether retention is based upon the syntactic or the semantic aspects of a sentence. To test out this notion an

experiment was devised in which both syntactic details and semantic form were varied in the interpolated task. Overall, the results indicated that the syntactic aspects of a sentence are more susceptible to retroactive interference.

Two studies have used levels of approximation to English to define the interpolated task. Heise (1956) found retention best where the lists were most dissimilar. However, variations in the order of approximation for both original and interpolated learning failed to result in any overall pattern for RI in another experiment by King and Cofer (1958).

There is some support in the literature which indicates that when prose materials are used retroactive interference varies in relation to degree of acquisition and similarity in much the same way as it does for paired-associate and serial learning tasks. However, the fact that the retroactive interference effect has not been found in a number of other prose studies precludes the making of any direct comparisons between prose studies and those employing traditional laboratory tasks.

#### Prose Studies Using Intact Passages

In addition to studies which present original and interpolated materials in the form of lists of sentences, the method of presenting intact passages of original and interpolated material has been used in a number of studies.

In a study by McGeoch and McKinney (1934) subjects learned either a highly similar passage or nonsense syllables for the interpolated task. Significant differences were not found in comparison to a control group for either level of interference. Evidence of retroactive interference was found by Entwisle and Huggins (1964) in a study which used closely related topics in circuit theory to achieve the similarity effect. However, the results of the study may be confounded due to interference being generated from other instructional materials on electronic theory recently studied, in addition to wide differences among subjects in their knowledge of circuit theory prior to beginning the course.

Ausubel has taken the position that the interpolated passage affects retention to the extent that it fosters a rehearsal or clarification of the original passage. This notion was tested in a study (Ausubel, et al., 1957) where the original task consisted of a passage on Buddhism followed by four types of interpolation: a passage comparing Buddhism and Christianity, a restudy of the original passage, a passage on Christianity, and a condition of no interpolated task. Instead of interference, the condition of high similarity resulted in retroactive facilitation. In a similar study Ausubel (Ausubel et al., 1968) used a passage on Zen Buddhism for original learning followed by a passage on Buddhism for one

interpolated task and a passage on drug addiction for the other. Again facilitation was found for the highly similar passage. Overlearning was also a variable investigated in the experiment but it did not interact with the type of interpolated task.

Taking into account Ausubel's theory, Shuell and Hapkiewicz (1969) incorporated into an experiment a condition of interpolation wherein subjects were instructed to compare and contrast the material in the two passages. This condition along with other levels of topical similarity did not significantly affect retention of the original passage.

There has been some evidence, reported recently, that retroactive interference can be shown using intact prose passages. Anderson and Myrow (1970) defined stimulus and response elements in their prose material in terms of the test questions based on the passages, similar to what was done in the present study. Retroactive interference was found where the original and interpolated passages had similar stimuli and conflicting responses. In addition, the interference effect was found to be more pronounced for multiple-choice than for short-answer questions. Taking a test immediately after original learning also had a significant effect upon retention.

In two other studies similarity has been shown to affect retroactive interference. Crouse (1970) defined

similarity in terms of experimenter generated questions related to the prose passages and found a 45% decrement in recall for similar and identical conditions and no decrement for a different condition. Jensen and Anderson (1970) also measured retention using a recall procedure and found evidence of retroactive interference when two unfamiliar passages dealing with theories of adolescence were read as the original and interpolated tasks.

The retroactive interference which has been found with some consistency in paired-associate and serial learning studies and shown to vary systematically with degree of acquisition and similarity has not always occurred when the materials have consisted of connected discourse. Most studies using connected discourse have focused primarily upon the variable of similarity and then have often lacked adequate operational definitions which would assure that similarity had indeed been varied systematically. Also lacking from many prose studies was a concern for establishing a performance criterion for the original learning task. Until it can be established that a predetermined level of learning has been achieved, there is no way of knowing whether or not the interpolated task has something to interfere with. In addition to including instructions and degree of learning as independent variables, this study has attempted to achieve a greater degree of control over these other aspects of experimental design.

Subjective Organization in Transfer  
and Free Recall Studies

The occurrence of retroactive interference or facilitation in a prose learning task may also be explained in terms of subjective organization. A number of studies based on the free recall method have demonstrated that subjective organization may be a useful construct for explaining the effect of positive or negative transfer as well as interference or facilitation.

Underlying the notion of subjective organization in free recall is the interdependence hypothesis. According to Tulving (1962, 1964, 1966) the interdependence hypothesis states that in memorizing a list of words, the subject organizes the words into higher-order memory units (S units). Recall is facilitated by the development of higher-order S units and within each unit the recall of one word influences the recall of others.

The interdependence hypothesis would not predict positive transfer for whole to part list learning. In learning the part list the subject is hindered because of the prior organization he developed for learning the items in the whole list. This notion was tested in an experiment (Tulving and Osler, 1967) where subjects in both experimental and control groups learned an 18-word list followed by a nine-word list. List two words were taken from list one for experimental subjects whereas list two words were different from those in list one for

control subjects. Recall and organization scores were lower for the experimental group indicating the presence of negative transfer. These results suggested that a reorganization of items had to occur before the part list could be learned.

A study by Wood (1969) extended these findings by using the same type of procedure, but required that list two be learned as a serial task. There was evidence that experimental subjects were hindered by their inability to abandon the organization they used for learning list one. In a closely related experiment (Wood, 1969) negative transfer was clearly evident when experimental subjects were given six trials on list one but was not found when only one trial was provided.

Bower, Clark, Lesgold, and Winzenz (1969) have investigated the effects of hierarchical organization in free recall and have demonstrated that in reconstructing a list of items from memory, a subject makes use of a retrieval plan based upon a rule for organization. The results indicated that with both associative and conceptual categories recall was improved when lists were presented in a hierarchically organized as opposed to a random manner. In another experiment the effect of retroaction was studied by constructing lists on the basis of conceptual hierarchies. Four such hierarchical levels were defined. The items learned in list two were

superordinates of list one items. Retroactive facilitation was found for list one items. These results suggested that the superordinates of list two served a cuing function in a plan to retrieve items from list one.

Retroactive interference in free recall was also studied by Postman and Keppel (1967) in an experiment where experimental subjects practiced list one for four alternate study and test trials and practiced an interpolated list for two, four, or six such trials. Requiring subjects to recall both first and second list items on a retention test, it was found that as the number of trials of interpolated learning increased recall of first list items decreased and second list items increased. This evidence of interference was seen as an unlearning of contextual and sequential associations.

Similarity as a variable has also been manipulated in retroaction studies using the method of free recall. Shuell (1968) employed seven conceptual categories among 35 words in original and interpolated lists. In one condition the interpolated list consisted of words from the same categories as the first list, and in the other condition the words in the interpolated list represented different categories. Greater retroactive interference in the similar condition was attributed to similarity between organizational cues in developing higher-order memory units.



Watts and Anderson (1969) also varied similarity on the interpolated task by using three conditions: highly organized in the same categories as the original list; highly organized but in different categories; and a low organized list. Clustering decreased and retroactive interference increased with the similar condition. It was suggested that when different types of organization are required for the two lists there is less disruption of higher-order memory units in the first list.

### Rationale

On the basis of findings from free recall studies that had investigated transfer and retroaction, it appeared that the notion of subjective organization could be used to predict outcomes similar to those predicted on the basis of studies using paired-associate tasks. In the experimental design of this study, where the subject learned passage A, then passage B, and then was given a retention test on A, it could not be stated with certainty whether learning specific information from a prose passage constituted a paired-associate task or one more closely resembling free recall. It could be thought of as a paired-associate task if one considered a question asked about the passage to be the stimulus and the specific answer to this question the response. In this way, for the high similarity condition where two passages had similar content and structure, the same question stem could be

used in a multiple-choice item for both the original and interpolated passage, only the answers (responses) would be different. This would correspond to an A-B, A-C paradigm. The highly dissimilar condition, in which the interpolated passage was based upon totally different content and structure, required a new question stem and a new response, resembling an A-B, C-D paradigm.

The use of Venn diagrams in defining the structure of the passages used in this study made it possible to arrange the content of each passage as a hierarchy of nested categories. Learning the passage resembled a free recall task in that the subject had to remember the hierarchical order of names of sets and subsets along with their attributes according to their location in a system of superordinate and subordinate categories. The passages were written in such a way that the sets and subsets referred to groups of people, other living organisms, and events; the subjects had to remember what sets were included within other sets in order to reconstruct the entire passage in memory. It was expected that as the subject read the passage he would organize the information into higher-order memory units.

A study by Frase (1969a) supported the notion that subjects do organize prose material in a recall task. The prose learning task consisted of 48 sentences dealing with six chessmen and eight attributes. Passages were

organized by grouping these sentences according to concepts (chessmen), attributes, and a random selection process. Recall measures indicated the greatest amount of clustering when the passage was organized according to concepts. The group which read the sentences presented in a random order was significantly lower than the other two groups in recall, but they did cluster the information as well as the group learning the passage organized by attribute. These findings seem to suggest that even when information is presented in an unordered sequence subjects tend to reorganize the information by taking note of relations existing within the material.

The passages for this study were written so that the subject could impose an organization on the passage that would aid him in remembering its content. Each passage contained three main sets which could be organized by the subject as higher-order memory units and retrieved later as separate clusters. In learning the passage the subject could use the name of the main set as a mediator or common associate. The name assigned to each set and subset in the passage was associated with certain attributes, and each subset was considered to possess all the attributes of the larger sets to which it belonged. In this way, either directly or indirectly, an association could be formed between the name of the main set and all of its subsets and all of the attributes assigned to each

set and subset. It was expected that as additional trials were given in reading the passage more of these associations would be established and more information would be stored in the form of higher-order memory units. Through this process the subject could develop an organization which would aid him in remembering the content of the passage in the form of major clusters. Since the name of each of the main sets represented a superordinate category it could be used as a means of cuing the recall of subordinate categories within it along with their attributes. These major set names thus could mediate the recall of the entire passage and serve as the principal components of a general retrieval strategy.

If a subject learned the original passage using this type of organization process and then learned a highly similar passage, it seemed reasonable to expect that the second passage would be learned by reorganizing many of the same or similar categories used in learning the original passage. It seemed likely that this would cause more disruption in the higher-order memory units that were used in learning the original passage than if the second passage were to be highly dissimilar and based on different content and a different logical structure. In learning a dissimilar second passage an organization could be developed which would be entirely different and not require any reorganization of the original passage,

thereby leaving the higher-order memory units of original learning intact.

On the basis of this rationale it was predicted that retroactive interference would be greater for an experimental condition where the type of organization required to remember the content of each passage was highly similar. Where the two passages were highly dissimilar there would be less interference, since higher-order memory units established when the first passage was learned would not have to be reorganized when the second passage was learned; the organizational structure of the original passage could be left intact and more easily retrieved if the appropriate mediators could be recalled.

#### Rationale for Including Instructions as an Independent Variable

A number of recent studies have suggested that it may be possible to attain some degree of control over what stimuli a subject attends to when reading a prose passage. It is for this reason that the variable of instructions was included in this study.

Rothkopf (1965) has demonstrated that acquisition and retention of information in prose material are directly affected by the responses a person makes during reading, responses he has termed mathemagenic behaviors. It is suggested that these mathemagenic behaviors can be brought under the control of questions, instructions,

and other test-like events. For example, the facilitative effect of placing questions after segments of prose (Rothkopf, 1966; Frase, 1967; Rothkopf and Bisbicos, 1967) is explained by the mathemagenic hypothesis as being due to the strengthening of inspection behaviors. These studies have also indicated that questions placed before segments of prose facilitate the retention of information which is relevant to the question. Frase (1968) investigated the retention of prose material by exposing subjects to three types of questions--specific, comparative, and general, prior to the reading of the passage. Total retention and retention of items relevant to the questions were lowest for general questions.

In a study which varied the placement of questions, Rothkopf (1966) also included two control conditions for the purpose of ascertaining the effect of instructions. In control A subjects were told to remember as much as they could and informed that they would be tested later. In control C instructions were given to read slowly and carefully, paying attention to detailed facts. Retention was found to be significantly greater for control C. The results of this study along with those previously reviewed suggest that subjects' reading behaviors may be modified by variations in instructions and test-like events. Since retention appeared to be affected by this type of manipulation it seemed reasonable to attempt to

control mathegenic behaviors in a study of retroactive interference.

It also seemed reasonable to suspect that the retention of the information learned in the original learning task may depend upon the total amount of information stored in memory and the ability of the subject to set aside the essential information in the passage from other extraneous passage material. Gagné (1969) has demonstrated the effect of contextual interference by showing that when facts are presented in isolation they are retained better over a 48-hour period than when they are presented along with other facts. Instructions were manipulated in the investigation reported here in order to test the hypothesis that subjects who were instructed to attend to specific information in the passage would retain that information better than subjects who were instructed to attend to all aspects of the passage in a general way. It was suggested that the extraneous material in the passage, if attended to, could create interference on its own in addition to contributing to the total information load on the memory of the subject. Therefore, restricting the subject's attentional responses to the essential information in the passage could have the effect of enabling the subject to set this information apart from other extraneous stimuli, thereby lessening the total amount to be remembered and making the

essential information more resistant to interference from the extraneous material in which it was embedded. This would apply to the interpolated learning passage as well as the original.

If learning the content of a prose passage is seen as a free recall task, there is some evidence to indicate that information supplied prior to the task may have a facilitating effect upon recall. In a study by Frase (1969a) referred to earlier, in which subjects learned passages organized randomly or by concepts or attributes, half of the subjects were given preinformation about the structure of the material before they read the passage. The facilitating effect of this preinformation became more evident with additional trials. In a free recall experiment using word lists, Wood and Terborg (1968) found that instructing subjects to link together successive items facilitated recall.

In the present experiment it was expected that subjects receiving instructions to organize the content of the passage would respond selectively to facts and relations contained within the passage. Informing the subject that the passage had an inherent organizational structure would influence recall to the extent that this type of information would aid the subject in attending to those stimuli which could be associated in a hierarchical



manner, thereby resulting in the formation of higher-order memory units.

### Methodological Aspects in the Quanti- fication of Prose

Since this study was concerned with an operational definition of similarity based upon a logical analysis of essential information in the passage, a review of related methodology was deemed appropriate. A study investigating cognitive distortion was carried out by Dawes (1964) in which passages were constructed on the basis of four basic set relations: exclusion, identity, inclusion, and disjunction. Prose passages which were developed from these basic relations could in turn be represented symbolically by the use of Venn diagrams. Relationships among groups described in the prose passages were diagrammed as nested and disjunctive. Following the presentation of the passages subjects were asked questions dealing with the set relations described. Distortion was defined in terms of two types of errors. If the subject stated that all members of one set were included within a larger set when the two sets were really disjunctive, this was termed an overgeneralization error. The other type of error, termed pseudo-discrimination, occurred when the subject believed that two sets were disjunctive when in fact all members of one set were included within the larger set. In addition to the finding that overgeneralization

errors were more prevalent, a major contribution of this study was its methodology which provided a means of symbolizing and quantifying the essential information in a prose passage.

The set relations methodology of Dawes was later used in a study by Martin (1967), wherein blind children were tested on their ability to comprehend the essential information presented in passages of three different lengths. All three passages were based upon the same Venn diagram, but two of them were reduced in length by excluding different amounts of unimportant information which was unrelated to the information represented in the Venn diagram. Learning and retention were found to be comparable among the three versions.

A recent study by Frase (1969b) has introduced the application of graph theory as a means of quantifying the depth of logical inferences which can be drawn from textual material. Logical classes included in his prose materials were represented as points and directed lines or arrows represented the relationship of class inclusion. For example, the sentence "The people called the Fundalas are the outcasts of Central Ugala" was represented by  $A \longrightarrow B$ , a primary assertion. The letters A and B represent Fundalas and outcasts, respectively, and the arrow signifies that A is a member of B. Each class was assigned a letter and used as a heading in an "adjacency

matrix" (Harary, Norman, & Cartwright, 1965). Raising the adjacency matrix to higher powers indicated the number, depth, and content of valid inferences. In the experiment itself subjects were given different orienting directions which constrained their selection of stimuli in the reading task. It was found that when subjects were required to make inferential assertions they were more likely to recall text-points lying on the solution path than text-points that were not. As solution path lengths became longer more text-points were recalled. More primary assertions were recalled than inferential assertions.

This study has particular relevance for the experiment described here not only for its implications regarding orienting directions but for its method of quantifying prose material dealing with the process of inference or deduction. As in the case with using Venn diagrams, employing adjacency matrices provides another means of establishing operationally the essential information in a passage as well as defining a variable such as similarity in a systematic manner.

### Hypotheses

On the basis of previous research dealing with retroaction which had investigated the effects of degree of acquisition, the degree of similarity between original and interpolated learning, and the effect of instructions, it is hypothesized that:

1. retention of information from the original learning task is greater when specific instructions precede both original and interpolated tasks;
2. retention of information from the original learning task varies inversely with the amount of practice on the interpolated task;
3. retention of information from the original learning task varies inversely with the degree of similarity between the original and interpolated tasks;
4. extended practice on the interpolated task produces the greatest retention decrement when original and interpolated tasks are highly similar, but has less of an effect when the two tasks are dissimilar, and almost no effect when they are completely different tasks;
5. retention of information from the original learning task is greater when the learning tasks are preceded by specific instructions, but this effect is more apparent when there is less practice on the interpolated task;
6. specific instructions inhibit retention to a greater extent when original and interpolated

tasks are highly similar than when they are dissimilar or completely different.

## CHAPTER III

### EXPERIMENTAL DESIGN AND PROCEDURES

#### Materials

The passages used in both original and interpolated conditions were constructed to approximate, as closely as possible, the style of instructional prose commonly found in classroom learning situations. In order to provide a means of holding essential information constant in both original and interpolated passages, while at the same time manipulating the degree of organizational similarity in the interpolated passage, the passages were constructed using the set relations technique formulated by Dawes (1964). In addition to providing a means of operationally defining the degree of organizational similarity in the interpolated passage, the use of set relations in passage construction also made it possible to assess meaningful learning from the passage on the part of the subject. Evidence of meaningful learning, as it was operationally defined here, was the ability of the subject to correctly answer questions where an inference or deduction was required. None of the answers to these kinds of questions were given directly in the passage itself.

The original and interpolated passages used in the experiment were written after the particular combinations of basic set relations were decided upon and illustrated through the use of a Venn diagram. Each passage was approximately 1350 words in length. Since the content of the passages dealt with groups of people or other organisms and their identifying attributes, in addition to their relationships to other groups and attributes, the content could be symbolized through the use of nested and disjunctive relations in the Venn diagram. A relationship where one entire group is a subset of another is referred to as nested. A disjunctive relation is found where two groups have some elements in common.

The passage used in the original learning condition was the same for all subjects. It was constructed as described above and was intended to be representative of instructional prose in the area of anthropology. The Venn diagram upon which it was based is illustrated in Figure 1.

Since the purpose of the interpolated passage was to provide varying degrees of interference, and since these levels of interference corresponded to the extent to which the interpolated passage was similar in organization to the original learning passage, these variations in degree of organizational similarity were operationally defined by systematically varying the Venn diagram representing the interpolated passage. The diagram representing

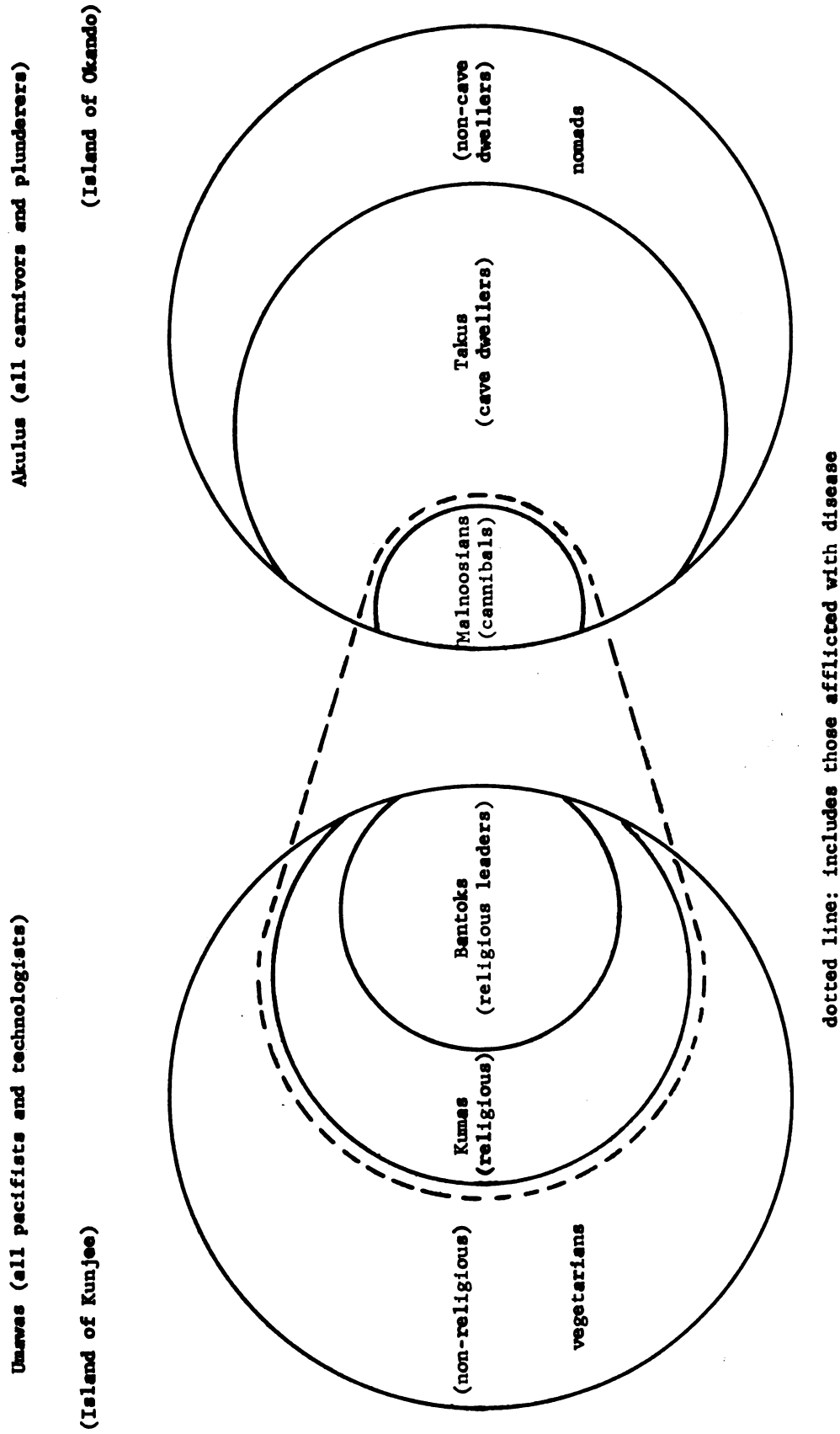


Figure 1. Venn diagram for original learning passage.



the passage of high organizational similarity, shown in Figure 2, has only a few changes in its nested and disjunctive relations. In contrast to this is the diagram representing the passage with a highly dissimilar organization, shown in Figure 3. Prose passages corresponding to Figures 1, 2, and 3 are included in Appendix B.

In addition to manipulating set relations, similarity was also defined in terms of changes in the basic factual information presented directly in the passage. The interpolated passage that had an organization highly similar to that of the original passage had only minor changes in its Venn diagram, but in place of the names used in the original passage other names were substituted which had a similar phonetic sound. In addition, some relationships were reversed. The interpolated passage which had a highly different organization was characterized by a completely different Venn diagram, new names which bore no resemblance to those used in the original passage, completely different set relations, and a totally different type of content. The content of this highly dissimilar passage could be described as science fiction and again it was constructed after the basic set relations had been established.

Granted that this type of instructional prose has an artificial quality when compared to the way in which classroom learning material is usually constructed,

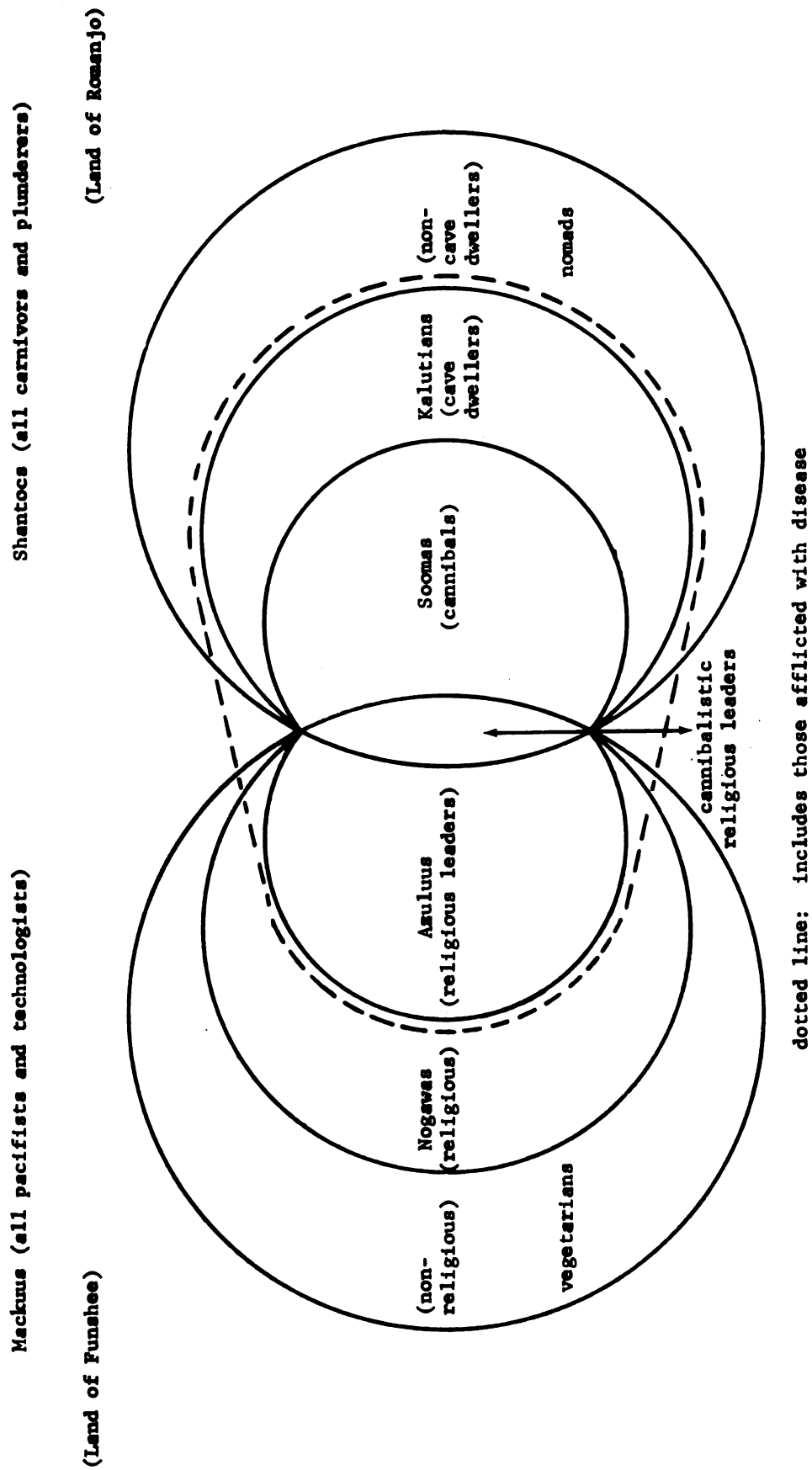


Figure 2. Venn diagram for similar interpolated passage.

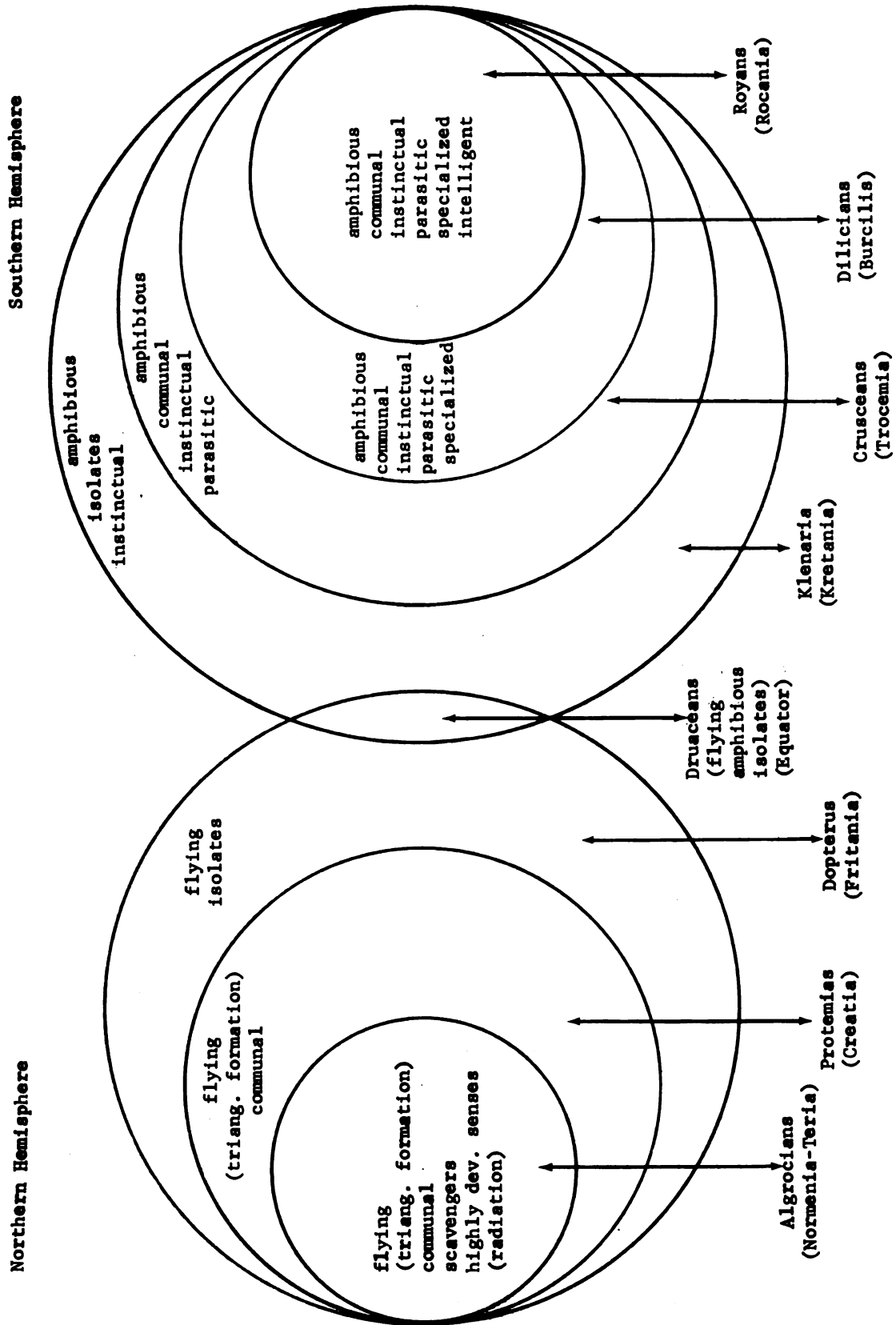
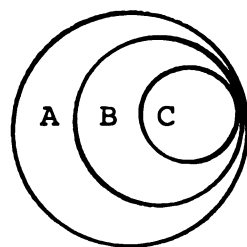


Figure 3. Venn diagram for dissimilar interpolated passage.

its usefulness in providing an operational definition for organizational similarity, in addition to providing a means of describing the quantity of information contained within each passage, made its use justifiable.

In order to establish that the content of the original passage had been learned to a relatively high degree, all subjects read the passage twice and took a test following the second reading. In the interpolated learning phase tests were taken after each passage was read. Two types of questions were used in constructing these tests: (1) questions that required the subject to recall from the passage items of information that were explicitly presented; and (2) questions for which answers were not to be found directly in the content of the passage, but which required the subject to make an inference or a deduction based upon what he had read. Questions based upon the solution to a simple syllogism are an example of this second type, as illustrated in Figure 4.



All B is A  
 All C is B  
 $\therefore$  All C is A

Figure 4.--Example of Syllogism Used in Constructing Inference Questions.

In this illustration the inferential question would be in the following form:

All C is 2.      1. D  
                                 2. A  
                                 3. E  
                                 4. F

The answer "All C is A" would not have been stated directly but could have been correctly deduced if the subject were able to remember the two premises "All B is A" and "All C is B." It seems reasonable to believe that the solution to this syllogism requires something more than just remembering a stated fact. Because answering these kinds of questions required the making of an inference or a deduction they were considered to be more representative of what might be called meaningful learning.

In order to identify each of the two types of questions in scoring the answer sheets, all fact questions, or those for which answers were explicitly given in the passage, were assigned odd numbers. Inference questions, for which answers had to be deduced, were given even numbers.

The immediate and delayed retention tests that were used to determine the extent to which the interpolated passage was effective in creating interference or facilitation were composed of the same questions used in the test which followed the reading of the second original learning passage. However, the questions appeared in a different order.

The experimental materials, which included instructions, passages, performance tests, filler tasks for control subjects, and retention tests, were printed on 8 1/2 x 11 sheets of paper and arranged sequentially in separate test booklets. Twelve different types of booklets were required, one for each experimental condition. Overhead transparencies were prepared containing test questions for the original learning passage. This was done to enable the experimenter to control the time allowed for each item on the original learning test. Separate answer sheets accompanied the test booklet. A system of color coding was used to identify each answer sheet with its corresponding retention test.

#### Pilot Testing of Materials

The materials were tested by presenting them to 82 subjects in three education classes at Michigan State University. This was done in order to obtain item analysis data on all questions as well as to get an indication of the mean number correct for each passage after one reading. Overall means for subjects taking a test which matched the passage they read were as follows: original learning passage, 19.8; dissimilar, 16.3; and similar, 18.0. The overall mean was 18.0 or 60% correct. Since this was below the 65-70% criterion established as desirable for the level of original learning, the decision

was made to include two presentations of the original learning passage in the actual experiment.

This testing procedure was also designed to determine if reading one passage would result in raising scores above the chance level on another test. Two groups read the similar and dissimilar passages but took the original learning test. Their scores were 7.4 and 7.3 respectively, both below the level of chance responding.

#### Procedure

The sample consisted of 120 male and female undergraduate students in education at Michigan State University. All subjects volunteered for the experiment and were paid two dollars apiece for their participation. With the exception of a delayed retention test, all other data were collected in group testing sessions conducted during a three-week period. Test booklets containing materials for the 12 experimental conditions were randomly ordered and distributed to the subjects at the beginning of the testing sessions.

All instructions were included in the test booklets. Within the sequence of materials, general or specific reading instructions preceded each passage depending upon the experimental condition to which the subject was assigned. All subjects received these instructions when the experiment began.

This is an experiment to find out how people learn from reading instructional materials. Please read carefully all directions provided in this booklet. Do not turn to the first page until the initial directions are given.

### Original Learning Phase

The original learning phase was the same for all subjects, with the exception that half of the subjects received general and the other half specific instructions. Each subject read the original learning passage twice. Nine minutes were allowed for the first reading and five minutes for the second. Following the reading of the passage the second time, the original learning test was administered. Each question was presented individually on an overhead screen for a period of 30 seconds.<sup>1</sup>

### Interpolated Learning Phase

In the interpolated learning phase degree of learning was defined as the number of times a subject was presented with a passage and retention test. Subjects in the high degree of learning condition read the passage twice and took the accompanying test twice, corresponding to two study-test trials. Questions on the second test

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<sup>1</sup>An unanticipated 12-minute delay occurred during one of the testing sessions resulting from a burned-out bulb in the overhead projector. A one-way analysis of variance performed on original learning scores across groups indicated no significance difference. The decision was made not to discard these data.



were the same as those on the first but appeared in a different order. Subjects assigned to the low degree of learning condition read the passage once and took the test only once. The interpolated phase differed from the original learning phase in that no time limits were imposed, except for control subjects, and all questions appeared together in a single test included in the sequence of materials.

An accommodation had to be made to test control subjects who did not read an interpolated passage but worked on arithmetic problems as a filler task instead. Since high degree of learning groups took about twice as much time to complete the interpolated learning phase as did the low degree groups, the time given control group subjects to work on their filler task had to be varied accordingly. As a result of this, each testing session was devoted exclusively to collecting data for only one of the two degree of learning conditions. In this way some control data could be collected during each session. For sessions where low degree data were collected control subjects were given 15 minutes to work on the filler task; for high degree sessions control subjects were given 30 minutes.

### Retention Phase

After completing the interpolated learning phase, subjects continued on to the retention phase of the

experiment. The first retention test was unpaced and consisted of a random reordering of the same questions used on the original learning test. The fact retention test was made up of the 15 odd numbered items and the inference retention test consisted of the 15 even numbered items. As another retention measure, subjects were given the Venn diagram representing the original learning passage and asked to label each circle. The names assigned to the two largest circles appeared on the diagram in order that the subject could begin with the proper orientation. A list of names representing the other circles was also provided. The maximum score for the Venn test was 13 items correct. The fact, inference, and Venn retention tests were the three immediate dependent measures representing what the subject had remembered from the original learning passage after being subjected to a certain level of interpolated activity.

Two long-term retention measures were also employed. The same 30-item test used in the immediate retention phase was mailed to all subjects approximately 10 weeks after they had participated in the experiment. This provided two additional dependent measures, delayed fact and delayed inference. Of the 120 subjects who participated in the experiment 113 returned the delayed retention test.

### Design and Experimental Treatments

The experiment was set up as a 2x2x3 factorial design with five dependent measures. The three independent variables were instructions, degree of learning, and degree of similarity.

### Instructions

Two levels of instructions, general and specific, were used in an attempt to manipulate the information processing behavior of the subjects. These instructions were given just prior to the reading of the original and interpolated passages. The following instructions are written in specific form as they appeared in the test booklet for the passages dealing with anthropology. Variations for general instructions and science fiction content are noted in parentheses.

Original learning.--The following passage is an account of life in primitive tribes, typical of what may be found in a textbook on anthropology. Read the passage carefully since you will be tested later. Try to remember as much as you can, paying particular attention to statements of facts and relationships. In addition, try to think of any inferences that may be drawn from the information presented in the passage. If possible, attempt to organize the material in a way that will help you remember it later. (The last four sentences were replaced in the general instructions by: Read the passage carefully. Try to remember as much of what you read as possible since a test will be given later.)

You will have approximately nine minutes to read the passage. If you wish to read over any parts of it do not go back any farther than the preceding paragraph. Do not take any notes on the information you read.

Interpolated learning.--The following passage is an account of life in primitive tribes, typical of what may be found in a textbook on anthropology. (For the science fiction passage this would read: The following passage is written as a science fiction account of biological life on another planet.) Read the passage carefully since you will be tested later. Try to remember as much as you can, paying particular attention to statements of facts and relationships. In addition, try to think of any inferences that may be drawn from the information presented in the passage. If possible, attempt to organize the material in a way that will help you remember it later. (The last four sentences were replaced in the general instructions by: Read the passage carefully. Try to remember as much of what you read as possible since a test will be given after you have finished.)

Read the passage at your own pace, but if you wish to read over any parts of it do not go back any farther than the preceding paragraph. Do not take any notes on the information you read. When you finish reading the passage through once, answer the questions that follow by marking the appropriate spaces on your IBM answer sheet. Do not look back on the passage once you have begun to answer the questions.

### Degree of Learning

Degree of learning was manipulated only in the interpolated phase and was operationally defined in terms of the number of exposures a subject had to the interfering passage and the questions on the passage. A low degree of learning is defined as one exposure to the passage and questions, or one study-test trial, and a high degree of learning is defined as two exposures or two study-test trials.

### Degree of Similarity

For purposes of analysis three levels of similarity were established: high, low, and no similarity. The

no similarity level was the control where subjects worked filler tasks in the interpolated phase. Degree of organizational similarity of the interpolated passage in relation to the original passage was defined for the other two levels in terms of high and low similarity. In contrast to the passage used in the original learning phase, the interpolated passage of high organizational similarity had a slightly modified Venn diagram, highly similar names (phonetically), a reversal of some relationships, and similar content (some alteration of events). The interpolated passage of low organizational similarity had an entirely different Venn diagram, completely different names and relationships, and a totally different content.

### Analysis

Since five dependent measures were taken on each subject the most appropriate statistical technique to be used in analyzing these data was the multivariate analysis of covariance (Finn, 1967). This analysis was carried out with the assistance of the Michigan State University Computer Laboratory.

## CHAPTER IV

### RESULTS

The results for two separate experiments will be reported in this chapter. The first experiment, which was described in Chapter III, incorporated three independent variables in a 3x2x2 factorial design: (1) similarity; (2) degree of learning; and (3) type of instruction. A preliminary analysis of the data from this experiment indicated that a second experiment, which would manipulate only the variable of similarity, would be in order. After the data analysis for the original experiment has been reported, the rationale and design of this follow-up experiment will be presented along with its findings.

#### Experiment I

Five separate dependent variables were used in the first experiment. These measures are represented by the scores subjects obtained on five retention tests based on the original learning passage. A retention test of factual and inferential information followed the interpolated learning phase. Although a single test was used totals for odd (factual) and even (inferential) scores

were analyzed as separate measures. The same test was used as a measure of delayed retention and odd and even score totals were treated the same way in the analysis. The other retention measure was the labeling of sets and subsets of the Venn diagram used in constructing the original learning passage. This test was also taken as part of the immediate retention phase of the experiment. To summarize, the five retention measures are identified as: (1) immediate fact retention; (2) immediate inference retention; (3) delayed fact retention; (4) delayed inference retention; and (5) Venn diagram retention.

It was of primary interest to determine if retroactive interference would be found to operate in the same way for retention of both factual and inferential information. For this reason it was essential to the design of the experiment to provide for more than one retention measure on each subject. As a result of this aspect of the experimental design, it had to be assumed that the five dependent measures taken on each subject were correlated and could not be treated as if they were independent. In a design such as this where there are multiple independent and dependent variables and where the dependent variables must be studied simultaneously, the most appropriate statistical technique for analysis is the multivariate analysis of variance. The scores on the dependent variables are assumed to be distributed in multivariate normal form.

The rationale for applying the multivariate model to this type of design has been set forth by Bock and Haggard (1968). These authors contend that although separate univariate F tests could be performed on each of the dependent measures, these tests of significance could not be considered statistically independent and a single probability statement could not be applied to all five measures taken together. In addition to determining the role of the independent variables in predicting and explaining the nature of the dependent variables, the multivariate model provides for the formulation of a probability statement that considers the degree of relationship between the dependent variables.

In this experiment it was possible to build into the design two other measures which would improve prediction of the dependent measures. These two measures are the total fact and inference scores obtained from the retention tests given immediately after the reading of the original learning passage. Since original learning fact and original learning inference scores could be used as concomitant variables, or covariates, the technique which was used to analyze all data in the first experiment was the multivariate analysis of covariance.

The overall design of the first experiment is illustrated by Table 1. This design is described as non-orthogonal due to proportional but unequal cell sizes.



Table 1.--Design Used in Data Analysis for Experiment I.

	High Similarity			Low Similarity			No Similarity		
	High DOL		Low DOL	High DOL		Low DOL	High DOL		Low DOL
	Gen. Spec.	Gen. Spec.	Gen. Spec.	Gen. Spec.	Gen. Spec.	Gen. Spec.	Gen. Spec.	Gen. Spec.	Gen. Spec.
OL Fact	11*	11	11	11	11	11	5	5	5
	12**	12	12	12	12	12	6	6	6
OL Inf.	11	11	11	11	11	11	5	5	5
	12	12	12	12	12	12	6	6	6
Imm. Fact	11	11	11	11	11	11	5	5	5
	12	12	12	12	12	12	6	6	6
Imm. Inf.	11	11	11	11	11	11	5	5	5
	12	12	12	12	12	12	6	6	6
Venn	11	11	11	11	11	11	5	5	5
	12	12	12	12	12	12	6	6	6
Del Fact	11	11	11	11	11	11	5	5	5
	12	12	12	12	12	12	6	6	6
Del. Inf.	11	11	11	11	11	11	5	5	5
	12	12	12	12	12	12	6	6	6

\*Data used in analysis.

\*\*Data actually collected.

Individual cells within the high and low similarity conditions contain 11 subjects whereas the cells within the no similarity condition have five subjects. For purposes of analysis the no similarity condition, or control, has approximately half as many subjects. Although the first part of the experiment was done with 12 subjects per cell in the high and low similarity conditions and six in the no similarity condition, it became necessary to equalize cell sizes by randomly throwing out subjects when it became apparent that not all of the delayed retention tests would be returned. This information is also summarized in Table 1.

Cell means and standard deviations corresponding to all levels of similarity, degree of learning, and type of instruction for the two covariables and five dependent variables are presented in Table A-1. Rows of the data matrix represent both concomitant and dependent measures with columns denoting levels of the independent variables.

The within cells sample correlation matrix for all seven measures is displayed in Table 2. Standard deviations for these same variables are also included. Correlations between concomitant variables (original learning fact and original learning inference) and immediate retention measures (immediate fact and immediate inference) indicate a degree of relationship justifying the use of covariance in this analysis. A Chi Square test of no

Table 2.--Within Cells Sample Correlation Matrix and Standard Deviations for Dependent and Concomitant Variables--Experiment I.

	S.D.	Venn	Imm.	Inf.	Imm.	Fact	Del.	Inf.	Del.	Fact	OL Inf.	OL Fact
Venn	4.32	1.00										
Imm. Inf.	3.02	0.52	1.00									
Imm. Fact	2.23	0.52	0.60	1.00								
Del. Inf.	2.86	0.47	0.35	0.43	1.00							
Del. Fact	2.20	0.37	0.33	0.44	0.56	1.00						
OL Inf.	2.75	0.51	0.80	0.54	0.37	0.31	1.00					
OL Fact	2.21	0.52	0.56	0.73	0.44	0.45	0.60	1.00				

association between dependent and independent variables for the multivariate regression analysis yielded a significant  $\chi^2$  of 143.2, with 10 d.f. This further supports the contention that increased precision of prediction is obtained when original learning fact and original learning inference scores are used as covariates.

Whenever possible, operations described for the multivariate case will refer to analogs in a univariate analysis. What would correspond to the common mean square error term in a univariate analysis of covariance is found in the within-cell variance-covariance matrix of Table 3.

This matrix was constructed from a matrix of correlations of the five dependent measures (with covariates eliminated). Multiplying each correlation coefficient by the standard deviations of the corresponding

Table 3.--Within Cells Variance-Covariance Matrix Adjusted for Covariates--Experiment I.

	Imm. Fact	Imm. Inf.	Venn	Del. Fact	Del. Inf.
Imm. Fact	2.31				
Imm. Inf.	0.79	3.29			
Venn	1.03	1.16	12.72		
Del. Fact	0.54	0.32	1.16	3.92	
Del. Inf.	0.58	0.21	2.61	2.28	6.59

dependent variables produced the diagonal and off diagonal elements of the matrix. The variances which appear along the diagonal in Table 3 for each dependent measure correspond to adjusted mean squares in univariate analyses.

### Tests of Hypotheses

Significance tests will be reported in this chapter for all hypotheses made a priori on the basis of previous findings reported in the literature. This includes all main effects for instructions, degree of learning, and similarity, as well as the interactions between instructions x degree of learning, instructions x similarity, and similarity x degree of learning. A significance test was also performed for the three-way interaction of instructions x degree of learning x similarity as part of the analysis and will be reported. Tables of univariate and step-down F's for each main effect and interaction will be included in Appendix A.

Significance tests for all main effects and interactions in the first experiment were performed using the multivariate analysis of covariance procedure. The dependent variables, which were considered simultaneously for all of these tests, represented scores from the following retention measures: immediate fact (imm. fact); immediate inference (imm. inf.); delayed fact (del. fact); delayed inference (del. inf.); and completion of

Venn diagram (Venn). In order to make clear the analog between the multivariate case and the univariate case additional detail will be included in reporting the results of the first hypothesis only.

Hypothesis one stated that retention of factual and inferential information from the original learning passage would be greater when specific instructions preceded learning. A multivariate test of this main effect indicated no significant difference in retention between general and specific instructions ( $p < .408$ ). The multivariate F ratio is based upon Wilk's likelihood ratio criterion. Results of this test are summarized in Table 4. As can be seen in Table 5, cell means were in the predicted direction for immediate fact and Venn diagram measures only.

Table 4.--Multivariate Test for Main Effect of Instructions.

Multivariate					
Source	d.f.	Multivariate F Ratio		p Less Than	
Instructions	5, 90	1.025		0.408	
Mean Products					
Imm. Fact	1.15				
Imm. Inf.	-2.62	5.96			
Venn	4.82	-10.95	20.12		
Del. Fact	-0.70	1.59	- 2.93	0.43	
Del. Inf.	1.01	- 2.29	4.21	-0.61	0.88

Table 5.--Mean Correct Responses of Two Covariates and Five Dependent Variables for Degree of Similarity and Instructions.

	Hi Sim.		Low Sim.		No Sim.		Totals	
	Gen.	Spec.	Gen.	Spec.	Gen.	Spec.	Gen.	Spec.
OL Fact	12.09	11.91	11.96	12.14	10.90	11.80	11.82	11.98
OL Inf.	10.77	11.27	11.46	11.04	9.30	9.20	10.78	10.79
Inm. Fact	11.91	11.64	12.00	12.86	10.80	11.20	11.74	12.06
Inm. Inf.	11.32	11.27	12.40	11.27	10.40	10.70	11.59	11.11
Venn	7.64	8.68	7.91	9.68	8.30	7.40	7.87	8.85
Del. Fact	7.41	7.36	8.32	8.36	7.00	6.70	7.70	7.64
Del. Inf.	7.41	7.96	7.59	7.36	5.90	6.60	7.20	7.46

The hypothesis<sup>1</sup> mean products matrix in Table 4 and the within-cell variance-covariance matrix of Table 3 are both estimates of the population variance-covariance matrix under the null hypothesis. In the absence of treatment differences these two matrices should be the same.

It will be noted that in the univariate case the numerator and denominator of the F ratio would consist of the diagonal elements of these two matrices. The off-diagonal elements in the matrices are estimates of the covariance between two associated variables. If the correlations between the dependent measures in this experiment had been equal or equal to zero then the univariate analysis of covariance could have been used. However, where this is not the case the multivariate analysis is more likely to detect differences resulting from the covariance terms of the mean products matrix. The hypothesis mean products matrices are derived from a table containing the least square estimates adjusted for covariates (effect x variables). This is Table B found in Appendix A. Row vectors being different from zero in the multivariate case is analogous to individual elements differing from zero in the univariate case.

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<sup>1</sup>Another way to describe this matrix to highlight its univariate analog would be to refer to it as a "between groups mean product matrix."



In hypothesis two it was predicted that retention of information from the original passage would be greater when the interfering passage was presented once than when it was presented twice. No significant difference was found ( $p < .498$ ) between high and low degrees of learning when this main effect was tested. The data relating to this hypothesis are summarized in Table 6. It can be seen in Table 7 that only for the delayed retention test of factual information were cell means in the predicted direction.

Hypothesis three tested the notion that retention of information from the original learning passage would vary inversely with the degree of similarity between the original and interpolated passages. It was predicted

Table 6.--Multivariate Test for Main Effect of Degree of Learning.

Multivariate					
Source	d.f.	Multivariate F.	Ratio	p Less Than	
Deg. of Lrn.	5, 90	0.881		0.498	
Mean Products					
Imm. Fact	1.97				
Imm. Inf.	-0.53	0.14			
Venn	3.88	-1.04	7.64		
Del. Fact	-2.80	0.75	-5.51	3.98	
Del. Inf.	3.02	-0.81	5.94	-4.28	4.62

Table 7.--Mean Correct Responses of Two Covariates and Five Dependent Variables for Degree of Learning and Instructions.

	Hi DOL		Low DOL		Totals	
	Gen.	Spec.	Gen.	Spec.	HiDOL	LowDOL
OL Fact	12.11	11.82	11.52	12.14	11.96	11.83
OL Inf.	11.63	11.44	9.92	10.14	11.54	10.03
Imm. Fact	12.26	12.11	11.22	12.00	12.18	11.70
Imm. Inf.	12.07	11.81	11.11	10.52	11.94	10.82
Venn	8.63	9.48	7.11	8.22	9.06	7.66
Del. Fact	7.59	7.48	7.81	7.81	7.54	7.81
Del. Inf.	7.70	7.70	6.70	7.22	7.70	6.96

that retention would be highest for the no similarity condition (control), next highest for the dissimilar condition, and lowest for the highly similar condition. The multivariate test for all five measures taken simultaneously proved to be nonsignificant ( $p < .106$ ). Significance test data are summarized in Table 8. Cell means were not in the predicted order for any of the five measures as shown in Table 9.

In the fourth hypothesis an interaction was predicted between level of similarity and degree of learning. It was expected that reading the interfering passage twice instead of only once would affect retention most of all when the second passage was highly similar to the first; it would affect retention less under the

Table 8.--Multivariate Test for Main Effect of Similarity.

Multivariate					
Source	d.f.	Multivariate F Ratio		p Less Than	
Similarity	10, 180	1.612		0.106	
Mean Products					
Imm. Fact	5.20				
Imm. Inf.	0.53	4.07			
Venn	0.94	5.30	6.92		
Del. Fact	8.01	0.82	1.47	12.35	
Del. Inf.	0.49	-4.25	-5.49	0.74	4.66

Table 9.---Mean Correct Responses of Two Covariates and Five Dependent Variables for Degree of Similarity and Degree of Learning.

	Hi Sim.			Low Sim.			No Sim.			Totals		
	Hi DOL	Low DOL	Hi DOL	Low DOL	Hi DOL	Low DOL	Hi DOL	Low DOL	Hi DOL	Low Sim	Hi Sim	No Sim
OL Fact	12.00	12.00	12.00	12.00	12.09	11.80	10.90	12.00	12.04	11.35		
OL Inf.	11.54	10.50	11.68	10.82	11.20	7.30	11.02	11.25	9.25			
Imm. Fact	11.86	11.68	12.59	12.27	12.00	10.00	11.77	12.43	11.00			
Imm. Inf.	11.54	11.04	12.27	11.40	12.10	9.00	11.29	11.84	10.55			
Venn	8.46	7.86	9.41	8.18	9.60	6.10	8.16	8.80	7.85			
Del. Fact	7.18	7.59	8.04	8.64	7.20	6.50	7.38	8.34	6.85			
Del. Inf.	7.86	7.50	8.04	6.91	6.60	5.90	7.68	7.48	6.25			

low similarity condition, and hardly at all under the condition of no similarity (or control). This interaction was not found to be significant ( $p < .934$ ). Multivariate test data are summarized in Table 10. Graphic representations of cell mean differences for degree of learning at each level of similarity were not consistent with that hypothesized for any of the five dependent measures.

Hypothesis five stated that retention of information from the original learning task would be greater when the learning tasks were preceded by specific instructions, but this effect would be more apparent when there was less practice on the interpolated task. The multivariate test for this interaction proved to be

Table 10.--Multivariate Test for Interaction of Degree of Learning x Similarity.

Multivariate					
Source	d.f.	Multivariate F Ratio		p Less Than	
Deg. of Lrn. x Similarity	10, 180	0.423		0.934	
Mean Products					
Imm. Fact	1.21				
Imm. Inf.	0.21	0.76			
Venn	1.23	1.06	2.22		
Del. Fact	0.88	-0.28	0.38	0.90	
Del. Inf.	-0.88	1.35	0.85	-1.54	3.73

nonsignificant ( $p < .807$ ). Cell means illustrated in graphic form failed to reveal the pattern which would be predicted by this hypothesis for any of the dependent measures. Summary data for hypothesis five are presented in Table 11.

Table 11.--Multivariate Test for Interaction of Instructions x Degree of Learning.

Multivariate					
Source	d.f.	Multivariate F Ratio		p Less Than	
Instructions x Degree of Lrn.	5, 90	0.458		.806	
Mean Products					
Imm. Fact	0.54				
Imm. Inf.	-1.56	4.48			
Venn	-1.03	2.97	1.97		
Del. Fact	-0.59	1.61	1.06	0.58	
Del. Inf.	0.06	-0.18	-0.12	-0.06	0.01

The interaction of instructions x degree of similarity was tested in hypothesis six. It was predicted that specific instructions would inhibit retention to a greater extent when original and interpolated tasks were highly similar than when they were dissimilar or completely different. This interaction was not significant ( $p < .437$ ). The expected pattern of cell means was not

found for any of the five dependent measures. Multivariate test data for this interaction are summarized in Table 12.

Table 12.--Multivariate Test for Interaction of Instructions x Similarity.

Multivariate					
Source		d.f.	Multivariate F Ratio	p Less Than	
Instructions x Similarity		10, 180	1.010	0.437	
Mean Products					
Imm. Fact	3.30				
Imm. Inf.	-2.01	1.98			
Venn	5.24	-5.97	18.56		
Del. Fact	0.57	-1.12	3.76	0.90	
Del. Inf.	-2.35	1.22	-2.97	-0.19	1.74

A significance test was also performed to test the three-way interaction between instructions, degree of learning, and degree of similarity. The multivariate test was nonsignificant ( $p < .437$ ). Summary data for this interaction are presented in Table 13.

To summarize, none of the hypotheses were supported which made predictions regarding the main effects of instructions, degree of learning, and degree of similarity in the first experiment. Hypotheses dealing with the interactions of instructions x similarity, instructions

Table 13.--Multivariate Test for Interaction of Instructions x Degree of Learning x Similarity.

Multivariate					
Source	d.f.	Multivariate F Ratio		p Less Than	
Inst. x Deg. of Lrn. x Similarity	10, 180	0.832		.599	
Mean Products					
Imm. Fact	1.32				
Imm. Inf.	-0.94	3.87			
Venn	1.02	-0.41	0.82		
Del. Fact	2.66	-0.97	2.15	5.63	
Del. Inf.	0.12	3.39	0.44	1.25	3.79

x degree of learning, and degree of learning x similarity were likewise not supported by the multivariate test of significance. A three-way interaction of instructions x degree of learning x degree of similarity was found to be nonsignificant.

### Experiment II

The relatively high retention scores on the dependent measures suggested that some aspect of the experimental procedure may have been responsible for the maintenance of the original level of learning despite variations in the interpolated activity. One procedural aspect thought to be contributing to this result was the



amount of practice given in learning the original passage. Subjects read the passage twice and received a retention test immediately following the second reading. Since the retention tests of factual and inferential information consisted of the same items found on the tests following the original learning passage (except for a reordering), there was also reason to suspect that subjects may have answered the retention test items correctly by remembering how they answered the items previously, instead of selecting an answer on the basis of what they remembered from reading the passage itself.

For these reasons it was decided that a second experiment was needed which would include the original learning test as an independent variable and also manipulate the variable of similarity. Similarity was retained since it was the variable of primary interest. Type of instructions and degree of interpolated learning were not included as independent variables since they did not appear to have a significant effect upon retention in the first experiment.

### Hypotheses

On the basis of the results of the first experiment and previous findings reported in the literature dealing with the effect of similarity on retroactive interference, it is hypothesized that:

1. immediate and long term retention of factual and inferential information from the original learning passage is significantly higher when a test is administered immediately after the passage has been read; and
2. under the condition that no test is given following the reading of the original learning passage, immediate and long term retention of factual and inferential information from the passage is significantly higher when the original and interpolated passages are highly dissimilar.

### Materials

The experimental materials consisted of the same three prose passages used in the first experiment along with their respective retention tests. The only retention test which was modified was the test following the original learning passage. Instead of presenting one question at a time using an overhead projector, the questions appeared together in the form of a 30-item test and were included as part of the test booklet. All instructions preceding passages were those described earlier as being specific. The second experiment differed from the first in that all experimental materials were included in the test booklets and no time limits were imposed during any part of the experiment.

### Procedure

The sample consisted of 40 male and female students in a school learning course at Michigan State University. Test booklets for the four experimental conditions were distributed randomly to all subjects at one testing session. Preliminary instructions were the same as for the first experiment.

In the original learning phase all subjects read the same anthropology passage only once. Since it was the purpose of the experiment to try to determine what effect the original learning test had on overall retention, one-half of the subjects received the test after reading the passage and the other half did not.

The interpolated learning phase consisted of only two levels of interference. One level represented a high similarity condition, making use of the other passage on anthropology (constructed with a similar Venn diagram) as the learning task. The other level of interference used the science fiction passage as a highly dissimilar or control condition. The interpolated phase resembled the high degree of learning condition in the first experiment in that all subjects read the interfering passage twice and took a retention test after each reading.

The retention phase was identical to that used in the first experiment. After the second interpolated test had been taken subjects completed the final retention

test, which contained the same items as the test of original learning (except in a different order). As a second retention measure, subjects labeled a copy of the Venn diagram corresponding to the original learning passage. A delayed retention test was administered to all subjects six weeks later. This test was identical to the immediate retention test given earlier.

As in the first experiment subjects recorded all answers on separate answer sheets. These answer sheets were color coded to correspond with each part of the testing sequence. Complete instructions for each phase of the experiment are included as part of Appendix B.

#### Design and Experimental Treatments

A 2x2 factorial design was used with the following five dependent measures: (1) immediate retention of factual information; (2) immediate retention of inferential information; (3) delayed retention of factual information; (4) delayed retention of inferential information; and (5) completion of Venn diagram. The two independent variables were test-no test after original learning and degree of similarity.

Test-no test.--In order to determine the influence of the original learning test on final retention, 20 of the 40 subjects took the test as in the first experiment;

the other 20 were instructed to go right on to the interpolated passages.

Degree of similarity.--Degree of organizational similarity between original and interpolated learning was operationally defined as it was in the first experiment. The passages used in this experiment were also the same as those used in Experiment I.

### Analysis

Retention scores for factual and inferential information were obtained for each subject on the immediate and delayed retention tests. In addition to these four measures each subject also completed the Venn diagram test. Since this resulted in five dependent measures on each subject the appropriate analysis was the multivariate analysis of variance. Arbitrary contrasts were set up to test for the main effect of the test-no test variable and the effect of similarity within the test and no-test levels of the design. Means and standard deviations for all five dependent measures are shown in Table 14. This table also illustrates the overall design of the experiment.

The within cells sample correlation matrix is displayed in Table 15 along with standard deviations corresponding to each variable. The variance-covariance matrix which corresponds to the mean square error in a univariate analysis is presented in Table 16.

Table 14.--Mean Correct Responses and Standard Deviations for Five Dependent Variables--Experiment II.

	Test			No Test		Total	
	Hi Sim.	Low Sim.	Hi Sim.	Low Sim.	Hi Sim.	Test	No Test
Imm. Fact	$\bar{x}$	12.10	11.40	8.00	10.20	11.75	9.10
	S.D.	1.79	1.84	3.59	2.04		
Imm. Inf.	$\bar{x}$	11.60	13.30	7.00	8.60	12.45	7.80
	S.D.	2.27	1.70	3.56	3.60		
Venn	$\bar{x}$	9.60	7.40	6.50	4.70	8.50	5.60
	S.D.	3.53	4.93	4.35	3.92		
Del. Fact	$\bar{x}$	9.20	7.90	6.10	7.30	8.55	6.70
	S.D.	1.55	2.56	2.81	2.31		
Del. Inf.	$\bar{x}$	9.60	9.40	5.60	7.00	9.50	6.30
	S.D.	2.91	3.13	3.60	2.94		

Table 15.--Within Cells Sample Correlation Matrix and Standard Deviations for Dependent Variables--Experiment II.

	S.D.	Imm. Fact	Imm. Inf.	Venn	Del. Fact	Del. Inf.
Imm. Fact	2.43	1.00				
Imm. Inf.	2.90	0.49	1.00			
Venn	4.21	0.50	0.59	1.00		
Del. Fact	2.35	0.51	0.36	0.22	1.00	
Del. Inf.	3.16	0.30	0.57	0.42	0.56	1.00

Table 16.--Within Cells Variance-Covariance Matrix--Experiment II.

	Imm. Fact	Imm. Inf.	Venn	Del. Fact	Del. Inf.
Imm. Fact	5.91				
Imm. Inf.	3.47	8.41			
Venn	5.18	7.22	17.76		
Del. Fact	2.90	2.45	2.21	5.54	
Del. Inf.	2.30	5.20	5.60	4.13	9.98

### Tests of Hypotheses

Hypothesis one stated that immediate and long term retention of factual and inferential information from the original learning passage would be higher when a test was included in the original learning phase. The multivariate

test revealed a significant difference between the test and no-test condition ( $p < .001$ ). Since the difference was in the predicted direction the hypothesis was supported. Summary data are provided in Table 17.

Table 17.--Multivariate Test for Contrast of Test-No Test

Multivariate					
Source	d.f.	Multivariate F Ratio		p Less Than	
Test-No Test	5, 32	5.198		0.001	
Mean Products					
Imm. Fact	70.22				
Imm. Inf.	123.22	216.22			
Venn	76.85	134.85	84.10		
Del. Fact	49.02	86.02	53.65	34.22	
Del. Inf.	84.80	148.80	92.80	59.20	102.40

Univariate and step-down F's are reported in Table 18. The ordering of dependent variables is especially crucial in the step-down F test. In order to take advantage of the power of the multivariate test for this experiment as well as the first one, measures of delayed fact and delayed inference were placed in the fourth and fifth positions. Since immediate fact, immediate inference, and Venn tests were taken at the time of the main experiment, effects due to experimental manipulations were more apt to be detected on these measures.



Table 18.--Univariate and Step-Down Tests for Contrast of Test-No Test.

Variable	Univariate F	p Less Than	Step-Down F	p Less Than
Imm. Fact	11.87	0.002	11.87	0.002
Imm. Inf.	25.70	0.0001	10.98	0.002
Venn	4.74	0.04	1.08	0.30
Del. Fact	6.18	0.02	0.007	0.94
Del. Inf.	10.26	0.003	0.16	0.69

For this reason they were ordered in the first, second, and third positions. Further, the ordering is important because a step-down F at any position is considered to be the F value obtained if all variables preceding it were partialled out or treated as covariates. Due to this feature of the step-down test, it seemed reasonable to place the variables in the temporal order in which they occurred.

An inspection of step-down F values in Table 18 indicates that most of the significance observed in the multivariate F ratio resides in immediate fact and immediate inference retention measures. Those measures falling below the last one which is significant do not contribute anything to the overall significance level. In this case it would be the Venn, delayed fact, and delayed inference.

A comparison of univariate and step-down F's in this table points out the importance of using multivariate analysis for experiments of this kind. If only univariate analyses had been done, it may have been concluded that the test effect was significant for each of the five measures since all univariate F's are below the .05 level of significance. This, however, would have been in error since the five measures are not independent.

In the second hypothesis it was predicted that degree of similarity between original and interpolated passages would affect retention only when the original learning test was not given. Under the no-test condition, retention of factual and inferential information should be significantly higher when the interpolated passage is highly dissimilar. The first of two arbitrary contrasts set up to test this hypothesis indicated no significant difference between similar and dissimilar mean vectors ( $p < .121$ ) when the original learning test was included. This contrast is summarized in Table 19. Corresponding univariate and step-down F ratios are displayed in Table A-10.

Under the condition where the original learning test was not given, the similar-dissimilar contrast had a p value of .078, with 5 and 32 d.f. Summary data for this contrast are presented in Table 20.

Table 19.--Multivariate Test for Similar-Dissimilar Contrast Within Test Condition.

Multivariate					
Source	d.f.	Multivariate F Ratio		p Less Than	
Similar- Dissimilar Within Test	5, 32	1.907		0.121	
Mean Products					
Imm. Fact	2.45				
Imm. Inf.	-5.95	14.45			
Venn	7.70	-18.70	24.24		
Del. Fact	4.55	-11.05	14.30	8.45	
Del. Inf.	0.70	-1.70	2.20	1.30	0.20

Table 20.--Multivariate Test for Similar-Dissimilar Contrast Within No-Test Condition.

Multivariate					
Source	d.f.	Multivariate F Ratio		p Less Than	
Similar- Dissimilar Within No- Test	5, 32	2.210		0.078	
Mean Products					
Imm. Fact	24.20				
Imm. Inf.	17.60	12.80			
Venn	-19.80	-14.40	16.20		
Del. Fact	13.20	9.60	-10.80	7.20	
Del. Inf.	15.40	11.20	-12.60	8.40	9.80

Step-down F ratios appearing in Table 21 give some indication about which measures contributed to the .078 value reported for the multivariate test of this contrast. Immediate retention of fact was significant at the .05 level while the difference between the groups was significant at the .02 level for retention on the Venn measure. Interpretation of individual probability statements must be made with caution, however, since the measures cannot be considered to be independent. It should also be noted that the means were in the opposite direction to that predicted for the Venn. Reversing the order for immediate inference and Venn resulted in the same variables being significant and did not change the multivariate F ratio. Therefore, immediate inference, delayed fact, and delayed inference did not appear to contribute to the overall significance level.

Table 21.--Univariate and Step-Down Tests for Similar-Dissimilar Contrast Within No-Test Condition.

Variable	Univariate F	p Less Than	Step-Down F	p Less Than
Imm. Fact	4.09	0.05	4.09	0.05
Imm. Inf.	1.52	0.22	0.06	0.80
Venn	0.91	0.35	6.23	0.02
Del. Fact	1.30	0.26	0.04	0.83
Del. Inf.	0.98	0.33	0.56	0.46

In summary, the test-no test contrast was found to be significant in the predicted direction, thereby lending support to the hypothesis that the test of original learning used in this experiment had a significant effect upon retention. The influence of a highly similar interpolated passage was most apparent under the condition where no test of original learning was given. This effect was most pronounced for immediate retention of factual information and completion of the Venn diagram. All means were in the predicted direction for this contrast with the exception of the Venn retention measure.

## CHAPTER V

### DISCUSSION AND IMPLICATIONS

The two experiments described in the previous chapters were designed to show that retroactive interference or facilitation may result from the way prose materials are constructed. Since the construction of prose was directly related to the variable of organizational similarity, this was the variable of most interest in this study. Although the effect of similarity was found to be nonsignificant in the first experiment, this may have been due to the particular methodology used in the original learning phase. This notion will be discussed in relation to the findings of the second experiment. In addition to the overall effect of similarity, it was also of major interest to determine if systematic variations between original and interpolated passages would affect the retention of information explicitly stated in the original passage in the same way that it would affect information from the original passage which was based upon making an inference. Data from the second experiment will be the focal point of this discussion.

In the first experiment all subjects read the original learning passage twice and took a retention test

immediately after. Although other experimenters (Anderson & Myrow, 1970; Michael & Macoby, 1961; Roderick & Anderson, 1968; Spitzer, 1939) reported that providing a retention test immediately after reading a passage has a powerful effect upon long-term retention, the decision was made to include the original learning test for a number of reasons. First, it was the intent of the experiment to study the effect of similarity in producing retroactive interference under the most difficult conditions. It was therefore considered desirable to establish a criterion of performance on the original learning task that would serve as evidence that a relatively high degree of learning had been attained. Second, the inclusion of the original learning test was necessary to make the procedure of this experiment closely approximate the procedure used in classical verbal learning studies. In order to have made predictions based upon the retroactive interference paradigm, stimulus and response elements had to be identified in the original learning phase that would correspond to first-list learning in a study using nonsense syllables or words. The question stems and responses on the original learning test were considered analogous to learning A-B, or first-list associations, in a paired-associate experiment. Omitting the original learning test would have made the analogy to the A-B, A-C, A-B paradigm incomplete. The original

learning test was also included in order to provide a measure that could be used as a concomitant variable in the analysis. Since the same test would be given before and after the treatment it was suspected that the two sets of scores would very likely be highly correlated, and the original learning scores could then be used as a covariate in order to gain precision.

On the basis of the results of the two studies reported here, it appears that providing additional practice on the original learning task and administering a test immediately after makes the content learned from reading the original learning passage more resistant to interference. The test itself seemed to be especially effective in facilitating retention. This notion is supported by the fact that a significant difference was found for the test-no test variable manipulated in the second experiment. Subjects who took the retention test immediately after reading the original learning passage had significantly higher retention scores than those who had not. Even though the significance was due primarily to the influence of the immediate retention tests for fact and inference, the overall multivariate test was still significant for all five measures tested simultaneously.

The findings reported here concerning the influence of the original learning test upon later retention are consistent with those reported by other investigators



who have used prose materials. Anderson and Myrow (1970) included the original learning test as an independent variable in a study which investigated retroactive interference in a similar manner to the way in which it was studied here. That is, question stems were considered to be the stimuli and the answers the responses. In addition to finding that recall was significantly higher when the original learning test was given, there was also an interaction between the immediate test and response mode. When the test was given, retention was facilitated to a greater extent for short-answer questions than for multiple-choice. In another experiment Roderick and Anderson (1968) included an immediate test as an independent variable in a study which compared a programmed instruction sequence to the reading of a summary. The presence of an immediate test facilitated retention significantly on a delayed test and again the effect was more pronounced for short-answer questions. The facilitating effect of an immediate test on later retention was also observed in an earlier prose study by Spitzer (1939) and in a study by Michael and Macoby (1961) where films were used as the learning task.

The significantly improved performance of subjects who took the original learning test in the second experiment is evidence that test questions placed after a prose passage facilitate later retention. Two explanations are

offered for this outcome. First of all, subjects may have remembered how they answered the question the first time as a result of forming an association between the question stem and the chosen response. In this way they could have performed well on later retention tests even though they had forgotten the actual content from the original learning passage. Rothkopf (1966) investigated the effects of placing test questions after prose passages by using two different criterion tests. One test consisted of the same questions presented to subjects after they had read various segments of prose and the other test was made up of new questions based on the passages read. Compared with control groups, subjects who had responded to questions after reading the passages had significantly higher scores on both kinds of criterion tests, but performance was substantially higher on tests made up of questions they had seen before.

In addition to providing a means of determining the extent to which the original learning test influenced overall retention, the design of the second experiment also permitted contrasts to be made between similar and dissimilar conditions when the original learning test was given and when it was not. When subjects were administered the test, the probability statement for the similar-dissimilar contrast was .121 and none of the step-down F tests were below the .05 level. To some extent this

contrast replicated the test of similarity performed in the first experiment for subjects assigned to the high degree of learning condition. Even though the original learning passage was read only once, taking the test immediately after reading the passage seemed to facilitate performance to the extent that it made the highly similar passage appear ineffective in creating interference.

The contrast between highly similar and dissimilar conditions reached the .078 level on the overall multivariate test when no test of original learning was given, thereby lending some support to the contention that the highly similar passage could have created a certain amount of interference. An inspection of the step-down tests revealed that immediate fact retention was significant at the .05 level and therefore contributed heavily to the overall probability level. As in the similar-dissimilar contrast for the test condition, immediate inference was nonsignificant. Although these results must be interpreted with caution since the variables are not independent, these data provide some evidence that retroactive interference may have been responsible for a retention decrement when subjects were required to remember information explicitly stated in the original learning passage. Why this retention decrement was not found when the original learning test was given may be explained by postulating that a different kind of information-processing

behavior may be involved when at least some of the questions answered after reading the original passage require making a deduction. This notion is supported by a recent study conducted by Watts and Anderson (1970) in which subjects read five 450-word passages and were given a question following each one which required them to remember names or examples of a principle mentioned in the passage or required them to apply a principle. Significantly higher posttest scores were attained by subjects who were required to answer the application-type questions. The posttest included all three types of questions. The authors suggested that requiring an application to a new example forced the subjects to review the passage before deciding upon an answer, thereby facilitating retention of different kinds of information. If questions requiring the making of inference exert this type of "backward influence" on the passages they follow, it seems possible that the inference questions in the original learning test may have forced the subject to rehearse the passage more than when the test was not given.

Given that the original learning test may have countered the effect of similarity in much of this research, the data resulting from the similar-dissimilar contrast under the no-test condition seem to provide the most reliable test of similarity as a factor contributing to retroactive interference. The findings of evidence

for retroactive interference for immediate fact retention and not for immediate inference suggests that, at least in this experiment, the type of learning measured by fact questions may be more like that required in paired-associate learning tasks, where similarity has been shown to create interference. The fact questions used in these experiments could be answered correctly if the subject could make associations between names and attributes while reading the original learning passage and retain those associations until the retention tests had been taken. If prose learning can be considered a paired-associate task at least in learning these kinds of associations, then the data for fact retention seem to fit the retroactive interference paradigm. According to this paradigm, associations learned during the original task, represented by A-B, become extinguished if one has to learn similar responses (A-C) on the interpolated task. However, associations learned during original learning would be left intact when a dissimilar passage is read since completely different associations (C-D) would be made between a new set of names and attributes.

Since inference questions could not be answered on the basis of a direct association made during the reading of the original passage, it is understandable that they did not appear to be affected in the same way by the interpolated passages. It may be more appropriate to

consider data from inference questions in terms of subjective organization theory. However, if answering inferential questions correctly depended upon the type of subjective organization subjects developed during original learning and the extent to which this organization was left intact during interpolated learning, one would have to conclude that the variations in passage construction for the similar and dissimilar passages used here were not sufficient to cause a significant loss of retention in either condition.

In retrospect, it would have been desirable to administer the Venn diagram test immediately after the original learning passage since this would have provided a good indication of the extent to which subjective organization had taken place up to that point. A perfect score would have indicated that the hierarchical structure between sets and subsets had indeed been attained. The only time the Venn test was given in this experiment was right after the immediate test for fact and inference. Average retention as measured by this test was approximately 54% correct. If the test had been given as part of the original learning phase, a more direct measure could have been obtained of the extent to which subjective organization is affected by similar and dissimilar interpolated passages.

The fact that a retention decrement was not found on inference items even though original and interpolated passages were highly similar in structure may be explained in part by data collected during the time of pilot testing. An experiment was carried out at that time to check on transfer between the three passages and the original learning test. The results indicated an interaction between testing condition and item type. Subjects who read the similar interpolated passage and took the original learning test had significantly higher scores on inference items than on fact items. One explanation for this finding is that subjects may have developed an organizational structure for remembering the information in the original learning passage, and since the highly similar passage was based on a Venn diagram that was changed only slightly, they could still make use of a basic structure that could possibly aid them in answering inferential questions. If reading one passage improves performance on inferential items based on another passage with a similar structure, then it seems reasonable that when a highly similar passage is used as an interpolated task performance on inference items may not be depressed but facilitated.

A similar explanation may be applicable to the significant result obtained on the Venn diagram measure for the similar-dissimilar contrast under the no-test condition. As reported in Chapter IV the Venn step-down

test was significant at the .02 level but the mean retention score was higher for the high similarity condition. If an interpolated passage that is similar in structure to the original passage facilitates the retention of information dealing with inferences, it seems reasonable that this same type of facilitation would operate to keep the organizational structure for original learning intact. It is likely that this would result in a higher Venn score since the Venn diagram, when correctly labeled, would represent the hierarchical organization of the original passage. Subjects in the dissimilar condition would be faced with developing a second organizational structure for learning the interpolated passage, during which time the structure for the original passage may be extinguished.

It will be noted that significant differences were not found for measures of delayed fact and delayed inference for the similar-dissimilar contrast under the no-test condition. It is suggested that the significant difference found for immediate fact but not for delayed fact may indicate that associations made during original learning by subjects in the highly similar condition were extinguished at the time of the immediate retention test but later recovered during the long retention interval. Spontaneous recovery may have operated here in the same way it has been shown to occur in verbal learning studies using lists of words (Underwood, 1948). This analogy



seems appropriate in terms of the comparison made earlier between learning information which could be tested by fact items and learning paired-associate lists.

This study has attempted to shed some light upon the issue concerning whether or not similarity is a factor contributing to retroactive interference when prose materials are used. The significantly lower scores for fact retention under the high similarity, no-test condition is consistent with what would be predicted using the traditional retroactive interference paradigm. This would tend to support the position that connected discourse investigations can be conceived of in terms of paired-associate learning tasks. However, the evidence reported here would support this position only in terms of learning that would be considered associative, such as name-attribute pairs.

If learning that requires making an inference can be considered a form of meaningful learning some of the evidence reported here supports the position that retroactive interference may not follow the same rules when meaningful materials are used in creating a similar interpolated task. The lack of significance on the test of inferential information under the no-test condition, along with a significantly higher Venn score for the highly similar condition, both provide support for this position. Although these findings may in some way be related to the

argument made by Ausubel (Ausubel, et al., 1968) that when materials are meaningful high similarity results in facilitation, any conclusions in this regard will be deferred until further research has been completed.

Further studies employing the same type of materials are necessary in order to substantiate the speculations made here. Although the materials used in these experiments were unsuccessful in demonstrating retroactive interference on inference test items, this may have resulted from the particular arrangement of passages or the basic structure of the passages. This suggests a number of new directions for research of this type.

Since the test of original learning appeared to play an important role in the outcome of the experiments reported here, a replication of the basic experiment is being planned which would include modification of the question stems as well as the responses. Questions would be converted to short-answer form, thereby providing a means of checking on response availability in each phase; or if left in the multiple-choice format the questions stems could be restructured systematically through the use of transformational grammar, and responses appropriate to one passage could be used as foils for questions based on the other passage. These changes would preclude the possibility that questions could be answered correctly on the retention test because the actual test items were remembered and recognized.

Perhaps one of the most promising possibilities is to devise a means of checking on how the subject organizes the information in the original passage. This could be done by using a Venn diagram test or an instrument based on digraph theory. Measures of this type could be taken after original learning and again as a retention test and compared with pretest and posttest measures such as those used in the experiments reported here.

Another means of checking on subjective organization would be to have subjects take a free recall test immediately after reading a passage. The test would consist of a list composed of all the names and identifying attributes used in the passage. If the subject developed an organization for remembering the content, it seems reasonable to expect that with increasing recall trials there would be more and more evidence of clustering for those items that were related to each other logically through their set relations structure. For example, if this were done with the passages used in this study an inspection of recall protocols may show a clustering effect for the two main sets; names and attributes associated with each set are likely to be recalled together. It would also be of interest to determine if the terms would be recalled in a manner related to the temporal order in which they were mentioned in the passage. Since the number of times a subject reads the passage may be

related to how quickly he develops a means of organizing its content, reading trials would be an important variable to manipulate. There is the possibility, however, that subjects may develop an organization quite different from that used in constructing the materials. Brown and Read (1970) found less negative transfer and forgetting for subjects who were allowed to develop their own associative organization in paired-associate learning in comparison to subjects who learned lists where stimulus and response terms were designated beforehand by the experimenter.

The method of free association might also be used to determine the extent to which associations have been made between attributes and names of sets and subsets. If a subject were presented with a name or attribute from one of the passages used in this study as a stimulus word in a free association test, after he had read the passage, it seems likely that other terms which were part of the same logical structure as the stimulus word would be given as associates. The strength of these associations may be related to the extent to which the subject has been involved in learning the passage content and the period of time between reading the passage and taking the test. Johnson (1964) used 18 physics concepts as stimulus terms in a free association test with subjects having varying degrees of involvement in the area of physics. Those who were most involved in the study of physics tended to give

other words in the list as associates. Using free recall and free association tests in the ways described here may be an important means of determining how associative structures change during each phase of a retroactive interference experiment.

It may be that retroactive interference, as measured by inferential test items, can be produced by using passages based on diagrams that are not similar at all. If conflict or interference with original learning depends upon the extent to which a new organization has to be developed for the interpolated passage, then forgetting of original learning may vary with the degree to which the passages are different from each other; the complexity of individual passages may also be a factor. It could well be that the Venn diagrams used in this study were not representative of the particular combinations that would result in the creation of retroactive interference.

Any implications this study may have for the preparation of written instructional materials must be made with caution since many questions remain unanswered. The finding that the original learning test had a significant influence upon later retention is consistent with the results of other investigations (Anderson & Myrow, 1970; Rothkopf, 1966), but any conclusions regarding the insertion of test questions at certain places in a sequence of instructional prose seem premature at this time.

Recommendations such as this will have to wait until it can be determined what a subject does as a result of interacting with a question. The research reported here and elsewhere (Watts & Anderson, 1970) has created some uncertainty about the directional influence of certain types of questions. It is possible that questions may facilitate retention by exerting a backward influence on passages just read as well as influencing retention of subsequent passages as has been predicted by the mathe-magenic hypothesis. Also, until it can be established that retroactive interference does vary systematically with the construction and arrangement of prose passages, it cannot be said with any degree of certainty what effect an immediate test would have on working against this type of interference.

The results of this study suggest that retroactive interference may operate differently for retention of information stated explicitly in the passage than it does for information resulting from making a deduction. Until more research is done using different types of measures to detect the presence of retroactive interference, statements regarding the advisability of placing similar prose segments together in an instructional sequence must be deferred. Testing retention of inferential information within the retroactive interference paradigm was only a first step in the process of attempting to determine how

different kinds of information are affected by interference.

The research reported here demonstrates the feasibility of analyzing simultaneously different measures of retroactive interference taken on the same subject. If different kinds of information are not affected in the same way by an interfering passage, it seems that the most appropriate way to test this notion is to have each subject serve as his own control. Due to the complexity of prose learning, it may be necessary in future experiments to analyze simultaneously many other dependent measures. Since this is now possible through the use of multivariate analysis, this statistical technique should play a prominent role in future research involving connected discourse.

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## APPENDICES

## APPENDIX A

### TABLES



Table A-1.--Mean Correct Responses and Standard Deviations for Two Covariates and Five Dependent Variables--Experiment I.

	High Similarity				Low Similarity				No Similarity			
	High DOL		Low DOL		High DOL		Low DOL		High DOL		Low DOL	
	Gen.	Spec.	Gen.	Spec.	Gen.	Spec.	Gen.	Spec.	Gen.	Spec.	Gen.	Spec.
O.L. Fact.	12.36	11.64	11.82	12.18	12.27	11.73	11.64	12.54	11.20	12.40	10.60	11.20
S.D.	3.20	2.06	1.60	2.60	1.42	1.68	2.50	1.57	3.63	1.52	1.82	2.17
O.L. Inf.	12.00	11.09	9.54	11.45	11.82	11.54	11.09	10.54	10.40	12.00	8.20	6.40
S.D.	2.19	2.91	3.67	3.33	2.04	1.75	2.47	2.62	3.36	1.41	3.19	3.58
Imm. Fact	12.18	11.54	11.64	11.73	12.64	12.54	11.36	13.18	11.60	12.40	10.00	10.00
S.D.	2.82	2.58	1.96	2.41	1.43	1.81	3.26	1.33	1.95	1.52	2.24	1.87
Imm. Inf.	11.91	11.18	10.73	11.36	12.45	12.09	12.36	10.45	11.60	12.60	9.20	8.80
S.D.	3.05	3.57	3.77	3.29	1.44	2.02	3.11	3.39	2.61	2.30	3.19	3.19
Venn	8.18	8.73	7.09	8.64	8.73	10.09	7.09	9.27	9.40	9.80	7.20	5.00
S.D.	5.58	4.45	4.85	4.25	4.08	2.77	5.32	3.50	2.88	3.42	3.90	4.53
Del. Fact	6.91	7.45	7.91	7.27	8.45	7.64	8.18	9.09	7.20	7.20	6.80	6.20
S.D.	2.51	2.80	2.43	2.10	1.81	1.75	2.82	2.21	1.30	1.30	1.30	1.48
Del. Inf.	7.64	8.09	7.18	7.82	8.27	7.82	6.91	6.91	6.60	6.60	5.20	6.60
S.D.	3.64	2.77	3.16	2.56	3.50	1.94	3.27	2.38	2.70	1.14	3.27	1.67

Table A-2.--Least Square Estimates Adjusted for Covariates-Effect x Variables.

	Imm. Fact	Imm. Inf.	Venn	Del. Fact	Del. Inf.
Grand Mean	2.83	0.83	-4.59	2.10	0.07
Instructions	0.21	-0.47	0.86	-0.12	0.18
Deg. of Learn.	-0.28	0.08	-0.56	0.40	-0.44
Similarity 1	-0.12	0.77	0.99	-0.18	-0.85
Similarity 2	0.60	0.36	0.49	0.92	-0.26

Table A-3.--Univariate and Step-Down Tests for Main Effect of Instructions.

Variable	Univariate F	p Less Than	Step-Down F	p Less Than
Imm. Fact	0.50	0.48	0.50	0.48
Imm. Inf.	1.81	0.18	2.57	0.11
Venn	1.58	0.21	1.78	0.18
Del. Fact	0.11	0.74	0.31	0.58
Del. Inf.	0.13	0.72	0.02	0.88

Table A-4.--Univariate and Step-Down Tests for Main Effect of Degree of Learning.

Variable	Univariate F	p Less Than	Step-Down F	p Less Than
Imm. Fact	0.85	0.36	0.85	0.36
Imm. Inf.	0.04	0.84	0.24	0.63
Venn	0.60	0.44	0.45	0.50
Del. Fact	1.01	0.32	1.55	0.22
Del. Inf.	0.70	0.40	1.31	0.26

Table A-5.--Univariate and Step-Down Tests for Main Effect of Similarity.

Variable	Univariate F	p Less Than	Step-Down F	p Less Than
Imm. Fact	2.25	0.11	2.25	0.11
Imm. Inf.	1.24	0.29	1.41	0.25
Venn	0.54	0.58	0.35	0.70
Del. Fact	3.15	0.05	2.30	0.11
Del. Inf.	0.71	0.50	1.75	0.18

Table A-6.--Univariate and Step-Down Tests for Interaction of Degree of Learning x Similarity.

Variable	Univariate F	p Less Than	Step-Down F	p Less Than
Imm. Fact	0.52	0.59	0.52	0.59
Imm. Inf.	0.23	0.79	0.25	0.78
Venn	0.17	0.84	0.08	0.92
Del. Fact	0.23	0.80	0.16	0.85
Del. Inf.	0.56	0.57	1.12	0.33

Table A-7.--Univariate and Step-Down Tests for Interaction of Instructions x Degree of Learning

Variable	Univariate F	p Less Than	Step-Down F	p Less Than
Imm. Fact	0.23	0.63	0.23	0.63
Imm. Inf.	1.36	0.24	1.83	0.18
Venn	0.15	0.70	0.10	0.76
Del. Fact	0.15	0.70	0.14	0.71
Del. Inf.	0.001	0.97	0.05	0.82

Table A-8.--Univariate and Step-Down Tests for Interaction of Instructions x Similarity.

Variable	Univariate F	p Less Than	Step-Down F	p Less Than
Imm. Fact	1.43	0.24	1.43	0.24
Imm. Inf.	0.60	0.55	1.19	0.31
Venn	1.46	0.24	1.44	0.24
Del. Fact	0.23	0.80	0.13	0.88
Del. Inf.	0.26	0.77	0.92	0.40

Table A-9.--Univariate and Step-Down Tests for Interaction of Instructions x Degree of Learning x Similarity.

Variable	Univariate F	p Less Than	Step-Down F	p Less Than
Imm. Fact	0.57	0.57	0.57	0.57
Imm. Inf.	1.18	0.31	1.52	0.22
Venn	0.06	0.94	0.05	0.96
Del. Fact	1.44	0.24	1.13	0.33
Del. Inf.	0.58	0.56	0.94	0.40

Table A-10.--Univariate and Step-Down Tests for Similar-Dissimilar Contrast Within Test Condition.

Variable	Univariate F	p Less Than	Step-Down F	p Less Than
Imm. Fact	0.41	0.52	0.41	0.52
Imm. Inf.	1.72	0.20	3.36	0.08
Venn	1.36	0.25	3.59	0.07
Del. Fact	1.52	0.22	1.95	0.17
Del. Inf.	0.02	0.89	0.002	0.96

APPENDIX B

ORIGINAL LEARNING PHASE (OL), INTERPOLATED  
LEARNING PHASE (IL)--SIMILAR, INTERPOLATED  
LEARNING PHASE (IL)--DISSIMILAR, INTER-  
POLATED PHASE--CONTROL, AND  
RETENTION PHASE

ORIGINAL LEARNING PHASE (OL)

Instructions (p. 115)

General (OL)

Specific (OL)

Passage (OL)--Anthropology (p. 117)

Questions (OL) (p. 120)



The following passage is an account of life in primitive tribes, typical of what may be found in a textbook on anthropology. Read the passage carefully. Try to remember as much of what you read as possible since a test will be given later.

You will have approximately nine minutes to read the passage. If you wish to read over any parts of it do not go back any farther than the preceding paragraph. Do not take any notes on the information you read.

The following passage is an account of life in primitive tribes, typical of what may be found in a textbook on anthropology. Read the passage carefully since you will be tested later. Try to remember as much as you can, paying particular attention to statements of facts and relationships. In addition, try to think of any inferences that may be drawn from the information presented in the passage. If possible, attempt to organize the material in a way that will help you remember it later.

You will have approximately nine minutes to read the passage. If you wish to read over any parts of it do not go back any farther than the preceding paragraph. Do not take any notes on the information you read.

The following passage gives an account of two native tribes living in an area unknown to the civilized world before 1700 A.D. It may be typical of many other descriptions of primitive tribal life, in that it was constructed with a considerable amount of speculation.

Two tribes, the Umawas and the Akulus, inhabited two large islands in the South Pacific between 1200 and 1700 A.D. The entire Umawa tribe lived on the island of Kunjee, claiming this land as their only territorial possession. Ascribing to a different way of life altogether, the members of the Akulu tribe lived on the island of Okando, one hundred miles to the southeast. For centuries the two tribes knew nothing of each other's existence, and had it not been for a certain bizarre and unexpected event, to be explained later, this may have continued for many more years.

The tribes had almost nothing in common in the way that they lived. Being an inventive people, the Umawas had developed a culture over the years that was based largely upon technology. Depending upon agriculture to sustain themselves, all members of the Umawa tribe became farmers and generally lived in the same geographical area most of their lives. Although they believed each family should be self-sufficient, there was an emphasis upon working together as a group, often in order to develop new systems for irrigation and planting. All Umawas were pacifists and held a strong taboo against the killing of other human beings and even animals. As a result of this they were also vegetarians.

Although all Umawas were believers in technology, roughly half of them believed there was a connection between their technological success and their belief in various spirit gods that ruled the universe, such as the gods of thunder and lightning and the god of rain. This resulted in a population which was divided into two distinct groups, those who believed only in technology and those who could be called religious technologists. These religious technologists came to be known as Kumas.

Among the Kumas there was a group called the Bantoks. All Bantoks were men and women who belonged to the Kuma tribe but in addition to being farmers they also had the function of maintaining the beliefs of the Kuma religion. All Bantok children automatically assumed this position of religious leadership upon reaching adulthood and were permitted to marry only the sons or daughters of other Bantoks.

In contrast to the Umawa tribe the Akulus were nomads. They established no permanent homes and changed location frequently within the boundaries of the island of Okando. They sustained themselves by stealing from each other and their neighbors on nearby islands. The Akulu tribesmen were not vegetarians and held no religious beliefs, but were warriors who believed that killing was necessary for survival. It was the tradition of the Akulu tribesmen to hunt their prey by themselves and were never seen in groups. They believed in "every man for himself."

A great number of Akulu tribesmen inhabited only the coastal areas of Okando, making temporary homes in the many caves found along the shoreline. Even though they were all members of the Akulu tribe, they became known as Takus. Since they were all nomadic cave dwellers and sustained themselves primarily by attacking and plundering sailing

vessels that came too close to Okando, they came to have an identity of their own. After many years of existing in this manner they became dependent upon their caves for shelter against storms and used them for storing their stolen goods.

Historical accounts reveal that some of these Takus were also cannibals. The Takus who did not practice cannibalism had such a strong taboo against it they set the cannibals apart by giving them the separate name of Malnoosians. Even though all Malnoosians were also Takus the attitudes toward cannibalism on both sides made it mandatory that children of each group always marry within their group. Sailors who were shipwrecked on the coral reefs just off the shoreline of Okando often became victims of the cannibalistic Takus.

Even though each had lived on their respective islands for hundreds of years unaware that the other tribe existed, a bizarre event suddenly brought the members of the Umawa and Akulu tribes together. In the year 1600 a group of Umawa tribesmen had invented a new type of sailing craft and were commissioned to test its sea-worthiness by sailing it a considerable distance. Having traveled farther from the island of Kunjee than any Umawas before them, they unexpectedly discovered an uninhabited island which they called Ranguru. The news of this discovery led to much disagreement as to how best to make use of this new island, which the Umawas claimed for themselves. Through much political maneuvering the Bantoks finally won out and the island of Ranguru came to be used exclusively for religious festivals and ceremonies honoring their spirit gods, including the god Zenus who they credited with their success in agriculture and related technology.

The first major religious ceremony to be held on Ranguru was to honor Solus, their sun-god, and was attended by all Kumas. Although this religious ceremony was traditional, the Bantoks introduced the practice of eating the bark from the Mangus tree, a new plant discovered on the island which appeared similar to a substance back on their homeland which was known to produce hallucinations and exotic sensations if eaten raw. They felt sure that the Mangus bark would produce the same effect and enhance their participation in the ceremony.

At the same time all of the Kumas were on the island of Ranguru for the celebration a group of Malnoosians had sailed farther than usual in search of ships to plunder in order to satisfy their cannibalistic desires. Having accomplished this goal by raiding an unsuspecting ship in the waters near the island of Ranguru, the cannibals found themselves caught in a storm and hastily sailed for the island which they thought would be a safe place to hide their stolen treasures.

Darkness had fallen on the island of Ranguru by the time the Malnoosians had landed on its shores. Searching in the night for caves in which to store their treasures they came upon the unsuspecting Kumas who were by this time feeling the full toxic effect of eating the Mangus bark and were in no condition to protect themselves from the forthcoming Malnoosian attack. The cannibals attacked their prey swiftly and many Kumas became their victims since they had no chance to escape. However, some Kumas were able to hide in the jungle and managed to reach their boats and sail away from the island under the cover of darkness.

Unknown to both Kumas and Malnoosians was the disease produced in the body of a person who eats the Mangus bark. The disease is known as Tokavi and leaves its mark in the form of red pockmarks on the

surface of the skin. The Tokavi disease was known to result in a permanent genetic change, which meant that all the offspring of the escaping Kumas would also inherit the physical change in appearance caused by the disease.

Since the entire tribe of Malnoosians took part in this particular attack on the unsuspecting Kumas, they too were to suffer the effects of the disease due to their cannibalistic practice of devouring their victims. From that time on all Malnoosians and their offspring bore the mark of that infamous attack by having their skin marked with the unsightly red pockmarks.

The Bantoks who managed to survive the attack and return to Kunjee explained the affliction of the permanent red pockmarks as resulting from the displeasure of Medula, their god of health and safety. The Bantoks decreed that no Kuma was ever to return to the island of Ranguru again and that Kuma children were restricted to marriages only among other Kumas in order that following generations would be spared this affliction.

The Malnoosians explained their changed appearance by attributing it to this one unfortunate occurrence and thereafter became fearful of visiting the island again. Their changed appearance made the Malnoosians easy to recognize and reinforced the belief held by other Takus that the Malnoosians were made to suffer from the curse of cannibalism they put on the tribe.

1. Which group became the victims of a cannibalistic attack on the newly claimed land?
  - a. Kumas
  - b. sailors
  - c. Akulus
  - d. Takus
2. Religious leaders are to cave dwellers as:
  - a. Kumas are to Takus
  - b. Bantoks are to Takus
  - c. Kumas are to Akulus
  - d. Umawas are to Akulus
3. Before the cannibalistic attack, the groups allowing their children to marry only within their own group were the:
  - a. Malnoosians, Takus, and Kumas
  - b. Umawas, Akulus, and Bantoks
  - c. Malnoosians, Bantoks, and Takus
  - d. Bantoks, Malnoosians, and Kumas
4. A nomad could never be a \_\_\_\_\_.
  - a. Kuma
  - b. Malnoosian
  - c. plunderer
  - d. cannibal
5. The group of people who were nomadic cave dwellers were the:
  - a. Takus
  - b. Akulus
  - c. Umawas
  - d. Kumas
6. Pacifists are to nomads as:
  - a. Umawas are to Bantoks
  - b. Umawas are to Akulus
  - c. Akulus are to Malnoosians
  - d. Akulus are to Umawas
7. Which of the following tribes considered killing to be necessary for survival?
  - a. Bantoks
  - b. Akulus
  - c. Kumas
  - d. Umawas
8. Which statement is most nearly correct.
  - a. Some Akulus and some Umawas were afflicted with the disease.
  - b. All Akulus were afflicted with the disease.
  - c. Some but not all Bantoks were afflicted with the disease.
  - d. All pacifists and all nomads were afflicted with the disease.

9. The disease mentioned in the story was:
- a. Ravani
  - b. Tokavi
  - c. Mangus
  - d. Takuli
10. Any tribesman who was a cannibal was also:
- a. a Bantok
  - b. a Kuma
  - c. an inhabitant of Kunjee
  - d. an Akulu
11. Which of the following groups were the religious technologists?
- a. Akulus
  - b. Bantoks
  - c. Kumas
  - d. Medulas
12. Some but not all vegetarians were \_\_\_\_\_.
- a. Umawas
  - b. Akulus
  - c. Takus
  - d. Bantoks
13. The disease mentioned in the story resulted from the consumption of \_\_\_\_\_.
- a. Tokavi bark
  - b. Mangus bark
  - c. Rangus plants
  - d. Mangus leaves
14. Some but not all nomads were:
- a. Kumas
  - b. Akulus
  - c. cannibalistic cave dwellers
  - d. believers in technology
15. The homelands of each of the two tribes were approximately \_\_\_\_\_ miles apart.
- a. 100
  - b. 1000
  - c. 50
  - d. 500
16. Religious leaders are to cannibals as:
- a. Malnoosians are to Bantoks
  - b. Bantoks are to Takus
  - c. Bantoks are to Malnoosians
  - d. Umawas are to Akulus

17. The two main tribes in the story had contact with each other for the first time on a land area known as:
- Okando
  - Kunjee
  - Ranguru
  - Karunu
18. If a man had a strong belief in the value of applying technology to farming he would never be:
- an inhabitant of Okando
  - a Bantok
  - a Kuma
  - a pacifist
19. According to the story, the civilized world did not know these tribes existed until the year \_\_\_\_.
- 1750 A.D.
  - 1700 A.D.
  - 1650 A.D.
  - 700 A.D.
20. Which of the following groups would include the fewest people?
- all Umawas and all Akulus
  - all those afflicted with the disease
  - all Kumas and all Malnoosians
  - all Bantoks
21. The tribe that was first to claim the new land decided that it should be used primarily for:
- cannibalistic rites
  - religious festivals
  - marriage festivals
  - puberty rituals
22. Which of the following groups had their entire population afflicted with the disease?
- Umawas
  - Akulus
  - Takus
  - Bantoks
23. Which of the groups mentioned in the story were notorious for being cannibals?
- Umawas
  - Akulus
  - Takus
  - Malnoosians
24. The religious leaders considered \_\_\_\_\_ to be their homeland.
- Kunjee
  - Okando
  - Takura



25. The tribes mentioned in this story lived in the:
- a. Caribbean
  - b. South Pacific
  - c. seas around South Africa
  - d. Aleutian islands
26. Nomads are to cannibals as:
- a. Malnoosians are to Bantoks
  - b. Akulus are to Malnoosians
  - c. Akulus are to Bantoks
  - d. Umawas are to Malnoosians
27. Which of the gods did the religious technologists associate with success in agriculture?
- a. Solus
  - b. Zenus
  - c. Medula
  - d. Atola
28. The cannibals mentioned in the story considered \_\_\_\_\_ to be their homeland.
- a. Kuma
  - b. Okando
  - c. Kunjee
  - d. Medula
29. Which tribe developed a culture based largely upon agricultural technology?
- a. Akulus
  - b. Malnoosians
  - c. Umawas
  - d. Takus
30. Which of the following groups is the largest?
- a. religious technologists
  - b. Malnoosians
  - c. cannibalistic nomadic cave dwellers
  - d. all those afflicted with the disease

INTERPOLATED LEARNING PHASE (IL)--SIMILAR

Instructions (p. 124)

General (IL)--Anthropology  
Specific (IL)--Anthropology

Passage (IL)--Anthropology (p. 126)

Questions (IL) (p. 129)

The following passage is an account of life in primitive tribes, typical of what may be found in a textbook on anthropology. Read the passage carefully. Try to remember as much of what you read as possible since a test will be given after you have finished.

Read the passage at your own pace, but if you wish to read over any parts of it do not go back any farther than the preceding paragraph. Do not take any notes on the information you read. When you finish reading the passage through once, answer the questions that follow by marking the appropriate spaces on your IBM answer sheet. Do not look back on the passage once you have begun to answer the questions.

The following passage is an account of life in primitive tribes, typical of what may be found in a textbook on anthropology. Read the passage carefully since you will be tested later. Try to remember as much as you can, paying particular attention to statements of facts and relationships. In addition, try to think of any inferences that may be drawn from the information presented in the passage. If possible, attempt to organize the material in a way that will help you remember it later.

Read the passage at your own pace, but if you wish to read over any parts of it do not go back any farther than the preceding paragraph. Do not take any notes on the information you read. When you finish reading the passage through once, answer the questions that follow by marking the appropriate spaces on your IBM answer sheet. Do not look back on the passage once you have begun to answer the questions.

Much of what information might be known about the early civilization of tribes living in tropical regions of the Western Hemisphere is unavailable to students of anthropology today because of the inaccessibility of these areas and an unfriendly environment. However, this passage provides an account of what was thought to be the life styles of the Shantoc and Mackuu tribes living in this area between 500 and 1000 A.D. The existence of these two tribes became known to the civilized world only after archeologists studied remains in the area around 1850.

Geographical features of this part of the world prevented the two tribes from having any social contact with each other until the year 900 A.D. Each had only limited interaction with other people. The Shantocs and Mackuus both lived in coastal areas but were separated by 500 miles of tropical rain forest, an area known as the **Gamaza**, which provided a natural barrier between them. And this was a fortunate thing since it prevented violent conflicts during the first 400 years of tribal life for two groups of natives who could never peacefully coexist because of their different beliefs.

The Mackuus lived in a region of the continent known as Funshee. They were an agricultural people and believed that the only food allowable for consumption was that produced on their farms. They believed that because they had the scientific know-how and technology to till the soil, they should not eat the flesh of the animals in the forest or the fish in the nearby ocean. Because of this basic belief a culture developed wherein they all became vegetarians and technologists and even pacifists. They became so successful in their scientific pursuits and technological innovations that everyone had his needs fulfilled and no one suggested changing the system to include killing and war.

Although the Mackuus had a culture based on science and technology, not all members of the tribe relied entirely upon scientific approaches in solving problems and explaining phenomena. Some believed that phenomena that could not be explained scientifically had to be attributed to some supernatural powers. For instance, large differences in crop yields were attributed to the changing moods of Turus, the god which brought them success in agriculture. The segment of Mackuu society which held these beliefs were known as the Nogawas, a name which identified all members of the group as spiritual scientists or religious technologists.

It was not a popular thing for the Nogawas to combine beliefs about spirit gods with what was substantiated by scientific inquiry. This strange combination of beliefs often resulted in their being discriminated against when they were competing with other members of the tribe for positions of responsibility. Cases of discrimination of this kind were most frequent for a small segment of Nogawas known as Azuluus. The Azuluus were the leaders of the religious technologists and were known to be quite outspoken in expressing their views, especially when some phenomenon was discussed which lacked an accepted scientific explanation. Antagonism toward the Azuluus because of their outspokenness became so great, even among Nogawas, that a law was passed forbidding Azuluu children to marry anyone outside their own small segment of Nogawan society.

On the other side of the tropical rain forest in an area known as Romanjo lived another tribe of people, the Shantocs. Anthropological archeologists believed that the Shantocs had no established form of civilized life since few remnants of their existence have been found.

This in itself led to the belief that they were a nomadic people and had very little structure in their society. In fact, since they were all nomads it was suspected that the tribe as a whole acquired some forms of psychotic behavior due to this way of life. Their society condoned killing and stealing and considered these acts necessary for survival in an environment where the law of the jungle prevails.

A number of Shantocs lived along the coast of Romanjo and left evidence of their life style in the form of wall drawings in caves. An analysis of the sketches showed that these people had a separate identity and were called Kalutians, even though they were all members of the Shantoc tribe. They portrayed themselves pictorially as successful plunderers of those who sailed the nearby seas. The Kalutians had no use for a permanent home. Many of the wall drawings were obviously done by more than one artist, indicating that the caves were only a temporary place to live and to hide stolen treasure. It is safe to say that they were all nomadic cave dwellers.

The Kalutians had a restless existence and this may have been partly responsible for a small number of their group showing extreme forms of psychotic behavior. This small group of people practiced cannibalism, and even the Kalutians, who condoned many acts of violence, considered their behavior unacceptable. All of these cannibals were referred to as Soomas, and were generally ignored by other members of the tribe. All Sooma children married within their group as a result of their being isolated from other tribal members.

The first contact between members of the Mackuu and Shantoc tribes occurred as a result of an ambitious scheme initiated by the Azuluus. Although no man had ever set foot in the tropical rain forest that separated Funshee and Romanjo, the people of the Mackuu tribe had for a long time speculated upon what the area was like. The Azuluus told such frightening stories about how the area had been turned into an uninhabitable region by Calorica, their sun god, that no one up to that time was willing to be part of an exploratory expedition. All this changed one day when the Azuluus decided that the region must be primarily swamp land and if it could be reclaimed more land would be available for growing crops. Instead of endangering the lives of other tribesmen the Azuluus decided that they as an entire group would enter the region, carry out the land reclamation project, and then attempt to grow crops.

After a few years of work they succeeded in accomplishing this goal and much to their surprise they discovered that this new land was also capable of producing some hybrid forms of vegetables that were also grown back in the Funshee region. They called these new vegetables coreatas and they soon became part of the diet for all Azuluus.

The Azuluus didn't have this new land to themselves for long since the Kalutians on the other side of the tropical rain forest soon discovered that they could now travel into the Gamaza area. They invaded the forest in large numbers and attacked the helpless Azuluus. The Soomas were the most aggressive of the Kalutians and victimized many Azuluus with their cannibalistic attacks. But most Kalutians were mainly interested in stealing the vast amounts of coreatas stored away by the Azuluus. Eventually all Kalutians had eaten these new hybrid vegetables.

The Azuluus, all being pacifists, decided not to oppose the invading Kalutians militarily and decided to return to their homeland of Funshee. Since the Kalutians could not survive if they did not steal from the Azuluus, they also decided to leave the area and spend their time plundering vessels on the seas.

Strangely enough, a few Azuluus and a few Soomas stayed in the tropical rain forest and decided to live peacefully together despite their widely different beliefs and ways of life. It was a strange alliance indeed

considering that out of this union came a group of people who had all of the characteristics of their respective tribes. To some degree anyway, they were agricultural technologists who practiced cannibalism and retained beliefs about spirit gods who ruled the universe.

As a strange aftermath to this story, there is some evidence to indicate that the entire episode left its mark upon all members of the Azuluu and Kalutian tribes. Apparently, all those people of the different groups who ate the coreatas were so impressed with the good taste and sense of vitality they experienced at the time they consumed this food that they did not pay attention to some subtle physiological changes that affected their digestive process. In time they did become aware of its symptoms but then it was too late to reverse its effect or prevent future generations from also acquiring the same affliction. The effect was serious enough to interfere with digestion and as a disease was known as kereanosis. All groups afflicted with the disease restricted the marriages of their children to others in their group in order that unaffected tribal members could be spared.

1. Which of the following tribes considered killing to be necessary for survival?
  - a. Shantocs
  - b. Azuluus
  - c. Nogawas
  - d. Mackuus
2. A nomad could never be a \_\_\_\_\_.
  - a. cannibal
  - b. Shantoc
  - c. Nogawa
  - d. cave dweller
3. Which tribe developed a culture based largely upon agricultural technology?
  - a. Shantocs
  - b. Soomas
  - c. Kalutians
  - d. Mackuus
4. Nomads are to cannibals as:
  - a. Shantocs are to Azuluus
  - b. Mackuus are to Azuluus
  - c. Shantocs are to Soomas
  - d. Nogawas are to Kalutians
5. Which group became the victims of a cannibalistic attack on the newly claimed land?
  - a. Shantocs
  - b. nomads
  - c. Kalutians
  - d. Azuluus
6. Which statement is most nearly correct?
  - a. All Shantocs were afflicted with the disease.
  - b. Some Nogawas and some Shantocs were afflicted with the disease.
  - c. Some but not all Soomas were afflicted with the disease.
  - d. All pacifists and all nomads were afflicted with the disease.
7. Which of the groups mentioned in the story were notorious for being cannibals?
  - a. Soomas
  - b. Kalutians
  - c. Nogawas
  - d. Mackuus



8. If a man had a strong belief in the value of applying technology to farming he would never be:
- a. a Nogawa
  - b. an inhabitant of Romanjo
  - c. a pacifist
  - d. an Azuluu
9. The disease mentioned in the story resulted from the consumption of\_\_\_\_\_.
- a. kercanosis
  - b. corenas
  - c. coreatis leaves
  - d. coreatas
10. Some but not all vegetarians were\_\_\_\_\_.
- a. inhabitants of Funshee
  - b. pacifists
  - c. Azuluus
  - d. Mackuus
11. Before the cannibalistic attack, the groups allowing their children to marry only within their own group were the:
- a. Azuluus and Soomas
  - b. Shantocs and Azuluus
  - c. Shantocs and Soomas
  - d. Mackuus and Nogawas
12. Some but not all nomads were:
- a. Shantocs
  - b. Soomas
  - c. carnivorous
  - d. inhabitants of Romanjo
13. The homelands of each of the two tribes were approximately\_\_\_\_\_ miles apart.
- a. 50
  - b. 100
  - c. 500
  - d. 1,000
14. Religious leaders are to cave dwellers as:
- a. Kalutians are to Azuluus
  - b. Mackuus are to Shantocs
  - c. Azuluus are to Kalutians
  - d. Azuluus are to Shantocs
15. The disease mentioned in the story was:
- a. coreatas
  - b. kalenatis
  - c. corotitis
  - d. kercanosis

16. Any tribesman who was a cannibal was also:
- a. a Shantoc
  - b. an inhabitant of Funshee
  - c. a Nogawa
  - d. a Sooma
17. Which of the gods did the religious technologists associate with success in agriculture?
- a. Calorica
  - b. Calorea
  - c. Turus
  - d. Tarsus
18. The cannibals mentioned in the story considered \_\_\_\_\_ to be their homeland.
- a. Romanjo
  - b. Coreata
  - c. Funshee
  - d. Soomaland
19. According to the story, the civilized world did not know these tribes existed until the year \_\_\_\_\_.
- a. 1875
  - b. 1850
  - c. 1825
  - d. 1800
20. The religious leaders considered \_\_\_\_\_ to be their homeland.
- a. Romanjo
  - b. Kalutia
  - c. Nogawa
  - d. Funshee
21. The tribes mentioned in this story lived in the:
- a. tropics of the Western Hemisphere
  - b. northern half of Africa
  - c. jungles of the Eastern Hemisphere
  - d. tropics of the Eastern and Western Hemisphere
22. Pacifists are to nomads as:
- a. Soomas are to Shantocs
  - b. Shantocs are to Nogawas
  - c. Mackuus are to Shantocs
  - d. Soomas are to Azuluus
23. The group of people who were nomadic cave dwellers were the:
- a. Shantocs
  - b. Kalutians
  - c. Nogawas
  - d. Mackuus

24. Which of the following groups is the largest?
- a. Soomas
  - b. Shantocs
  - c. Kalutians
  - d. cannibalistic cave dwellers
25. Which of the following groups were the religious technologists?
- a. Nogawas
  - b. Soomas
  - c. Mackuus
  - d. Kalutians
26. Which of the following groups would include the fewest people?
- a. all Azuluus and all Soomas
  - b. all cannibalistic religious leaders
  - c. all Mackuus and all Shantocs
  - d. all those afflicted with the disease
27. The tribe that was first to claim the new land decided that it should be used primarily for:
- a. herding cattle
  - b. hunting wild animals
  - c. religious festivals
  - d. growing crops
28. Religious leaders are to cannibals as:
- a. Mackuus are to Shantocs
  - b. Soomas are to Shantocs
  - c. Azuluus are to Soomas
  - d. Soomas are to Azuluus
29. The two main tribes in the story had contact with each other for the first time on a land area known as:
- a. Gamaza
  - b. Romanjo
  - c. Funshee
  - d. Romazo
30. Which of the following groups had their entire population afflicted with the disease?
- a. Nogawas
  - b. Shantocs
  - c. Mackuus
  - d. Azuluus

INTERPOLATED LEARNING PHASE (IL)--DISSIMILAR

Instructions (p. 133)

General (IL)--Science Fiction  
Specific (IL)--Science Fiction

Passage (IL)--Science Fiction (p. 135)

Questions (p. 138)

The following passage is written as a science fiction account of biological life on another planet. Read the passage carefully. Try to remember as much of what you read as possible since a test will be given after you have finished.

Read the passage at your own pace, but if you wish to read over any parts of it do not go back any farther than the preceding paragraph. Do not take any notes on the information you read. When you finish reading the passage through once, answer the questions that follow by marking the appropriate spaces on your IBM answer sheet. Do not look back on the passage once you have begun to answer the questions.

The following passage is written as a science fiction account of biological life on another planet. Read the passage carefully since you will be tested later. Try to remember as much as you can, paying particular attention to statements of facts and relationships. In addition, try to think of any inferences that may be drawn from the information presented in the passage. If possible, attempt to organize the material in a way that will help you remember it later.

Read the passage at your own pace, but if you wish to read over any parts of it do not go back any farther than the preceding paragraph. Do not take any notes on the information you read. When you finish reading the passage through once, answer the questions that follow by marking the appropriate spaces on your IBM answer sheet. Do not look back on the passage once you have begun to answer the questions.

With our rapid accumulation of knowledge about outer space, it seems reasonable to expect that one hundred years from now students will be learning about the biological forms existing on other planets, if life does exist there, as they do today in studying living organisms on the earth. This passage is an account of the social life of insects on the planet, Turanus, as it might appear to students studying the biology of the universe in the year 2070.

Although no form of plant or animal life was found to exist on Turanus at the time it was explored, space biologists found some interesting fossilized remains of creatures which once existed on the planet. To distinguish them from fossils found on the earth these remains of earlier forms of life in space were referred to as sporrals. The space biologists, or sporralogists as they came to be called, believed there were two major species of insects once living on Turanus. One species, the Dopterus, lived in the northern hemisphere and the other species, the Klenaria, lived in the southern hemisphere. This passage will describe the sub-families which evolved from each of these two principal species. Each sub-family of insects possessed all of the characteristics of the larger group from which it evolved.

A theory was developed which stated that during the time that life existed on the planet there were four distinct temperature zones in each hemisphere. Although the Dopterus species inhabited all four temperature zones of the northern hemisphere and the Klenaria species inhabited all four temperature zones of the southern hemisphere, most of the sub-families of each of these two species had a different appearance and different characteristics in each of the zones. These two species originated at the equator and as they grew in number they migrated in the direction of the polar regions, the Dopterus moving north and the Klenaria south. As they migrated into different temperature zones new sub-species or sub-families evolved. Turanus was like the earth in that it was spherical, but unlike the earth in that its coldest region was in the equatorial zone with temperatures becoming progressively warmer in each of the four zones as one progressed in the direction of the polar regions. It was believed that the dramatic change of temperature from one zone to the next was primarily responsible for the changed characteristics of the sub-species found in each zone.

Information about the life of insects living within each zone was obtained by studying actual specimens of insects preserved in a substance known as petrified formazoa. Formazoa was a secretion of the formazon tree which grew in abundance in all areas of Turanus and was a natural refuge for insect life.

The temperature zone extending from the equator to a parallel of latitude 10,000 miles to the north was referred to as Fritania, and it was here that the Dopterus insects existed in their most primitive form. They were flying insects but unlike their counterparts on earth they had no legs or other means of propelling themselves on the surface of the planet. All members of the species had natural instincts that guided them in their essential functions such as food gathering and reproduction. The common distinguishing feature shared by all members of the species was their simple but strong wing structure.

A sub-family of the *Dopterus* species evolved in the temperature region just to the north of Fritania, a region called Creatia. The members within this family of insects were all communal and had a highly structured social life. They were known as *Protemias*. A directly observable manifestation of their social instincts was their ever-present triangular formation in flight, a distinguishing characteristic which served the purpose of protecting them from natural predators.

Another group of insects evolved from the *Protemias* and inhabited the next two temperature zones to the north, the zone just north of Creatia, called Teria, and the polar region itself which was known as Normenia, a word which means "hot, polar atmosphere". The *Algrocian* insects lived in these two regions and were a sub-family within the *Protemias* group. They were more highly developed in the sense that their bodies could take in food of any kind and for that reason they became scavengers. Their nervous system was also sensitive to radiation belts existing in the northern polar region. This sensitivity enabled them to guide themselves in flight according to how their senses responded to the properties of the radiation.

The other major species of insects on Turanus referred to earlier were the *Klenaria*. They were the major insect species inhabiting the southern hemisphere, but were found in their most primitive form in the Kretania region, a temperature zone between the equator and a parallel of latitude 10,000 miles to the south. All of the members of this species were amphibians, having the capability to move on the planetary surface or on water. They also had basic instincts to direct their life-maintaining functions.

The next temperature region to the south of Kretania was called Trocemia and this was the habitat of the *Crusceans*, a sub-species of the *Klenaria* who had a highly developed social life. Since they lived in a region where the water was warmer, other forms of animal life were also present. The magnura, a huge creature about the size of a sea walrus, inhabited the seas of Trocemia and became extremely important to *Cruscean* insects. All *Crusceans* were parasites of the magnura, living together in large nests hidden in the fur of this unfortunate beast which served as their host.

Since the magnura inhabited all the waters of the southern hemisphere, sub-families of the *Cruscean* species used them as hosts in the other two temperature zones also. The zone just to the south of Trocemia was known as Burcilis and it became the home of a sub-family of the *Crusceans*, a group of insects known as *Dilicians*. They also had a distinguishing characteristic in that they were all specialists, practicing a division of labor in their essential functions. They were specialized according to tasks, with some being gatherers of food and others protectors of the commune.

Another sub-family of insects evolved from the *Dilicians* and were the most highly developed and complex form of insect life on the planet of Turanus. These were the *Royans*. They lived in the southern polar region known as Rocania and created an elaborate form of social structure. These insects were known to possess a form of intelligence, having the potential to solve problems and exhibit other forms of reasoning behavior. This was clearly in evidence when the host creature attempted to remove them from his body. The *Royans* would devise ingenious schemes to avoid being detected by the host; the complexity of carrying out these schemes could only be attributed to a true form of intelligence.



These two main species of insects, the Dopterus and Klenaria, were thought to have existed for a period of three million years. During this time both species remained in their pure form, with very little cross breeding between them. There were some preserved specimens found in the region of the equator, however, which had characteristics of both Dopterus and Klenaria insects. It was quite clear that these insects were amphibious but they also had a wing structure which enabled them to fly. They were a special group of insects known as Druaceans. It was estimated that they lived during the early period of insect life on Turanus and existed for less than 100 years. Their early extinction may have been due to their practice of cross breeding and their lack of a communal form of living.

It was believed that the last remaining members of the Dopterus and Klenaria species had died five million years before men from the earth first set foot on the planet of Turanus. The most popular theory of why insect life ended on Turanus suggests that there was a dramatic change in the chemical content of the atmosphere at one point in the history of the planet. As a result of this, water disappeared from the planetary surface and all plant and animal life died. However, because of this atmospheric change the remains of the once present insect life were well preserved.

1. The two main species of insects described in the story lived for about \_\_\_\_\_ million years.
  - a. ten
  - b. five
  - c. three
  - d. two
2. Insects with a problem solving or reasoning capacity would not have belonged to the \_\_\_\_\_ species.
  - a. Cruscean
  - b. Dilician
  - c. Dopterus
  - d. Klenaria
3. A word which means "hot, polar atmosphere" is"
  - a. Teria
  - b. Fritania
  - c. Kretania
  - d. Normenia
4. How many sub-species of insects in the passage were parasitic?
  - a. 3
  - b. 6
  - c. 5
  - d. 4
5. The scavenger insects were the:
  - a. Klenaria
  - b. Crusceans
  - c. Algrocians
  - d. Algorians
6. Protemias are to Dopterus as \_\_\_\_\_ are to Klenaria.
  - a. Dilicians
  - b. Crusceans
  - c. Royans
  - d. Protemias

7. The remains of earlier forms of life preserved on the plant, Turanus, were referred to as:
  - a. fossils
  - b. forrals
  - c. sporrals
  - d. klenaria
8. Which two groups of insects were sub-species of two larger groups?
  - a. Algrocians and Dilicians
  - b. Protემias and Dilicians
  - c. Protემias and Royans
  - d. Algrocians and Protემias
9. Directly south of Kretania was a region called:
  - a. Trocemia
  - b. Cruscea
  - c. Rocania
  - d. Normenia
10. Fritania is to the northern hemisphere as \_\_\_\_\_ is to the southern hemisphere.
  - a. Creatia
  - b. Kretania
  - c. Trocemia
  - d. Rocania
11. The creature known as a magnura was a host for the parasitic:
  - a. Dopterus
  - b. Protემias
  - c. Crusceans
  - d. Algrocians
12. Which statement is most accurate, according to information given in the story?
  - a. Some Klenaria and some Dopterus were parasites.
  - b. All Klenaria and all Crusceans were parasites.
  - c. No Klenaria and no Dopterus were parasites.
  - d. Some Klenaria but no Dopterus were parasites.
13. The Dilician insects were known to practice a form of:
  - a. population control
  - b. division of labor
  - c. non-verbal communication
  - d. genecide

14. Which of the following statements is most accurate?
- a. All Royans and some Crusceans had a reasoning capability.
  - b. Some Royans and all Dilicians had a reasoning capability.
  - c. All Royans but no Crusceans had a reasoning capability.
  - d. All Dilicians and all Dopterus had a reasoning capability.
15. All members of the major insect species living south of the equator were:
- a. scavengers
  - b. amphibians
  - c. sensitive to radiation
  - d. flying insects
16. How many temperature zones on Turanus were inhabited by flying insects?
- a. 2
  - b. 1
  - c. 4
  - d. 3
17. The main species of insects living in the northern hemisphere of the planet were the:
- a. Fritania
  - b. Protemias
  - c. Klenaria
  - d. Dopterus
18. The \_\_\_\_\_ are a sub-species of insects within the larger Dopterus species.
- a. Klenaria
  - b. Algrocians
  - c. Crusceans
  - d. Royans
19. Which group of insects had the most highly developed and complex form of life on the planet?
- a. Dilicians
  - b. Algrocians
  - c. Crusceans
  - d. Royans
20. The \_\_\_\_\_ are a sub-species within the Klenaria species.
- a. Royans
  - b. Algrocians
  - c. Protemias
  - d. Dopterus

21. Specimens of insects were found preserved in a substance called\_\_\_\_\_.
- a. formazon
  - b. sporrals
  - c. formazoa
  - d. petrified resin
22. Which two insect groups are the farthest apart?
- a. Algrocians and Royans
  - b. Dopterus and Klenaria
  - c. Protემias and Crusceans
  - d. Protემias and Dilicians
23. The temperature zone which extended 10,000 miles northward from the equator was known as\_\_\_\_\_.
- a. Creatia
  - b. Kretania
  - c. Fritania
  - d. Turanus
24. Which two groups are the closest to each other?
- a. Crusceans and Royans
  - b. Protემias and Crusceans
  - c. Crusceans and Dilicians
  - d. Algrocians and Royans
25. A distinguishing characteristic of the Dopterus species was their:
- a. leg structure
  - b. highly developed sense of smell
  - c. sensitivity to radiation
  - d. strong wing structure
26. Insects that were guided in flight by their sensitivity to radiation would not have belonged to the\_\_\_\_\_species.
- a. Algrocian
  - b. Protemia
  - c. Dopterus
  - d. Klenaria
27. The sub-species of insects known as Protემias could be easily identified by their:
- a. triangular flight formation
  - b. highly developed wing structure
  - c. ability to sense danger
  - d. problem-solving ability

28. Which one of the following types of insects would not be found on Turanus?
- a. a parasitic amphibian with reasoning ability living in the northern hemisphere
  - b. a scavenger sensitive to radiation living in the northern hemisphere
  - c. a parasitic communal insect living in the southern hemisphere
  - d. a flying communal insect living in the northern hemisphere
29. A group of winged insects that were also amphibious were the:
- a. Dilicians
  - b. Crusceans
  - c. Protemias
  - d. Druaceans
30. How many of the sub-species mentioned in the passage had a form of communal living?
- a. 6
  - b. 5
  - c. 3
  - d. 4

## INTERPOLATED PHASE--CONTROL

Instructions (p. 143)

Warm-Up Exercise (p. 144)

Problems (p. 145)

On the following pages you will find first some simple addition problems and then some more challenging problems designed to test your reasoning ability. Work out the addition problems first as a "warm-up" and then do the others in the order in which they appear. Do not do any writing in this test booklet. You will find in your envelope some sheets stapled together that are identical to these problem sheets in your test booklet. They are marked with a purple line across the top. Write all your answers directly on these sheets.



Addition problems:
$$\begin{array}{r} 24 \\ 36 \\ \hline \end{array}$$
$$\begin{array}{r} 236 \\ 713 \\ \hline \end{array}$$
$$\begin{array}{r} 418 \\ 617 \\ \hline \end{array}$$
$$\begin{array}{r} 6439 \\ 8120 \\ \hline \end{array}$$
$$\begin{array}{r} 7211 \\ 1839 \\ \hline \end{array}$$
$$\begin{array}{r} 1359 \\ 9689 \\ \hline \end{array}$$
$$\begin{array}{r} 5686 \\ 4329 \\ \hline \end{array}$$
$$\begin{array}{r} 79986 \\ 23572 \\ \hline \end{array}$$

**PROBLEM 1**

<i>T</i>		<i>E</i>		<i>D</i>
	<i>O</i>		<i>E</i>	
<i>E</i>		<i>E</i>		<i>Y</i>
	<i>E</i>		<i>V</i>	
<i>D</i>		<i>Y</i>		<i>R</i>

**INSTRUCTIONS**

When completed the five words reading across must be the same as the five words reading down. FILL IN THE MISSING LETTERS.



## PROBLEM 2

INSTRUCTIONS

There are a number of MURPLES lying side by side in a straight line along the bottom of a box. There were half as many yesterday. There will be twice as many tomorrow; for, owing to the force of circumstances, the number of MURPLES doubles every day.

At this rate the entire box will be full of them in just 60 days. But what is more important, hypothetically, is this:

IN HOW MANY DAYS WILL THE BOX BE  
JUST EXACTLY HALF-FULL OF MURPLES?

INSTRUCTIONS

In the first three tricks of a three-handed game of cards there was **only** one Queen, which was the highest card played. There was only one **E**ight, which was the lowest card played.

**No** two cards of equal value were played in any single trick.

**The** highest card played in the 3rd trick was equal in value to the 2nd **h**ighest card played in the 1st trick and to the lowest card played in the **2nd** trick

THE PROBLEM

**GIVE** THE VALUE OF ALL THREE CARDS IN EACH OF THE THREE TRICKS.

	Highest	2nd high	Lowest
1 st trick			
2nd trick			
3rd trick			



## PROBLEM 4



IN THE FOUR CARDS SHOWN ABOVE:

- A. The Jack is nearer to the Queen than the King is to the Jack.
- B. The Jack is nearer to the Ace than the Queen is to the Jack.
- C. The Spade is nearer to the Club than the Diamond to the Spade.
- D. The Spade is nearer to the Heart than the Club is to the Spade.
- E. The Heart is just to the left of the King.

INSTRUCTIONS

NAME ALL FOUR CARDS

Card No. 1 \_\_\_\_\_

Card No. 3 \_\_\_\_\_

Card No. 2 \_\_\_\_\_

Card No. 4 \_\_\_\_\_

## PROBLEM 5



IN THE THREE CARDS ABOVE:

- A. To the right of a King there is a Queen or two queens.
- B. To the left of a Queen there is a Queen or two queens.
- C. To the left of a Heart there is a Spade or two spades.
- D. To the right of a Spade there is a Spade or two spades.

THEREFORE THE THREE CARDS ARE:

No. 1 \_\_\_\_\_

No. 2 \_\_\_\_\_

No. 3 \_\_\_\_\_



## PROBLEM 6

		8
	5	
2		

The large square above is composed of 3 rows and three columns of smaller squares. Three of the smaller squares running diagonally from lower left to upper right contain the numbers 2, 5 & 8 respectively. These numbers when added together total 15, ( $2 + 5 + 8 = 15$ ).

INSTRUCTIONS

Using only positive numbers between 0 and 9, FILL IN THE REMAINING SIX SMALL SQUARES so that when added, each row and each column and the remaining diagonal each total 15. A given number may be used only once. Since the 2, 5, and 8 are already used they may not be repeated in any of the remaining six small squares.

## RETENTION PHASE

Retention Test (p. 152)  
Venn Diagram

Directions (p. 157)  
Sample (p. 158)  
Test (p. 159)  
Answer Sheet (p. 160)

On the following pages you will find test questions based on the first passage you read when this testing session started. You will recall that you read the passage twice. Answer these questions on the basis of what you remember from reading that first passage. Take as much time as you wish, but do not look back on any of the passages you read.

Please take from your envelope the IBM answer sheet marked with a green line across the top. Mark all your answers to these questions on this answer sheet.

1. Which of the following groups were the religious technologists?
  - a. Akulus
  - b. Bantoks
  - c. Kumas
  - d. Medulas
2. Religious leaders are to cave dwellers as:
  - a. Kumas are to Takus
  - b. Bantoks are to Takus
  - c. Kumas are to Akulus
  - d. Umawas are to Akulus
3. Before the cannibalistic attack, the groups allowing their children to marry only within their own group were the:
  - a. Malnoosians, Takus, and Kumas
  - b. Umawas, Akulus, and Bantoks
  - c. Malnoosians, Bantoks, and Takus
  - d. Bantoks, Malnoosians, and Kumas
4. If a man had a strong belief in the value of applying technology to farming he would never be:
  - a. an inhabitant of Okando
  - b. a Bantok
  - c. a Kuma
  - d. a pacifist
5. According to the story, the civilized world did not know these tribes existed until the year \_\_\_\_\_.
  - a. 1750 A.D.
  - b. 1700 A.D.
  - c. 1650 A.D.
  - d. 700 A.D.
6. Nomads are to cannibals as:
  - a. Malnoosians are to Bantoks
  - b. Akulus are to Malnoosians
  - c. Akulus are to Bantoks
  - d. Umawas are to Malnoosians

7. Which of the gods did the religious technologists associate with success in agriculture?
- a. Solus
  - b. Zenus
  - c. Medula
  - d. Atola
8. Which statement is most nearly correct:
- a. Some Akulus and some Umawas were afflicted with the disease.
  - b. All Akulus were afflicted with the disease.
  - c. Some but not all Bantoks were afflicted with the disease.
  - d. All pacifists and all nomads were afflicted with the disease.
9. The disease mentioned in the story resulted from the consumption of \_\_\_\_\_.
- a. Tokavi bark
  - b. Mangus bark
  - c. Rangus plants
  - d. Mangus leaves
10. The religious leaders considered \_\_\_\_\_ to be their homeland.
- a. Kunjee
  - b. Okando
  - c. Takura
  - d. Zenus
11. The homelands of each of the two tribes were approximately \_\_\_\_\_ miles apart.
- a. 100
  - b. 1000
  - c. 50
  - d. 500
12. Any tribesman who was a cannibal was also:
- a. A Bantok
  - b. a Kuma
  - c. an inhabitant of Kunjee
  - d. an Akulu
13. Which of the groups mentioned in the story were notorious for being cannibals?
- a. Umawas
  - b. Akulus
  - c. Takus
  - d. Malnoosians

14. Which of the following groups had their entire population afflicted with the disease?
- a. Umawas
  - b. Akulus
  - c. Takus
  - d. Bantoks
15. The tribe that was first to claim the new land decided that it should be used primarily for:
- a. cannibalistic rites
  - b. religious festivals
  - c. marriage festivals
  - d. puberty rituals
16. Which of the following groups is the largest?
- a. religious technologists
  - b. Malnoosians
  - c. cannibalistic nomadic cave dwellers
  - d. all those afflicted with the disease
17. Which of the following tribes considered killing to be necessary for survival?
- a. Bantoks
  - b. Akulus
  - c. Kumas
  - d. Umawas
18. Some but not all vegetarians were\_\_\_\_\_.
- a. Umawas
  - b. Akulus
  - c. Takus
  - d. Bantoks
19. The disease mentioned in the story was:
- a. Ravani
  - b. Tokavi
  - c. Mangus
  - d. Takuli
20. Some but not all nomads were:
- a. Kumas
  - b. Akulus
  - c. cannibalistic cave dwellers
  - d. believers in technology

21. The tribes mentioned in this story lived in the:
- a. Caribbean
  - b. South Pacific
  - c. seas around South Africa
  - d. Aleutian Islands
22. Which of the following groups would include the fewest people?
- a. all Umawas and all Akulus
  - b. all those afflicted with the disease
  - c. all Kumas and all Malnoosians
  - d. all Bantoks
23. The two main tribes in the story had contact with each other for the first time on a land area known as:
- a. Okando
  - b. Kunjee
  - c. Ranguru
  - d. Karunu
24. The cannibals mentioned in the story considered \_\_\_\_\_ to be their homeland.
- a. Kuma
  - b. Okando
  - c. Kunjee
  - d. Medula
25. Which group became the victims of a cannibalistic attack on the newly claimed land?
- a. Kumas
  - b. sailors
  - c. Akulus
  - d. Takus
26. A nomad could never be a \_\_\_\_\_.
- a. Kuma
  - b. Malnoosian
  - c. plunderer
  - d. cannibal
27. The group of people who were nomadic cave dwellers were the:
- a. Takus
  - b. Akulus
  - c. Umawas
  - d. Kumas

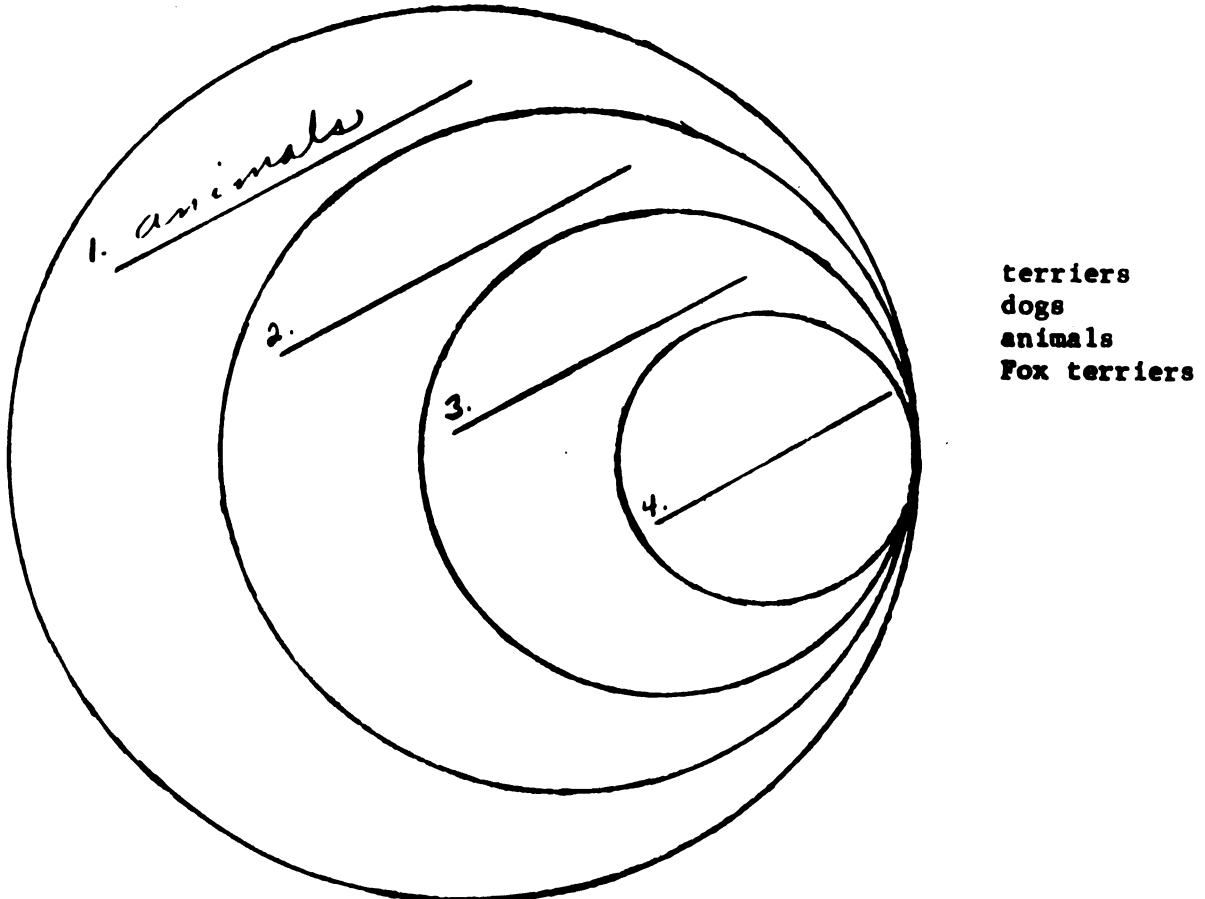
28. Pacifists are to nomads as:
- a. Umawas are to Bantoks
  - b. Umawas are to Akulus
  - c. Akulus are to Malnoosians
  - d. Akulus are to Umawas
29. Which tribe developed a culture based largely upon agricultural technology?
- a. Akulus
  - b. Malnoosians
  - c. Umawas
  - d. Takus
30. Religious leaders are to cannibals as:
- a. Malnoosians are to Bantoks
  - b. Bantoks are to Takus
  - c. Bantoks are to Malnoosians
  - d. Umawas are to Akulus

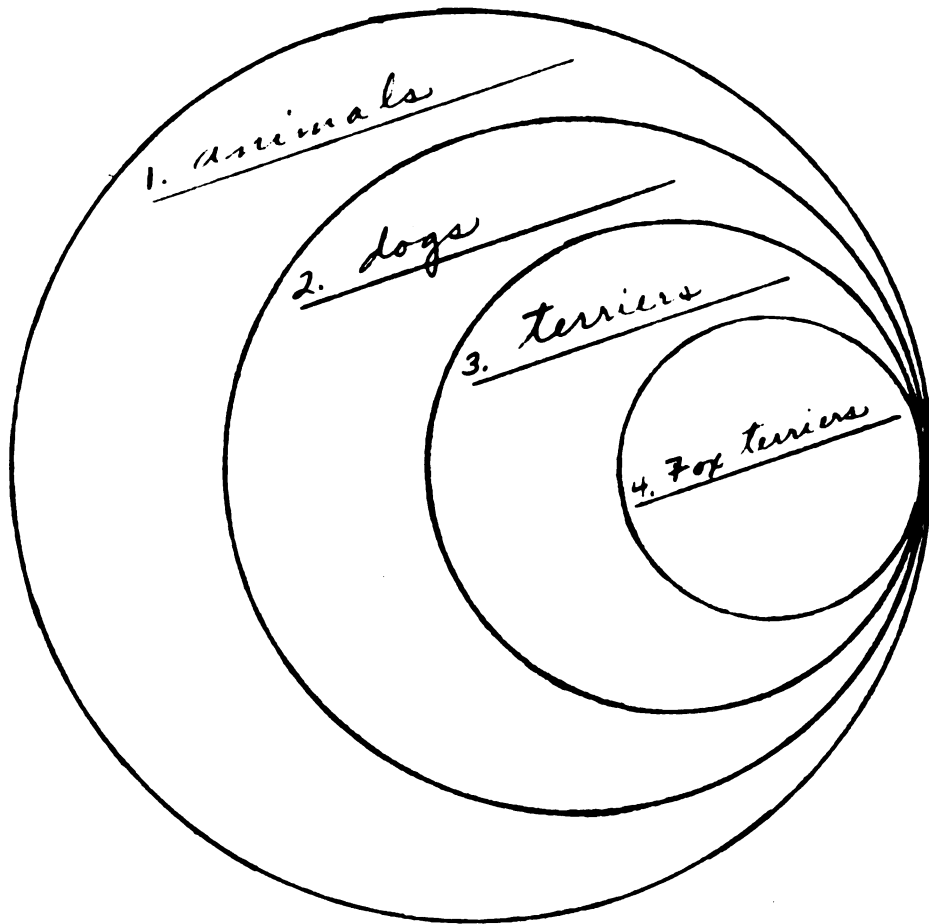


On the last page of this booklet is a diagram that was used in constructing the first passage you read. Each circle represents a group or event referred to in the passage. Below the diagram is a list of words which identify and describe all the groups mentioned.

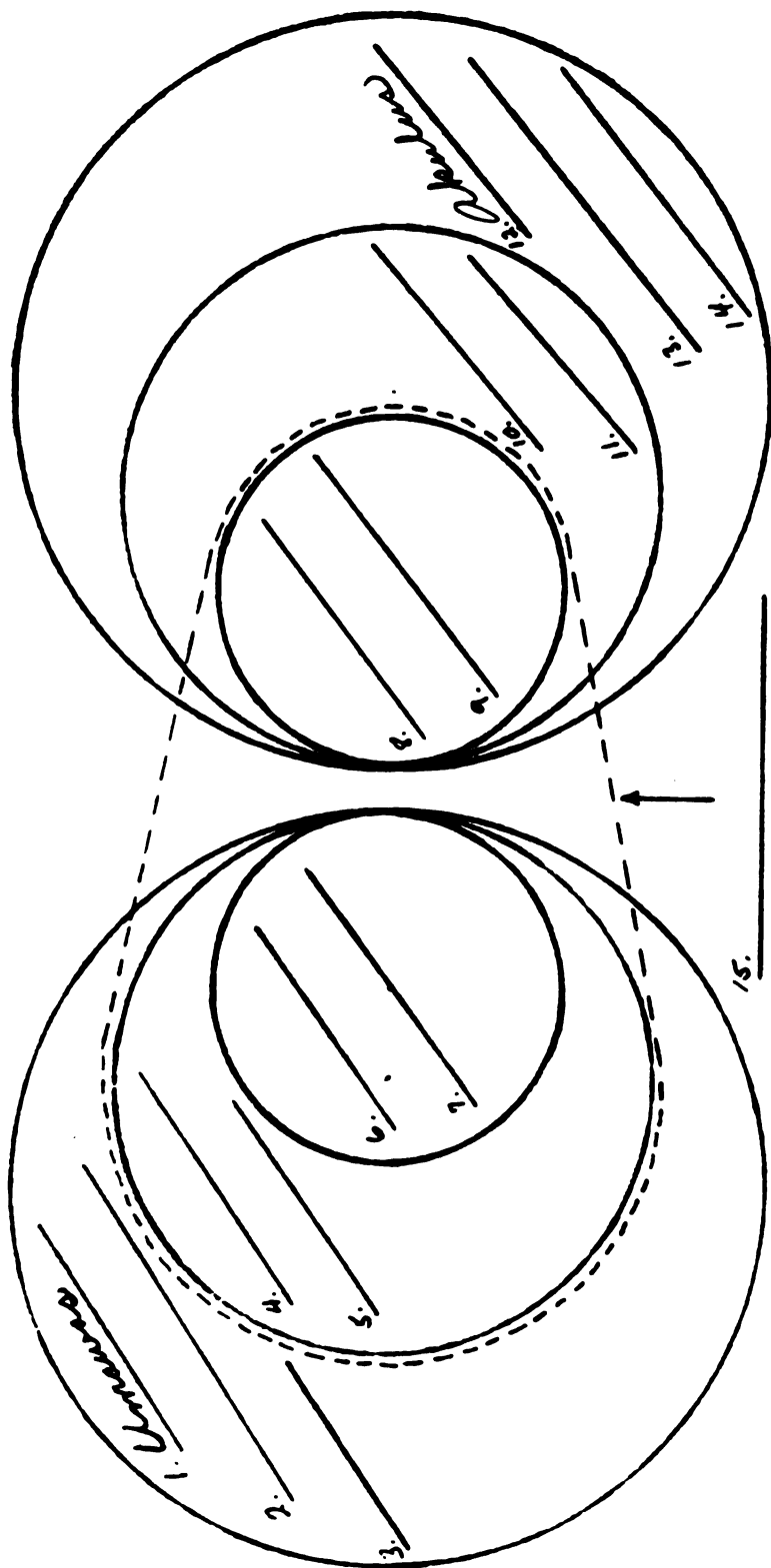
Please take from your envelope the answer sheet marked with a black line across the top. This answer sheet has been constructed to correspond to the numbered spaces that appear on the diagram on the last page of this booklet. You will notice that all the words that identify the circles in the diagram appear in a list along the left side of the answer sheet. According to where you would place each word on the diagram, draw an X through the number that corresponds to that space. Two of the words in the list, Umawas and Akulus, are written on the diagram to help you get started. They have also been correctly marked with an X on the answer sheet.

To be sure you understood these directions a simple example is provided below. The words that appear to the right of this diagram (dogs, etc.) are also printed at the top of the special answer sheet. Work out this example by putting an X through the appropriate numbers on the answer sheet and then check your answers with the completed diagram appearing on the following page. If you have any questions about this procedure ask the examiner for further clarification.





terriers  
dogs  
animals  
Fox terriers



plunderers  
Takus  
diseased  
religious leaders  
Malnoosians  
vegetarians  
Umawas

Kumas  
cannibals  
Akulus  
cave dwellers  
religious  
technologists  
Bantoks  
nomads

Answer sheet for example and diagram on last page of booklet.Example:

dogs	1	2	3	4
terriers	1	2	3	4
animals	1	2	3	4
Fox terriers	1	2	3	4

Diagram on last page of booklet (based on first passage read)

*Akulus	1	2	3	4	5	6	7	8	9	10	11	<del>X</del>	13	14	15
Bantoks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
cannibals	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
cave dwellers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
diseased	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Kumas	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Malnoosians	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
nomads	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
plunderers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
religious	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
religious leaders	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Takus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
technologists	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
*Umawas	<del>X</del>	2	3	4	5	6	7	8	9	10	11	12	13	14	15
vegetarians	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

## **APPENDIX C**

### **LETTERS**

COLLEGE OF EDUCATION • ERICKSON HALL

January 27, 1970

Dear \_\_\_\_\_:

In a recent class meeting of Education 200 you indicated that you would be willing to serve as a paid volunteer in a study conducted through the Department of Educational Psychology. Since the findings of this study may provide much valuable information about how people learn from reading instructional materials, your help is essential to the success of the project and is greatly appreciated.

We have scheduled you for the session which begins at \_\_\_\_\_ p.m. on \_\_\_\_\_. This session will be held in room 126 of the Psychology Research Building. A map is enclosed with this letter for those unfamiliar with this part of the campus.

Please try to arrive a few minutes early since everyone must be present before the session can begin. If you will be unable to attend this session please call us at 353-8900 or 353-0970.

The compensation for your time and effort will be \$2.00. Payment will be made immediately after the session has ended.

Thank you for offering to help us with this project.

Sincerely,

Dennis L. Anderson  
Research Assistant  
Educational Psychology  
401C Erickson Hall

COLLEGE OF EDUCATION • ERICKSON HALL

April 1, 1970

Dear \_\_\_\_\_:

During the month of February you participated as a paid volunteer in an experiment conducted through the Department of Educational Psychology which involved reading some passages and answering questions about them. As the last phase of the experiment, we ask that you take a few minutes and answer the questions on the enclosed test using the IBM answer sheet and the special scoring pencil. This test is based on the first passage you read the evening of the testing session. Please work independently and attempt to answer each question. You will very likely remember more than you think you can.

If possible, please take the test on the day you receive this letter. After you have marked the IBM answer sheet, place it in the self-addressed and postage-paid envelope along with the test booklet and scoring pencil. Please mail it back immediately since we must receive an answer sheet from everyone who participated in order that the final data analysis can be made. When this is done we can send each person a complete summary of the entire project.

Thank you again for your help in this study. Your prompt action on this last request will be greatly appreciated. If you have any questions call me at 353-0970 or 353-8900.

Sincerely,

Dennis L. Anderson  
Research Assistant  
Educational Psychology  
401C Erickson Hall