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THE EFFECT OF AN OUTLINE ON THE LEARNING AND RETENTION OF FACTS AND INFERENCES

City University of New York PH.D. 1980

THE EFFECT OF AN OUTLINE ON THE LEARNING AND RETENTION OF FACTS AND INFERENCES

by

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A dissertation submitted to the Graduate Faculty in Education in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

1980

This manuscript has been read and accepted for the Graduate Faculty in Education in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Abstract

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Adviser: Prof. Barry J. Zimmerman

The primary purpose of this research was to examine the effect of an outline on the learning and retention of information from prose text. Factual and inferential knowledge acquisition was measured. A secondary purpose of the research was to document outline utilization at two points in time with the aid of the dependent measures of underlining and clustering. It was hypothesized that an outline of the hierarchical relational network that connects the concepts in the prose text would interact with text components and result in knowledge acquisition.

One hundred fifty-seven undergraduate students who were enrolled in education courses participated in the study. Students were randomly assigned to one of six groups. The basic design was a 2 X 2 X 2 factorial (Outline X Underlining X Time of Testing) with repeated measures on the last factor. This design included four experimental groups: (1) Outline/Underlining, (2) No Outline/Underlining, (3) Outline/No

Underlining, and (4) No Outline/No Underlining. Students in the experimental groups read a series of 5 passages dealing with information about specific minerals. In addition, there were two control groups: (1) a dangling control to test for independent outline effects, and (2) a naive control to test for prior familiarity.

The most significant finding of the study is that an outline facilitates inferencing at immediate retention and after a 48-hour delay. The implications of this finding for education are discussed.

Another finding of the study is that evidence of forgetting depends on the exact type of testing procedure that is used. Factual recall showed a decline after a 48-hour delay. The 48-hour delay did not affect recognition scores or inference scores, however.

The present study did not replicate earlier findings that an outline improved factual recall. The results of the present study cast doubts about the generalizability of the earlier findings. A possible explanation for these differences should be explored in future research.

The two "process" measures of outline use, underlining and clustering, revealed discrepant results. It was evident from analyses of the students' underlining that the outline was used. However, no outline effects emerged from the clustering results. A possible explanation for these discrepant findings should be explored in future research.

Acknowledgements

I gratefully acknowledge the aid and advice of a number of people. The chairperson of my dissertation committee, Dr. Barry Zimmerman, guided and encouraged me through every stage of the dissertation research and preparation. He read this work with great care and his relentless insistence on clarity instilled in me a spirit of thoroughness in my research.

I want to thank the other members of my committee, Drs. Shirley Feldmann and Alan Gross for their valuable criticisms and suggestions. Thanks are also due to the outside readers, Drs. Dorothy Frayer and Lawrence Frase, for their insightful comments.

I owe a special thanks to the faculty in the Department of Social and Psychological Foundations of Education at The City College of The City University of New York, where this research was conducted. Drs. Alfred Weiss, Deborah Brink, Harwood Fisher, James Shields, Arnold Rothstein, Sigmund Tobias, and Edna Meyers provided professional support and assistance. I am deeply indebted, also, to the students at The City College without whose cooperation this thesis would not have been possible. Their interest and involvement is gratefully acknowledged.

I am most appreciative of the expert and conscientious typing provided by Geraldine Harrison, as well as her interest and concern.

Finally, I wish to express my deepest appreciation and love to my husband, Perry, and our children, Judith and Jonathan, for their unfailing encouragement and support throughout the time when I was preoccupied with this thesis and for their enthusiasm when my long sought goal was achieved.

To Perry, Judith, and Jonathan, I dedicate this opus.

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CHAPTER 1

Introduction

Context of the Problem

Much research in learning and instruction now has a cognitive orientation (Wittrock, 1978). Behavior is increasingly being explained and predicted on the basis of intervening learner variables. One of these variables is prior familiarity with the subject matter. Prior familiarity may be generally defined as prior achievement or prior knowledge. The importance of this variable has been documented in the aptitude treatment interaction (ATI) literature (Tobias, Note 1), some of which shows that prior familiarity interacts meaningfully with instructional treatment.

Prior familiarity has two significant attributes: (1) content itself, and (2) the context in which that content is embedded. The finding of the facilitating effects on learning of prior familiarity with content has been consistently replicated in several studies. Weiss and Fine (1956) have shown that exposure to key words prior to instruction facilitated learning and retention from a film strip about the United Nations. Abramson and Kagen (1975) have shown that familiarity with technical vocabulary and pictorial program content prior to instruction enhanced learning from programmed science materials.

The possibility exists, however, that it is not the content per se that is the critical attribute in prior familiarity studies, but rather it is the abstract structure in which that content is embedded. Several studies in the paired-associate and serial learning literature suggest that this may indeed be the case. They have shown that if learners were asked to somehow organize the content meaningfully, recall was enhanced.

Instructions to generate images have been shown to improve foreign-language vocabulary learning. In several studies, a subject was told to form an interactive image involving a key word and the meaning of the foreign word. For example, in order to learn the Spanish word "Carta" a subject might associate the word with the English key word "cart" and might generate the image of a letter in a shopping cart. With college students, this key word system has increased retention of Spanish vocabulary from 28% to 88% (Raugh and Atkinson, 1975) and Russian vocabulary from 46% to 72% (Atkinson and Raugh, 1975).

In a serial learning study, Bower and Clark (1969) instructed subjects to construct a meaningful story woven around the serial lists of words to be remembered. On a delayed recall test, on the average, the narrative group recalled 93% of the words while the control group recalled only 13%. In reviewing the study, Johnson (1975) concluded that:

> The differences in performance presumably resulted from the learners' differential success in relating the learning material to some central themes or organizational framework. (p. 431)

In summary, it appears that the success of a verbal or imaginal elaboration in enhancing learning and retention is due to the mapping of the learning materials onto an existing relational framework. It should, therefore, be profitable to expose students to a relational network prior to the introduction of the learning materials.

The Problem Statement

Researchers in learning from prose materials have devoted relatively little attention to the effects of prior familiarity with a relational network on acquisition. The paucity of research in this area has not been due to a lack of interest but to a vagueness in theoretical orientation and lack of a suitable paradigm. Recent developments in cognitive theory (Rumelhart and Norman, 1978) and a paradigmatic reorientation (Voss, 1978), however, have now provided the formulations which make this research possible.

The questions that need to be addressed with regard to the presumed efficacy of a relational framework are:

1. Does a relational framework enhance learning and retention?

2. Can one empirically discern the specific effects of a relational framework on text processing?

Purpose of the Study

The primary purpose of this study was to investigate the effect of a relational framework on the acquisition of factual and inferential knowledge from prose text. An outline was used to represent the relational framework. This outline was conceived of as a schematic representation of the hierarchical relational network that connected the concepts in the prose text. Factual information was defined as knowledge that was stated explicitly in the text. Inferential knowledge represented information that was derived from but not directly expressed in the given text.

A secondary purpose of the study was to assess the utilization of the outline at two points in processing time: during initial reading (discerned through underlining) and during recall (discerned through clustering of facts). Underlining is an overt measure of what subjects initially highlight during reading. Clustering is a measure of the degree to which the acquired information is structured by subjects in their recall protocols. Structure refers to the relational network provided by the outline.

This study is important for several reasons. The knowledge gained from this study could add to our understanding of learning within a cognitive framework. To date, cognitive theory has been concerned with problems of

perception and memory and has largely neglected learning from prose issues.

The knowledge gained from this study would also contribute to the study aids literature. An outline has been shown to improve recall in one prior study. In that study, Glynn and DiVesta (1977) demonstrated improved recall of specific facts, but failed to demonstrate that the outline improved inferencing. Glynn and DiVesta's test of inferencing, however, may not have been optimal. A discussion of that study will be found in the literature review section on study aids. Underlining has also been shown to improve factual recall in a study by Rickards and August (1975). This study did not examine inferencing effects although the data provided by the investigators suggest that underlining may serve an organizational function. A discussion of this study will also be found in the literature review section on study aids. Thus, this study should contribute data of interest to teachers and others who attempt to convey information through text sources.

CHAPTER II

Text Processing: Schema Theory Literature

Many insights and advances in cognitive learning have been made with the use of schema theory. In this chapter the thesis will be developed that the structure that a person brings to a prose text determines what is learned and remembered. Knowledge is postulated to be embedded in an abstract structure containing both subsuming concepts and contingent relations. This organized form of representation in memory will be referred to as a "schema" after Piaget (1926) and Bartlett (1932). Theoretical formulations of how a schema affects the processing of text will be described. Next, data supportive of schema theory will be reviewed. Finally, the implications of schema theory for the present study will be discussed.

Theoretical Formulations

The origin of schema theory is usually attributed to Bartlett (1932) in connection with his studies of memory. Bartlett formulated a general theory of memory in which he proposed that the heart of remembering involved an interaction between the learning task and the subject's conceptual structure or schema. In his famous book Remembering, Bartlett argued that the schema determined the interpretation given to learning materials. He described the schema in this way:

> Schema refers to an active organization of past reactions, or of past experiences, which must always be supposed to be operating in any well-adapted organic response. That is, whenever there is any order or regularity of behavior, a particular response is possible only because it is related to other similar responses which have been serially organized, yet which operate, not simply as individual members coming one after another, but as a unitary mass. (p. 201)

Bartlett assumed that the most recent conceptual structure was activated but did not specify in what way the passage engaged the schema. He stated the assumption as follows:

> The influence of 'schemata' is influence by the past... In its schematic form the past operates 'en masse' or, strictly, not quite 'en masse,' because the latest incoming constituents which go to build up a 'schema' have a predominant influence. (p. 202)

He went on to suggest that individuals tend to assimilate information into the schema in the direction of making the information compatible with prior knowledge and cultural experience.

Bartlett's theory grew out of his research using the method of repeated reproduction. Bartlett gave his subjects short stories of about 200-500 words in length. The stories were read through twice by the subject and then reproduced in writing after 15 minutes and at varying intervals in the following weeks and months. Bartlett's most important finding was that there was an increasing

number of distortions and inaccuracies over repeated reproductions. Furthermore, the subject appeared unaware of the extent of his inaccuracy. The high proportion of inaccuracies in a subject's reproduction was in part due to omissions and condensation but an even greater number were the result of transformations of the original material in the direction of making the content more compatible with a subject's prior knowledge. An example of this would be hearing the phrase "went down to the river to hunt seals" but remembering it as "was involved in fishing." Such errors demonstrated that memory storage is not entirely verbatim but rather a reconstructive elaboration of the input.

Bartlett's theory was not very detailed or specific. His conception of a schema as an organizing and orienting mechanism in cognitive functioning was vague. He also used the term "schema" loosely. However, in spite of these shortcomings in his theory, his contribution to cognitive psychology is an enormous one. Bower (1976) expressed these comments well when he said:

> His ideas... have proven seminal but frustratingly difficult to tie down. (p. 511)

Bartlett's schema theory has influenced modern cognitive processing theory. Rumelhart and Norman (1978) have drawn on it for a more specific formulation. They view memory

schemata as an active structural network. Each schema represents concepts and events and interrelationships among these components. Comprehension of a situation results when a particular schema interacts with the situation. This means that a selection of which schema to invoke in a given situation takes place initially. The schema that an individual utilizes influences his interpretation of the situation. It follows from this that: (1) different schemata result in different interpretations of the same situation, and (2) there may be optimal schemata for particular kinds of information.

Within this formulation, Rumelhart and Norman define learning as a change in the schema. This change may be the result of: (1) additions to the schema (accretion), (2) refinement of the schema (tuning) or (3) reorganization of the schema (restructuring). A description of each of these modes of learning follows.

The first schema change, accretion, is the addition of new information to existing structures. For example, after reading an article about hurricanes, the information could become internalized as an addition to the weather schema. The second schema change, tuning, is a refinement or modification of a schema to permit the knowledge contained in the schema to be used efficiently. Tuning has been described as an adjustment of the parameters of the schema. A good

example of tuning is typing. When one initially learns to type, the schema represents the response routines needed to perform the task. With increased practice, the routines undergo continual tuning until the task becomes automatic. The third schema change, restructuring, is the most difficult of the three. It occurs when new structures are created or a new organization is imposed on an existing schema. An example of this is concept learning. In concept learning, a variety of exemplars are acquired gradually. Restructuring is postulated to take place after the mass of information is found to be unwieldly and not well structured.

In summary, Bartlett and Rumelhart and Norman postulate that learning is determined jointly by the schema that an individual evokes and the given prose text. Evoking the appropriate schema, therefore, is crucial. The present study will investigate this issue. However, prior to formulating the research problem, empirical support for schema theory will be reviewed.

Empirical Evidence

Schema theory asserts that the structure of prior knowledge determines to a large extent what will be learned and remembered when reading a prose passage. One way of testing this assertion is by manipulating context. The studies to be described focus directly on the role played by schemata in comprehension.

Titles. Dooling and Lachman (1971) manipulated the evoking of a schema by prior presentation or nonpresentation of a short title reflecting the main idea of a prose passage. The passage was vague and contained metaphors and, therefore, the essential ideas were difficult to understand. However, if subjects knew the main idea of the passage, it was hypothesized that they could tap available schemata in memory that would facilitate comprehension and retention. The no-title control group was expected to find it difficult to understand the metaphor.

An example of the passages they used is the following:

> With hocked gems financing him/ our hero bravely defied all scornful laughter/ that tried to prevent his scheme/ your eyes deceive he had said/ an egg/ not a table/ correctly typifies this unexplored planet/ now three sturdy sisters sought proof/ forging along sometimes through calm vastness/ yet more often over turbulent peaks and valleys/ days became weeks/ as many doubters spread fearful rumors about the edge/ at last/ from nowhere/ welcome winged creatures appeared/ signifying momentous success.

The title that was presented for this passage was "Christopher Columbus Discovering America." The presence of the title increased the number of words recalled by 18%.

In a second experiment, which duplicated the training conditions of the experiment described above, subjects were given a recognition test and subjects were required to make a binary decision as to whether the words did or did not appear in the passage. The investigators presumed that

this procedure, if rapidly paced, would prevent subjects from reconstructing the events of the passage during retrieval. Subjects who had access to a thematic title correctly recognized significantly more words that were related to the main idea of the passage. These results again demonstrate that when a subject's appropriate schema is activated, recall is improved.

Pictures. Bransford and Johnson (1972) manipulated schema formation by the presence or absence of a picture that provided a conceptual base for the events described in the given passage. Whereas Dooling and Lachman had used an ambiguous passage, the passage used by Bransford and Johnson is clear and direct.

The passage that was used is the following:

> If the balloons popped, the sound wouldn't be able to carry since everything would be too far away from the correct floor. A closed window would also prevent the sound from carrying, since most buildings tend to be well insulated. Since the whole operation depends on a steady flow of electricity, a break in the middle of the wire would also cause problems. Of course, the fellow could shout, but the human voice is not loud enough to carry that far. An additional problem is that a string could break on the instrument. Then there could be no accompaniment to the message. It is clear that the test situation would involve less distance. Then there would be fewer potential problems. With face to face contact, the least number of things could go wrong.

The picture that provided the context (see Figure 1) showed a young man serenading a young woman with a guitar.

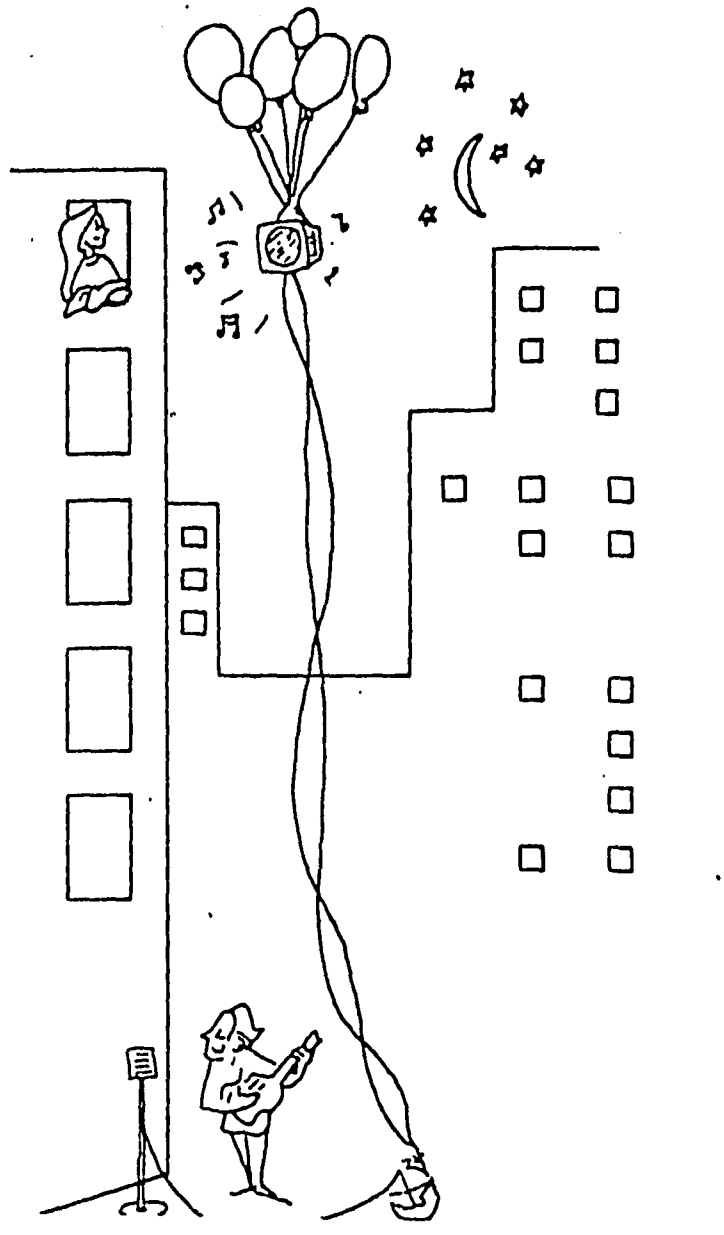

Figure 1. Appropriate context picture, Bransford and Johnson (1972). (Reprinted by permission.)

The music from the guitar was projected upward by means of a loudspeaker held aloft by a group of balloons. Subjects who received the appropriate context picture had significantly higher comprehension ratings. "High" as used in this sense means that these subjects rated the passage easy to comprehend. A low rating indicated difficulty in comprehension. On a free recall task, subjects having access to the picture also recalled a greater number of ideas from the passage. In summary, providing an appropriate integrating picture had a significant effect on both comprehension ratings and recall.

Bransford and Johnson, in comparing their results with those reported by Dooling and Lachman, suggest that the issue is not one of topic or picture but rather whether the given information activates a relevant schema. Pilot studies that they ran indicated that subjects receiving the topic "possible breakdown in communications during a serenade" recalled significantly fewer ideas than those given the picture.

Introduction. Another way of manipulating schematization is by providing alternate introductions to ambiguous text materials. Bower (as cited in Anderson, 1978, p. 71) used a passage about characters who visited a doctor. The passage ended with the doctor smiling as he says, "Well, it seems my expectations have been confirmed." One introduction to the passage described the character as a woman

who was worried that she was pregnant. The alternate version talked about a wrestler who was concerned about being underweight. Readers given the first introduction tended to recall that the doctor remarked that the woman was pregnant; those given the alternate version recalled the doctor as saying, "You're gaining weight." Bower reported similar results with a story about a series of mishaps during the filming of a commercial. Again, false positive recognition statements were formulated on the basis of the introductions that were given. These experiments support the thesis that schema selection influences one's interpretation of the information.

Story characters. Sullin and Dooling (1974) extended the literature on the role of schemata in prose retention by manipulating reference in the text proper. The main character in a short biographical paragraph was either a "famous" person or a "fictitious" character. For example, the following passage is about a fictitious woman named Carol Harris:

> Carol Harris's need for professional help (sic). Carol Harris was a problem child from birth. She was wild, stubborn, and violent. By the time Carol turned eight, she was still unmanageable. Her parents were very concerned about her mental health. There was no good institution for her problem in her state. Her parents finally decided to take some action. They hired a private teacher for Carol.

The investigators assumed that subjects who read the "famous" main character version (Helen Keller, in the passage above) would use a richer schema for comprehending and subsequently remembering the passage than the subjects given the "fictitious" main character version. As expected, subjects who read the passage with a "famous" main character made more false positive errors on a subsequent recognition test because of the additional information provided by the enriched schema. In addition, the nature of the errors depended on the thematic relatedness of the recognition foil (i.e., a sentence that did not occur in the original passage). The "high" recognition foil asserted a well-known fact about the "famous" main character. The "low" foil described a less well-known attribute of the "famous" person. An example of a recognition foil that was "high" in thematic relatedness was:

High foil: She was deaf, dumb, and blind.

An example of a recognition foil that was "low" in thematic relatedness was:

Low foil: A book was written about her life.

Subjects who read the "famous" main character passage made more false positive errors when the recognition foil was "high" in thematic relatedness than when it was "low" in thematic relatedness.

Also, these thematic effects were relatively greater after one week than at immediate retention. Acceptance of

relevant statements (not in the original passage) about a "famous" person named in the passage increased with time. The same statements were rejected for identical passages where the person named was unknown. Such errors provide important clues about how the information was encoded. Recognition of an "old" sentence (correct discrimination) decreases with the passage of time. Recognition of a "new" "high" thematic foil as "old" (a false positive) increases with the passage of time. Therefore, recognition is increasingly based on thematic information.

Thus, Sullin and Dooling tested two implications of schema theory. They demonstrated that: (1) prose passages are stored in schematic form, and (2) memory performance exhibits greater distortion over time in the direction of compatibility with preexperimental knowledge.

In summary, contextual cues (e.g., title, picture, introduction or manipulation of character) are thought to be effective because they provide access to an appropriate schema. When no contextual cue is available, it is presumed that the individual is less successful in understanding the prose. The studies that follow provide empirical support for this assertion.

Subject background. Anderson, Reynolds, Schallert and Goetz (1977) provided subjects with ambiguous paragraphs that lacked strong contextual cues such as titles or pictures. They wrote passages such as the following:

> Every Saturday night four good friends get together. When Jerry, Mike, and Pat arrived, Karen was sitting in her living room writing some notes. She quickly gathered the cards and stood up to greet her friends at the door. They followed her into the living room but as usual they couldn't agree on exactly what to play. Jerry eventually took a stand and set things up. Finally, they began to play. Karen's recorder filled the room with soft and pleasant music. Early in the evening, Mike noticed Pat's hand and the many diamonds. As the night progressed, the tempo of play increased. Finally, a lull in the activities occurred. Taking advantage of this, Jerry pondered the arrangement in front of him. Mike interrupted Jerry's reverie and said, "Let's hear the score." They listened carefully and commented on their performance. When the comments were all heard, exhausted but happy, Karen's friends went home.

The passage was interpretable in two ways. The passage could be understood as an evening of card playing or a rehearsal by a woodwind ensemble. The passage was read by a group of physical education students and by a group of music students. Anderson et al. found evidence that a subject's interpretation depended on his background and life situation.

The conclusion that a schema had a selective effect on text processing was based on results from a multiple-choice test. The test could clearly reveal a subject's underlying interpretation of the text since each question on the test had two correct answers, one for each text interpretation. One of the distractors was consistent with one of the expected interpretations, the other with the second in-

terpretation. For the passage illustrated above, an example of a test item is:

Q: What did the four people comment on?

A: a) The odds of having so many high cards
b) The sound of their music
c) The high cost of musical instruments
d) How well they were playing cards

Scores on this multiple-choice test were related to the subjects' background. Free recall protocols, which were scored for theme revealing selections as well as intrusions, showed strong relationships to the subjects' background.

Converging evidence from those studies which have manipulated contextual cues and those that have manipulated subjects' background indicate that text processing is influenced by a person's schemata.

By invoking a "schema" construct in text processing, the nature of knowledge acquisition and retention shifts from a verbatim learning "of" the text to a determination of what is learned "from" the text. The next chapter reviews the evidence for constructive aspects of knowledge acquisition.

CHAPTER III

Text Processing: Constructivism Literature

Schema theory argues that a given passage of prose (sensory input) needs to be transformed in order to become coherent to the reader. It assumes that the schema accomplishes this by interacting with the prose text.

This chapter examines the nature of these transformations. It begins by examining the premise that all our experiences involve constructions. This discussion is followed by empirical demonstration of the role of two types of constructive activities that are involved in language comprehension: integration of text information and inferential reasoning.

Philosophical Support

The belief is now generally held that humans are active processors of information. They select and transform information rather than act as a videotape recorder (Rumelhart and Ortony, 1977). They attend to meaning and often discard the words (Bransford and McCarrell, 1974). In order to understand and remember text materials, they usually construct psychological meaning.

The notion of constructing meaning, i.e., constructivism, is a general point of view which holds that the form and content of all experiences are constructed to a greater

or lesser degree, depending on the availability of relevant prior experience. The concept of mental constructions goes back to Aristotle and Plato (Baumrin, 1975, Weimer, 1973) who took the view that individuals come to know their world by actively constructing it. The constructivist position usually involves the following assumptions:

1. Humans are "knowing beings" and the knowledge they posses is a determinant of their interpretation of experience.

2. A human's intelligent behavior initially is under his control and much of it is purposeful. The locus of control may, however, be constrained by social norms.

3. Humans have the capacity for developing knowledge and organizing it.

In summary, these assumptions imply that most important behavior results from active constructions. This is why exact reproduction or recall of an event is rare. Magoon (1977) has put it this way:

> Just as individual scientists and scientific communities develop constructs, constructivists point out that individuals in their societies do precisely the same thing; i.e., invent, organize, and act via rules. (pp. 652-653)

In psychology, constructivism has usually been associated with studies of memory by Bartlett, 1932. Others, however, have extended the scope of constructivism to perception (Bruner, 1957) and personality (Mischel, 1968). Since the present study addresses issues in learning and

memory of an integrative and inferential nature, the empirical evidence for these constructions are presented next.

Empirical Support

Semantic Integration

After a person reads a text, the knowledge accumulated is multi-faceted. The person may remember certain ideas, sentences, phrases or words verbatim. However, the individual is often unable to differentiate the accumulated knowledge from what was originally presented (Sachs, 1967). Constructivist psychologists believe that mature people do not catalogue isolated facts in memory (Neisser, 1967). They consolidate text and eliminate redundancies. They put related information together and store it in memory in this fashion. They do not retain particular wordings or syntax when the propositions in a text involve common words such as "U.S." (Thorndyke and Bower, 1974). Hayes-Roth and Hayes-Roth (1977) found, however, that paraphrasing a common word in one of the propositions (e.g., the use of "American" in place of "U.S.") facilitated memory for the specific proposition.

Bransford paradigm. Bransford and Franks (1971) were the first investigators to provide empirical evidence of knowledge integration. The experimental paradigm that they used consisted of presenting subjects with a set of sentences, each representing a partial meaning of a

complex idea and assessing the nature of the information that the subjects retained.

In their study, subjects heard sentences such as the following:

> The ants were in the kitchen.
> The jelly was on the table.
> The jelly was sweet.
> The ants ate the jelly.

These propositions are an idea set which was derived from the following complex sentence:

> The ants in the kitchen ate the sweet jelly which was on the table.

In the acquisition phase, subjects did not hear all the propositions or the composite idea from which they were derived. Instead, they heard sentences which combined subsets of the partial ideas that made up the composite idea. Each acquisition sentence contained from one to three of these partial ideas. Subjects heard these sentences in a random order interspersed among acquisition sentences.

The subjects heard partial sentences such as:

> The jelly was on the table (a partial idea).
> The ants in the kitchen ate the jelly (combining two partial ideas).
> The ants ate the sweet jelly (combining two partial ideas).

Nevertheless, they integrated the information from these sentences and stored the composite idea in memory. They gave false positive recognition responses on a subsequent test to novel sentences such as:

The ants in the kitchen ate the sweet jelly (combining three partial ideas).

Bransford and Franks also found a direct relationship between the number of partial ideas in a recognition sentence and confidence that the sentences had been presented earlier. In conclusion, Bransford and Franks demonstrated that subjects spontaneously integrate incoming information and store wholistic semantic descriptions.

The sentences presented in this study were highly concrete. Subsequently, Franks and Bransford (1972) replicated these results using abstract sentences.

The two experiments taken together were interpreted as support for the notion that subjects spontaneously integrate information that is semantically related and that it is stored in memory as a single complex idea. Responses on the recognition test were a function of the stored complete idea rather than the discrete set of sentences that were presented during the acquisition phase. In other words, the integrated information governed the person's judgment as to whether or not sentences had been encountered previously.

Two aspects of the methodology of the Bransford et al. studies have been criticized by Reitman and Bower (1973). The first criticism involves the nature of the materials used in the studies. Reitman and Bower suggested that exposure to seven or eight partial ideas of each of four

different complex ideas may have resulted in "memory overload" and interference. The second criticism concerned the lack of an appropriate control group to examine forgetting. The Bransford et al. studies lacked a "non-concept" control group of subjects presented with randomly selected and combined elements from a small unordered set of elements.

Reitman and Bower used the Bransford procedures with simpler materials and with appropriate controls. They did not replicate the Bransford et al. finding that subjects were unable to discriminate between presented partial ideas and non-presented complex ideas. All subjects in the Reitman and Bower study accurately distinguished items which they originally experienced from those they did not. Therefore, these researchers questioned the Bransford et al. conclusion that subjects remember only the complex idea and not the partial ideas.

This outcome does not invalidate semantic integration hypotheses per se, just the hypothesis that semantic integration leads to a loss of text discriminability.

Constructed clusters. There is other evidence of covert organization of facts into higher order structures. One empirical approach to the investigation of organization in memory is to use a free recall paradigm. Clustering or contiguous grouping of facts into categories is the measurement used. In the studies to be reported below, the

categories were defined by the structure in the materials (text organization) or provided by preinformation (cueing).

Many investigators have studied the effect of various forms of organization on the recall of prose materials. Several of these studies have explored learning of text sentences that are derived from a matrix in which names and attributes are the row and column items and the attribute values are the tabular entries. An illustrative matrix is provided in Table 1. An example would be, The climate (attribute) in Melin (name of country) is humid (attribute value). These sentences can be organized in a prose passage by name or they can be grouped according to the attributes. Alternately, the sentences can be randomized. Examples of this approach are found in Frase (1969), Schultz and DiVesta (1972) and Myers, Pezdek and Coulson (1973).

Frase (1969) constructed 48 simple sentences about chesspieces and their moves, point value, etc., that he then ordered in three ways: (a) by concept name (name of chesspiece), (b) concept attribute (e.g., point values for chesspieces), or (c) by randomization. In the structured ordering, one category, either the name or the attribute, was exhausted before a new category was introduced. Clustering in recall was defined to be contiguous sentences in the same name or attribute category. A name and an attribute clustering measure was computed for each subject

Table 1

Name and Attribute Matrix
Myers, Pezdek and Coulson (1973)

Name	Attribute				
	Agricultural product	Climate	Language	Industrial product	Geography
Melin	corn	humid	French	machinery	plateaued
Pemol	rice	hot	German	automobiles	hilly
Tupel	potatoes	dry	English	appliances	coastal
Gamba	wheat	cold	Danish	transformers	mountainous
Sayon	tobacco	rainy	Spanish	airplanes	flat

and the higher of the two was used. Recall clustering was relatively high in all three conditions, but was significantly higher for the concept name organization. Clustering was also reported to be correlated with amount learned.

In a related study, Schultz and DiVesta (1972) extended the generalizability of Frase's findings to materials more closely representative of school learning materials. Subjects who read the two organized passages produced clustering in their recall protocols that were congruent with the organization of the passage they had been given. However, clustering by name and attribute were not used to the same extent. Clustering by name was preferred to clustering by attribute. The number of statements recalled correctly was not related to clustering.

Myers, Pezdek and Coulson (1973) investigated the effects of prose organization on free recall using materials about fictitious countries in order to provide categories to be learned in the experiment. The text passages were organized either by name, by attribute, or randomly as in the study by Frase. The investigators found more clustering when the text was organized by name categories than when it was organized by attribute categories or in random input. Again, there was a preference to cluster recall by name rather than attribute.

The aforementioned studies investigating name vs attribute organization of text indicated that all groups receiving text organized by name or by attribute or at random categorized their output around names. This finding suggests that text integration usually involves the consolidation of information along with concept or name classes.

Some studies have investigated the effect of cueing on organization in recall protocols. Cueing refers to the prior availability of pertinent information about the clusterable nature of the materials to be read.

Frase (1969) used text material about chess plays to study the effect of preinformation about text organization on text recall. Subjects were told in advance about which attributes of the chesspieces would be discussed in the written materials. For example, they were told that they would be reading about how many points each chesspiece was worth. This preinformation about the attribute topics did not produce differences in recall nor did it influence clustering. Since subjects were not told in advance about which chesspieces they would be reading about, the interpretation of these findings would suggest, that preinformation about "name" topic would be a more potent influence on clustering than information about an attribute topic.

Balser (1972) presented factual material in the form of complex sentences in either a blocked (by topic) or random fashion to subjects. One blocked group and two random groups were used. Prior to reading the materials, the blocked and one of the random groups were informed about the topics that they would find in the text. Two findings about the influence of this preinformation are of interest for the present study. First, knowing the topics in advance influenced the amount recalled. The informed random group recalled more facts than the uninformed random group. However, there was no difference in the amount recalled for the two informed groups: the one given the blocked and the one given the random arrangement of text sentences. Second, knowing the topics in advance had an overall effect on clustering. Subjects in the informed random condition clustered significantly more than those in the uninformed random condition. Also, subjects in the informed blocked condition clustered significantly more than those in the informed random condition.

Although no data were reported on the relationship between clustering and amount recalled, the following deduction can be made from the data given: The ratio of clustering to amount recalled is greater when comparing a structured with a nonstructured group than it is when comparing two structured groups. This suggests that a

cluster measure is needed that is more sensitive than amount of clustering, as measured by stimulus category repetition.

DiVesta, Schultz and Dangel (1973) investigated the effect of the interaction between instructional sets and passage organization. In this study, learners were instructed to use a name clustering strategy, an attribute clustering strategy, or a subjectively determined organizing strategy to learn the materials in the passage. The passages contained either a name organization, an attribute organization, or the statements were scrambled. Organization of information during retreival was influenced by the strategy imposed through instructional sets for organizing the material during learning. Also, incongruence between passage organization and advocated clustering strategy resulted in greater recalls than did congruency. Therefore, the outcome of this study supports the hypothesis that the organization of the passage and instructions influence how much is recalled and the manner in which it is organized. This finding is compatible with the constructivist hypothesis that the form as well as the content of experience is constructed.

In summary, the evidence for semantic integration (the consolidation and organization of text) indicates that humans efficiently process and store information. The result is a schematic representation that is parsimonious. In addition, semantic integration is presumed to provide a

basis for inferential reasoning. Suppose a reader encounters the sentences:

1. A local TV station has spot announcements about job opportunities.

2. Information about job opportunities is disseminated by the U.S. Department of Labor.

Not only would the reader spontaneously integrate the sentences, but he or she would most likely infer that the local TV station uses the U.S. Department of Labor as a source for its job opportunity announcements. The next section reviews the evidence for inferential constructions.

Inferential Constructions

Inferential thinking occurs when a subject goes beyond the information given. Evidence for spontaneous construction of inferences has been demonstrated by Bransford, Barclay and Franks (1972), Barclay (1973), Johnson, Bransford and Solomon (1973), Honeck (1973) and Thorndyke (1976). The work of these researchers demonstrates that generating inferences is a necessary part of language comprehension and that meaning is constructed.

In a seminal study by Bransford, Barclay and Franks (1972), subjects displayed evidence of inferential thinking about spatial relations among objects when they processed information. They heard sentences dealing with relatively simple spatial relationships as in the following:

1. Three turtles rested beside a floating log, and a fish swam beneath them.

2. Three turtles rested on a floating log, and a fish swam beneath them.

These sentences have identical deep structures, but only in sentence (2) can one derive the additional conclusion that the fish swam beneath the log.

The above two sentences were presented in a recognition task with the following modifications:

(1-M). Three turtles rested beside a floating log, and a fish swam beneath it.

(2-M). Three turtles rested on a floating log, and a fish swam beneath it.

Sentences (1) and (2) were modified by changing the final pronoun from "them" to "it." The critical difference between (1-M) and (2-M) is that (2-M) can be inferred from (2) but (1-M) cannot be inferred from (1). In (2) the turtles were on the log and the fish swam beneath them, and so the implication is that the fish swam beneath the log as well (2-M). The information that the fish swam beneath the log is an inferential construction. It is not directly stated in the original sentence (2) but had to come from prior knowledge about spatial relations.

Subjects had no difficulty in recognizing that (1-M) was a "New" sentence, i.e., it had not been presented earlier. However, the same subjects confronted with (2-M) believed that they had seen it earlier. Subjects based

their false recognition ratings on the inferences they had internalized.

Barclay (1973) extended the findings for spontaneous inferential constructions in comprehension in a series of 5 experiments which utilized a structured array of objects. The structure was based on spatial or comparative relationships. The objects were described in a random fashion by an acquisition sentence set of from 8 to 11 sentences. After subjects had used the acquisition sentences to construct a representation of the entire array, they were given a surprise test of recognition or recall. The purpose of the research was to emphasize the role of inferences in memory representation. From sentences such as the following:

> The lion is to the left of the bear
> (Sentence 1)
> The bear is to the left of the moose
> (Sentence 3)
> The moose is to the left of the giraffe
> (Sentence 5),

subjects could deduce that the array was ordered as follows:

LION BEAR MOOSE GIRAFFE COW

On a subsequent recognition test, subjects recognized the above mentioned acquisition sentences as "Old." However, they also misidentified as "Old," a sentence such as:

The bear is to the left of the giraffe.

While this sentence was true, it was a "New" sentence, i.e., it had not appeared on the acquisition list. In other

words, in the recognition test, subjects identified all true sentences as having been previously seen; they did mistakenly identify sentences that were not true.

Johnson, Bransford and Solomon (1973) investigated inferences about "objects" involved in certain relations and about the "consequences" suggested by certain relations. As in the previous studies, there was an acquisition phase and a recognition phase. Short descriptive stories were used in which an object was implied or a probable consequence was suggested. An example of a story in which an object was implied was:

Story: John was trying to fix the bird house. He was pounding the nail when his father came out to watch him and to help him do the work.

Inference: John was using the hammer to fix the bird house when his father came out to watch him and to help him do the work.

An example of a story in which a probable consequence is suggested was:

Story: When the man entered the kitchen he slipped on a wet spot and dropped the delicate glass pitcher on the floor. The pitcher was very expensive, and everyone watched the event with horror.

Inference: When the man entered the kitchen, he slipped on a wet spot and broke the delicate glass pitcher when it fell on the floor.

As in the previously described studies, subjects mistakenly identified "Old" novel sentences which contained information that could be inferred from the stories.

The results of the three studies by Bransford and his colleagues, described above, offer empirical support for the notion that comprehension depends not only on the linguistic input but on the inferences derived from the input.

In the work of Bransford and his colleagues there is a good deal of lexical overlap between acquisition sentences and test materials. Honeck (1973) investigated the possibility that an inference may be stored in an abstract or "inferentially distant" form. During acquisition, subjects heard proverbs and along with each proverb either a repetition (R), grammatical transformation (T), parasyntactic paraphrase (P) (i.e., an inference that overlaps on an abstract conceptual basis with the proverb but blocks the link between syntax and any implications of that syntax), or an unrelated control sentence (U). An illustration of a proverb and corresponding sentence conditions is the following:

Proverb: Wealth is an oil which lubricates the machines of life.

T: An oil which lubricates the machines of life is wealth.

P: Wealth is likely to contribute to the longevity and well being of those who have it.

U: There have been debates as to whether wealth should be distributed more equally in the population.

In a prompted free recall paradigm, subjects in the parasyntactic group recalled significantly more proverbs on recall measures than subjects in the other 3 groups: (R), (T), or (U).

Honeck suggests that the superiority of the parasyntactic group on prompted recall supports the hypothesis that the proverbs were stored in an inferentially distant form in semantic memory. He further suggests that the parasyntactic condition, by providing the subjects with conceptual implications, made the conceptual linkage possible.

Thorndyke (1976) used a paradigm that attempted to duplicate a "normal" processing environment. He also extended the earlier experiments by testing several types of inference constructions. These included: inferred result, inferred instrument, inferred antecedent condition, and inferences based on world knowledge.

Thorndyke used unrelated but coherent narrative passages to examine how people use inferences. Each passage contained about 20 sentences. Embedded in each passage were target sentences followed later in the passage by experimentally controlled continuation sentences. An example of a <u>target sentence</u> is:

> The hamburger chain owner was afraid his love for his french fries would ruin his marriage.

This sentence was followed later in the passage by the continuation sentence:

> The hamburger chain owner decided to join weight-watchers in order to save his marriage.

This continuation sentence depended on an inference link for its comprehension, the inference being that:

> The hamburger chain owner was very fat.

After reading the passages, subjects were asked to recognize explicit statements and inferences from the story. Subjects had difficulty identifying whether a statement was indeed an inference and had not been explicitly stated in the text. This recognition difficulty arose when comprehension of the continuation sentence depended on the target sentence plus an inferential link. In the example cited above, subjects believed that the inference sentence had been explicitly stated in the text. Apparently, the inference had become indistinguishable from explicitly stated information.

Thorndyke's study suggests that the construction of inferences plays an important role in the comprehension of prose passages. Inferences function to provide coherence and continuity to information from incoming propositions. They form a bridging structure to previous information. In the example cited, the continuation sentence about joining

weight-watchers would not have made sense without the backward inferencing to the target sentence by way of the inference that he was fat.

In summary, several researchers on inferential constructions have demonstrated that subjects cannot discriminate between inferences constructed during comprehension processes and information expressly stated. Subjects frequently thought that they had heard information which they had, in fact, inferred. This phenomenon was documented for several types of inference constructions. Recognition confusion was the result of integrating the inferences with the expressed information. These studies lend strong support to the notion that semantic representation results from the interaction of the linguistic input and prior knowledge.

The studies in support of spontaneous inference constructions suggest that verbatim text is not stored in memory. Hayes-Roth and Hayes-Roth (1977) have indicated, however, that this may not always be the case. One way of addressing the issue is to look at the effect of specific wordings on response latencies. If there is lexical content in memory, then subjects should take longer to verify an inference than to verify a synonym.

Singer (1976) investigated this hypothesis for the class of "context" inferences. A context inference is derived from the meanings of individual words within a

sentence. The following two sentences illustrate such inferences:

1. The girl spent the afternoon taking care of her cousin.

2. The girl spent the afternoon taking care of her uncle.

The inference implied in sentence one is that the cousin was young; the inference implied in sentence two is that the uncle was ill. Changing a word in the sentence alters significantly the inference that is constructed.

Subjects in the Singer study viewed sentences such as the ones in the illustration on a video screen. After each sentence there was a 7-second delay followed by a test sentence which was either a partial paraphrase of the original sentence (synonym) or expressed one of its implications (inference). An example of an acquisition sentence and the test sentences derived from it is the following:

Acquisition sentence:	The little girl spent the gleaming penny.
True synonym:	The penny was shiny.
False synonym:	The penny was dull.
True inference:	The penny was new.
False inference:	The penny was old.

Subjects were instructed to respond "True" to the test sentence if the situation obtained in the acquisition sentence. It took on the average 181 msec. longer to judge

the truth of inferences than the truth of synonyms. Increases in response latency for the inference test item is presumed to reflect increases in inferring from lexical information stored in memory.

In summary, the empirical evidence for constructive processes that has been reviewed above has demonstrated that in processing text, subjects spontaneously integrate information from text by consolidating and organizing it, usually along concept class categories. Subjects also tend to frequently construct inferences during the encoding process. Further, the implication is that all these constructions are the result of an interaction of a task-specific schema with the prose text. The next chapter addresses the issue of operationalizing a task-specific schema.

CHAPTER IV

Text Processing: Research Methodology

There has been a paucity of research concerned with schema effects in prose learning. The reasons for this include a difficulty in: (1) operationalizing constructs, (2) finding a suitable paradigm, and (3) considering only one methodological approach.

In this chapter it is proposed that schemata affect learning and retention of text information. Some assumptions about the characteristics of a schema will be described and it is proposed that an outline of the text structure can serve as a way of operationalizing the construct. Next, based on this definition, a model for investigating learning and retention effects will be presented. It will be suggested that a hierarchical outline is an efficient task-specific schema, and the supportive evidence from research which has manipulated text organization will be reviewed. Finally, an information-processing approach will be proposed as a conceptualization of the learning process.

Operationalizing a Schema

A schema is conceptualized as a data structure that represents a set of generic concepts stored in memory. Generic concepts are concepts whose attributes are generally shared. A schema comprises a network of interrelations

among constituent concepts. Rumelhart and Norman (1978) consider the schema to be the primary processing unit. The task-specific schema is assumed to be the structure against which text inputs can be matched and in terms of which they can be comprehended. Anderson (1978) talks of slots or placeholders for each component of the schema against which text inputs are matched.

There is more than one schema which can be evoked during any specific text processing. For example, one relatively unsophisticated schema for farming might contain the variables: land, crops, and animals. Another schema might contain the following: land, labor, specialized building machinery. A third schema might focus on crops and animals only. In a schema-based system, the individual searches for a schema which best accounts for the totality of the incoming information.

It is suggested that it is useful to think of a schema which is task-specific as an outline of a prose text. The outline specifies the conceptual relationships inferred in the body of the text.

There are several reasons why it is desirable to represent a task-specific schema as an outline. First, and foremost, it converts an abstract and vague construct (i.e., "task-specific schema") into one which is operationally defined. Second, learning an outline is a simple task and feasible within an experimental setting.

Finally, the degree to which the outline has been learned is easily quantifiable. This last point is important since the present study proposes to investigate the effect of a schema on learning and retention of prose materials.

Schema and Transfer

It is possible to study the learning effects of invoking a schema in text processing if one uses a transfer paradigm. Learning has traditionally been demonstrated within the transfer paradigm. This paradigm has a long history in psychology. From a cognitive perspective, the only change is one of using the outline or schema as the initial learning or training material. For this study, the paradigm involves (1) learning the outline (A), then learning the text (B) (i.e., target material) versus (2) learning a control task, then learning the text (B). Transfer is measured by comparing (B) acquisition in the two conditions.

Optimizing Schema Effects

Rationale. An outline (i.e., schema) can vary in the degree to which it emphasizes the interrelationships within a specific prose text. At a low level, that of categorization, the outline can show the relationship of instances to a main concept. At a high level, that of hierarchical organization, the outline can provide a framework within which the interrelationsips among the main

concepts is also revealed. Consider the following example of each type of outline.

One might read a text that provided information about the following: bee, canary, carp, cobra, elephant, halibut, monkey, mosquito, python, shark, sparrow, trout. At the level of categorization, the outline would appear as:

I. Mammal
   A. Elephant
   B. Monkey

II. Snake
   A. Cobra
   B. Python

III. Bird
   A. Canary
   B. Sparrow

IV. Insect
   A. Bee
   B. Mosquito

V. Freshwater Fish
   A. Carp
   B. Trout

VI. Saltwater Fish
   A. Halibut
   B. Shark

In this category outline, there is no indication of the relationship between, for example, mammals and snakes at one level or mammals and insects at another level. It is this set of interrelationships that a hierarchical outline highlights. It does so by presenting the high-level categories that serve as superordinate categories for the main concepts. Using the example cited above, the outline would appear as:

Animal					
Landbased		Flying		Swimming	
Mammal	Snake	Bird	Insect	Freshwater Fish	Saltwater Fish
Elephant	Cobra	Canary	Bee	Carp	Halibut
Monkey	Python	Sparrow	Mosquito	Trout	Shark

The hierarchical outline or schema, because it has a "rich" relational network, maximizes the possibilities for text integration and the construction of inferences. The importance of being able to construct inferences has been stated by Anderson, Reynolds, Schallert and Goetz (1977) in this way:

> schemata provide the basis for filling gaps, the basis for inferential elaboration, the basis for positing states of affairs, not expressly mentioned, that must hold if a passage is to permit a coherent interpretation. Comprehension involves going beyond the givens in a message, so to speak "reading between the lines." Readers must make logical inferences, pragmatic inferences, coordinate reference, and supply suppositions about an author's intentions. They must make inferences about the motives and mental states of characters, antecedent and consequent events, instrumentally, and illocutionary force as well as propositional content. (p. 370)

Based on this rationale, the present study will use a hierarchical outline to represent a task-specific schema. This hierarchical outline represents the structure that inheres in the prose. Schema theory suggests that matching outline (i.e., schema) and text structure maximizes the likelihood that the text will be comprehended.

Empirical support. Experimental studies of prose learning have indicated that content structure or organization of information in a passage is related to recall. Support for the efficacy of hierarchically organized prose comes from the work of Meyer (Meyer, 1977; Meyer, 1975; Meyer and McConkie, 1973). Her research indicates that an objective analysis of the logical structure of a prose passage allows one to make predictions about what will be remembered. Meyer used a prose analysis technique which yielded hierarchically arranged tree structures to display the structure or organization of the content in a passage. This content structure of a text passage shows how some ideas in the passage are subordinate to other ideas. Ideas for the passage are located at all levels of the tree structure. Those at the top, like the hierarchical outline, have several levels below them in a direct line relationship. Meyer has commented that, "The content structure is similar in this respect to the traditional outline."

In one study by Meyer and McConkie, subjects tended to recall groups of ideas from a passage that were related to one another in the hierarchical structure. The overall recall for the passages was about 23%. However, if a particular idea was recalled, then nearly 70% of the time the idea directly above it in the structure was also recalled.

In another study, Meyer (1975) investigated passages with identical structures of specific relations but different

content, on the whole pattern of recall. She compared the recall frequency patterns from the passages and found that the pattern of specific relationships in the structure as well as height in the structure influenced recall.

In line with Meyer's findings, this investigator will construct: (1) a hierarchical outline that represents a schema, and (2) a prose text that is based on the structure of the outline that will be used to represent the task-specific schema. Therefore, the use of the word "outline" in this study, while referring to the task-specific schema, can also be viewed as depicting the text structure in the manner of the traditional outline. For this reason the literature on outlines as study aids will be reviewed in the next chapter.

Evidence of Schema Utilization

The transfer paradigm proposed for this study will provide evidence on whether an outline is a determining factor in the behavioral outcomes that result from text processing. If the outcomes are significant, then one can infer that the outline entered into the processing activity but one can not infer at what point and for what purpose.

Text processing is a covert and complex activity and one which goes through many stages rather than occurring instantaneously (Haber, 1969). Since sensation, perception, memory, and thought are considered to be on a continuum of

cognitive activity, an information processing analysis of outline (i.e., schema) utilization may contribute to a cognitive theory of learning. Such an analysis attempts to look for correlations between the outline and responses measured during processing and at recall.

Evidence of outline utilization during text processing is limited by the points at which such probes are possible. In the present study there are two possible sources of evidence. The first of these is in the initial reading stages. Reading processes can be made overt if readers are allowed to underline selected portions of the text. By highlighting particular text portions, they overtly reveal their initial processing activities. Because underlining is quantifiable, it is a variable which can be used to examine the impact of an outline on the initial stages of the text processing. A review of the underlining literature appears in the next chapter on study aids.

A second source of evidence of outline utilization in text processing occurs during free recall. The influence of the outline can be inferred from clustering of textual content during free recall. Clustering is a measure of the grouping of items from the same category contiguously on recall protocols. If one can infer from the clustering data that the new information in memory parallels the outline structure, then indirect evidence is available that the outline was used to assimilate the text

information. The literature on clustering has already been reviewed in the previous chapter.

Evidence of outline utilization at different points of time and by different measures should contribute to a cognitive theory of text learning.

CHAPTER V

The Study Aids Literature: Outlines, Underlining

The first section of this chapter describes and analyzes two studies that have used an outline as a study aid in reading. The second section summarizes five studies in which underlining was used for this purpose. There are no reported studies in which both of these study aids were used jointly.

Outlines

In the studies to be reviewed, an outline is defined as an available plan that arranges the text ideas in a logical or chronological order based on their dependence, independence, or equality (Salisbury, 1935).

In an early study, Christensen and Stordahl (1955) presented an outline at the beginning of the passage which remained available throughout the study period. The outline that Christensen and Stordahl used contained the main points of the passage and included definitions, principles, generalizations, and propositions from which deductions and conclusions could be made. During posttesting, the outline did not significantly enhance understanding of concepts or the ability to make inferences from general principles as measured by a multiple-choice test. The reason for the failure to find significant differences

between the outline group and a control group is hard to interpret, since the researchers did not provide either a copy of the outline or of the text.

A more recent study of outlining was conducted by Glynn and DiVesta (1977). In this study, subjects were given the outline before reading the materials and did not have it available during the study period. One of the purposes of the Glynn and DiVesta study was to examine the effects of the outline on factual recall and inferencing. Because this study is directly relevant to the present study, it will be reviewed in somewhat greater detail.

The subjects were undergraduate students enrolled in an introductory educational psychology course. The design had three factors: the placement of the outline, the presence or absence of the outline, and paragraph sequencing. The factorial design had eight cells as shown in Figure 2. It should be noted that the design lacked a control measure to determine the effects of the outline itself on factual recall and inferencing.

The outline employed in the study was a highly modified version of a hierarchy originally used by Bower, Clark, Lesgold, and Winzenz (1969) for a list-learning study. It is shown in Figure 3. In this hierarchy, topics (i.e., main ideas) are identified for the reader. In addition, the class inclusion relationships (i.e., part-whole) across

	Outline Before Text		No Outline Before Text	
	Scrambled Text	Logical Text	Scrambled Text	Logical Text
Outline After Text				
No Outline After Text				

Figure 2. Experimental Design, Glynn and DiVesta (1977).

Level 1	Minerals			
Level 2	Metals		Stones	
Level 3	Rare Metals	Alloys	Gem Stones	Masonry Stones
Level 4	Silver Gold	Steel Brass	Diamond Ruby	Granite Marble

Figure 3. Outline, Glynn and DiVesta (1977).

and within categories are provided. Each level 4 topic is nested within a superordinate category (i.e., class). For example, at the lowest level, "granite" and "marble" are instances of the class "masonry stones." Similarly, at the next level "gem stones" and "masonry stones" are instances of the class of "stones" and this kind of hierarchical structure provides a first level of topic integration across categories. At a still higher level "stones" and "metals" form instances of the class of "minerals" and provide a second level of topic integration across categories. The outline also permits topic integration within categories, by subsuming level 4 topics under level 3 topics.

The textual material was generated from a matrix in which topic names from the outline and attributes (i.e., characteristics) of the topics were the dimensions of the matrix and the attribute values selected by the experimenter were the tabular entries. The section of the matrix dealing with gemstones is illustrated in Table 2. Each cell of the matrix was represented by a sentence in the text, as for example, "Diamonds are used in many types of rock drills."

The reading passage consisted of fifteen independent paragraphs, one for each topic. Each paragraph contained 3 sentences, one for each cell in the matrix. In all, there were about 500 words. The materials took from 45 to 60 minutes to read.

Table 2

Topic Name and Attribute Matrix
Glynn and DiVesta (1977)

Topic	Attribute		
	Physical Characteristics	Processing	Use
Gem Stones	impurities	cutting	jewelry
Diamond	carbon	pressure	drills
Ruby	pigeon's blood	squares	laser

Students were given the outline prior to reading the text and were instructed to memorize it. They were then asked to reproduce it from memory in the exact order in which it had been given and these reproductions were turned in to the examiner (personal communication from DiVesta). After following these initial procedures, the students began to study the prose text on "Minerals." At the end of the study period, students were given a recall test that requested information in sentences. The tests were scored for accuracy of factual information and presence of inferences.

For Glynn and DiVesta, inferences were of 3 types: intrusions (e.g., the pairing of a concept with the attribute value belonging to a second concept), elaborations (e.g., the pairing of a concept with an attribute value not mentioned in the text) and statements of superordinate - subordinate relations (e.g., the pairing of a concept with a superordinate category). Only inferences that were reasonable and logical were acceptable.

Glynn and DiVesta reported that the outline groups recalled more specific facts than the control group when the outline was presented before the text. However, the inferencing of these groups did not differ significantly.

Glynn and DiVesta's test for forming inferences can be criticized on several points. First, the operational definition of an inference is largely based on the

relationship of text items to the reader's assumed prior factual knowledge. This is an imprecise way to measure inferencing. There is no way of knowing which of the inferences are constructions based on prior knowledge and which are errors or misconceptions that are due to a superficial processing of the text. One could also argue that such a definition would allow as valid inferences, responses which are unrelated to the text. This possibility could have been assessed if a control group which just saw the outline, was included. Glynn and DiVesta did not have such a control group.

Second, Glynn and DiVesta's operational definition of an inference might not allow an optimal test of the effect of an outline. There was no need to use the outline to produce the kinds of inferences that Glynn and DiVesta accepted. For example, the outline may have reminded a student that there was a paragraph dealing with diamonds. If he remembered something about crystals from another paragraph and linked that with the concept diamond, his recall should really be scored as an error and not as an inference. Furthermore, the subject who did not have the outline could as easily have produced the same inference through a different associative chain. At best, the outline served only to assist recall of the concept name by the subject and was not involved in the production of inferences.

Third, Glynn and DiVesta's use of a free recall measure was a conservative way of measuring inferences. Subjects in the study were specifically instructed to be exact in recall. Such instructions would have had the effect of inhibiting the number of inferences that were drawn.

Fourth, there was no way of determining the extent to which the outline was used during the reading of the text. Even though the outline preceded the text, the degree to which it was used in organizing the text cannot be determined. If Glynn and DiVesta had provided a process measure, more definitive conclusions regarding the actual use of the outline could have been reached.

Finally, no effort was made to study factual recall and inference production over time. In other research (Shimmerlik, 1978) there is some evidence that organization effects may be more evident after a delay in testing. Therefore, the reliance on an immediate-retention measure by Glynn and DiVesta may have been a conservative test of an inference production hypothesis.

In summary, a more optimal assessment of the effect of an outline on the drawing of inferences should include the following:

1. The use of an inference measure that is precise, objective, and elicits inferences that are the result of integrating text statements.

2. The use of a process measure that indicates the nature of the reader's covert activity.

3. The use of a delayed-retention measure.

Underlining

Underlining is a marking, by the reader, that sets a section of text apart. The marking is usually a line drawn under the section but can sometimes be asterisks, parentheses, check marks, brackets, or highlighting. Highlighting changes the background color of a line of block print from white to a relatively unsaturated hue of yellow or blue. It has been shown to have the same effect as underlining (Fowler and Barker, 1974).

Most readers will underline to isolate statements in prose that they think are important. There are five studies that have investigated underlining. In the first four studies to be described, the subject was permitted to freely underline.

Unrestricted underlining. The earliest underlining studies were conducted by Mathews (1938) and Stordahl and Christensen (1956). Mathews, using specially written materials that were comparable to those found in a high school text book, examined the effects of underlining on the recall of detailed facts and the understanding of relationships between the important ideas. A two-part test was given immediately after reading the text and after a

delay of one month. Mutliple-choice questions were used to test for factual recall; students' understanding of the organization of the material was assessed by the way in which their arrangement of a set of "chief points" reflected relationships among the ideas. Stordahl and Christensen, using passages selected from Air Force training materials, examined the effects of underlining on the understanding of concepts and the ability to make inferences from general principles. A multiple-choice comprehension test to measure these objectives was administered immediately after studying and one week later.

Underlining did not facilitate learning or retention in either of these early studies. The lack of significant findings may be due to the particular populations of subjects that were tested. The Mathews study sampled high school students; the Stordahl and Christensen study used basic trainees in the Air Force, most of whom had not gone beyond high school. Both of these populations were, therefore, inexperienced in the use of underlining as a study aid. High school students do not generally own their own textbooks and, therefore, weren't normally free to underline. Further, there was no provision for pretraining or practice in underlining. In the next study to be reviewed, college students served as subjects. This population frequently uses underlining when reading text materials.

Idstein and Jenkins (1972) used college students to study the effects of underlining for review purposes. The material in the study was a 6,000 word passage on education and philosophical thought. Facts were presented in topic sentences and then were elaborated upon in subsequent paragraphs. Subjects were given 50 minutes to study the text and were instructed to underline the material in a manner that would aid a review of the material. The experimenters believed that the type of passage they provided would give the subjects an opportunity to selectively underline important points and that this would assist the subjects in a later review. Two weeks later, subjects were given a fifteen-minute period to review their original copy before being tested. The results failed to support their hypothesis. On a completion test, subjects who studied without underlining performed as well as those who studied with it.

Another study in the literature, Fowler and Barker (1974) investigated the effects of highlighting for review purposes. College students were asked to highlight as much of the text as they felt to be necessary for studying. The materials were scientific reprints of interesting but unfamiliar material. They were studied for one hour. One week later, the subjects returned for a ten-minute review period with the same copy. Following this review, a multiple-choice retention test was administered. An analysis

of total scores failed to reveal significant differences between highlighting and a reading condition.

In summary, the underlining studies that were described above did not control the amount of underlining a subject engaged in. On the basis of these studies, underlining does not appear to enhance text processing. The studies by Idstein and Jenkins and Fowler and Barker that examined the effects of reviewing using underlined text also failed to find significant improvement in learning.

In these studies, the failure to find underlining effects may be due to the unrestrained nature of the underlining. In the next study to be described, a subject's underlining was limited. This study has direct relevance for the present study and so will be reviewed in somewhat greater detail.

Controlled underlining. Rickards and August (1975) studied the effects of underlining when this process was restricted to only one sentence per paragraph. Ninety college students were randomly assigned to one of 6 conditions in the experiment. In 3 conditions, the subject did his own underlining; in 2 conditions, the experimenter provided the underlining; in the remaining control condition, students studied clean copy.

An 80-sentence passage of about 1,300 words on the evolution of the brain was used. The passage was presented

to the students one paragraph at a time, i.e., every paragraph was presented on a new page and once a page was turned, a subject could not look back. There were 16 paragraphs (i.e., pages) in all.

Students in the experimental groups knew that the purpose of the experiment was to examine the effects of underlining on the learning of textbook materials. Each of the experimental groups received a different set of task instructions. The three groups of students who did their own underlining were instructed to underline one sentence in each of the paragraphs. The "high" structure group was asked to underline the sentence "most" important to the structure of each paragraph. The "low" structure group was asked to underline the sentence "least" important to the structure of each paragraph. An "unrestrained" group was simply told to underline any one sentence in each of the paragraphs. Students who received underlined statements provided by the experimenter were given information about whether they had been given underlined sentences of "high" or "low" structural importance. The last group was a control. The control received no underlining in the text and no instructions to underline. Students were simply told to read the materials.

Rickards and August reported that the type of organization used in underlining affected recall. Students who were told to underline "high" structure sentences recalled significantly more than a group directed to underline "low"

structure statements. Rickards and August reported, however, that the group which underlined sentences entirely of their own choosing (i.e., any one sentence in each paragraph) performed significantly better than any other group, including a control group and a "high" structure group. This "unrestrained" group performed as well as the group instructed to underline "high" structure importance sentences, in the recall of underlined material and better in the recall of nonunderlined material. In summary, those who were "unrestrained" in their underlining were equal or superior to any other group on all measures of passage recall.

It is difficult to determine why the "unrestrained" group was better than the "high" structure group. A selective attention hypothesis may explain it. The instructions indicated that the intent of the study was to examine underlining and the students were also told that they would be tested. Perhaps directions to underline "high" structure statements encouraged the student to focus on high structural material at the expense of information that should be subsumed under it. On the other hand, the "unrestrained" group may have given equal processing time to all statements. Support for this selective attention hypothesis comes from the fact that the "unrestrained" and the "high" structure groups recalled roughly the same amount

of underlined material but only the "unrestrained" group recalled more nonunderlined material.

A second way of interpreting the discrepancy between what was underlined and total recall for the "unrestrained" and "high" groups is based on depth of processing. Subjects in the "unrestrained" group may have expended greater effort constructing a framework for interpreting the prose than those who just looked for key sentences. The greater depth of processing may not have been evident in the underlining itself.

The above interpretations of the Rickards and August study suggest that the act of underlining may have an organizational effect. This hypothesis will be further examined in the present research.

Outlines and Underlining

No previous study in the literature has investigated the effects of an outline and underlining in the same design. The literature review has indicated that the effect of outlines and underlining on knowledge acquisition is largely an unexplored area.

CHAPTER VI

Purpose of the Present Study

The present study investigated the question of whether learning and retention of text information can be augmented if an outline of the hierarchical relational network that connects the concepts in the prose text is known. The outline is conceptualized as a task-specific schema that is presumed to interact with the prose learning task.

The study examined the effects of an outline (present vs absent) and underlining (present vs absent) on learning and retention at two periods of time (immediate retention and 48-hour delayed retention). Learning and retention measures were inferred from the following dependent variables: factual recall, inference constructions, and clustering of facts. In addition, an "outline-related" underlining measure was reported for the underlining condition.

The questions that were examined were:

1. Does an outline improve factual recall, inference constructions, and clustering of facts?
2. Does underlining improve factual recall?
3. How do dependent measures change with time?
4. What are the joint effects of an outline and underlining?
5. What are the relationships among the major dependent measures?

Hypotheses

The specific hypotheses that were tested were the following:

1. Exposure to an outline will increase the number of facts recalled compared to a no outline condition.

2. Underlining will increase the number of facts recalled compared to a no underlining condition.

3. The number of facts recalled will be greater at immediate retention than at delayed retention.

4. Exposure to an outline will increase the amount of clustering in recall compared to a no outline condition.

5. Exposure to an outline will increase the maximum length of the clusters in recall compared to a no outline condition.

6. Exposure to an outline will increase the number of inferences constructed compared to a no outline condition.

7. The number of inferences constructed will be greater at immediate retention than at delayed retention.

8. Exposure to an outline will increase "outline-related" underlining compared to a no outline/underlining condition.

9. The correlation between factual recall and clustering will be positive.

10. The correlation between factual recall and inference constructions will be positive.

11. The correlation between inference constructions and clustering will be positive.

Rationale for the Hypotheses

Support for hypotheses concerning outline effects comes from the constructivist and study aids literature. The specific support for each hypothesis dealing with outline effects will be discussed separately as will the hypotheses dealing with underlining and time of testing.

Hypothesis 1. Exposure to an outline will increase the number of facts recalled compared to a no outline condition.

Exposure to an outline has been shown to significantly increase the number of facts recalled, relative to a control, in immediate retention (Glynn and DiVesta, 1977). Since it is generally believed that delayed retention depends heavily on how much was originally retained, delayed retention should also show a significant increase in the number of facts recalled relative to a control.

Hypothesis 2. Underlining will increase the number of facts recalled compared to a no underlining condition.

Support for this hypothesis comes from the underlining literature. The act of underlining forces students to actively process information and not be "passive consumers of information" (Shepherd, 1979). Rickards and August (1975) reported that when learners underlined sentences of their own choosing, learning was the highest, followed next by the underlining of sentences of high structural impor-

tance. The least effective procedure for learning was any type of experimenter-provided underlining.

Hypothesis 3. The number of facts recalled will be greater at immediate retention than at delayed retention.

Forgetting over time is well documented. Classroom studies have shown that recall of factual items in such courses as biology, chemistry, geometry, and physics are rapidly forgotten over time (Tyler, 1934; Kastrinos, 1965).

Hypothesis 4. Exposure to an outline will increase amount of clustering in recall compared to a no outline condition.

Evidence for clustering effects in recall when exposed to an outline comes from the organization literature. This literature has investigated cueing effects, i.e., the prior availability of pertinent information about the clusterable nature of the materials to be read. Balser (1972) reported that knowing the topics in advance resulted in significantly more clustering. DiVesta, Schultz and Dangel (1973) found that an instructional set to use a particular clustering strategy for oganizing the materials during learning influenced clustering in recall protocols. The outline in this study provides both the topics and a clustering strategy.

Hypothesis 5. Exposure to an outline will increase the maximum length of the clusters in recall compared to a no-outline condition.

This hypothesis is predicated on some theoretical notions of Anderson (1978). He postulated that a schema contains slots or placeholders for each component of knowledge from text. The encoded representation of the text consists of the schema that was evoked in the text processing plus the information that was processed and inserted into the slots. Subjects who were given the outline would be likely to have more places for text information to be stored than subjects who were not given the outline. Therefore, it was expected that the maximum length of a cluster would be greater for the group given the outline.

Hypothesis 6. Exposure to an outline will increase the number of inferences constructed compared to a no outline condition.

This prediction follows from the fact that a text is never fully explicit and from the claim that the outline or schema provides the basis for inference constructions (Anderson, 1978). Evidence for spontaneous production of inferences has been demonstrated by Bransford, Barclay and Franks (1972), Barclay (1973), Johnson, Bransford and Solomon (1973), Honeck (1973) and Thorndyke (1976). The logical implication of these findings is that the inference constructions result from the utilization of the schema in the text processing in order to comprehend a prose passage. The outline which provides a task-specific schema for integrating the entire text maximizes the number of possible inferences constructed.

Hypothesis 7. The number of inferences constructed will be greater at immediate retention than at delayed retention.

The basis of inference constructions is a body of explicitly presented facts and some relations among them. The literature on factual recall over time which has been previously cited in Hypothesis 3 would lead one to expect that recall of inference constructions would decrease over time.

Hypothesis 8. Exposure to an outline will increase "outline-related" underlining compared to a no outline/underlining condition.

Underlining is presumed to reflect a subject's covert organizational processes as well as serve an isolation function for him (Rickards and August, 1975). Since an outline provides an organizational framework and also indicates major thoughts and the relationships among them, exposure to an outline should be reflected in underlining behavior by a significant increase in "outline-related" underlining.

Hypothesis 9. The correlation between factual recall and clustering will be positive.

The use of clustering measures with prose materials is a viable procedure. Frase (1969) and Schultz and DiVesta (1972) have reported correlations between factual recall and clustering.

Hypothesis 10. The correlation between factual recall and inference constructions will be positive.

Inferences are constructed from a body of explicitly presented facts and some relations among them. These relations may be provided in the text or constitute the framework of a schema that is evoked during text processing. Therefore, this correlation between factual recall and inference constructions is presumed to be positive.

Hypothesis 11. The correlation between inference constructions and clustering will be positive.

This prediction of a positive correlation is predicated on the belief that inferencing and clustering are alternative measures of mental organization.

The next chapter discusses the methodology that was used to test the hypotheses.

CHAPTER VII

Methodology

Subjects

The subjects were 157 City College of New York undergraduates enrolled in education courses. From this total, 30 were dropped for failure to complete all of the parts and 22 for failure to learn the outline. Therefore, 105 subjects were considered in the interpretation of the results. Eighteen of these subjects were present for the delayed retention testing session only. They were designated as the "naive" control group in order to test the assumption that the experimental materials were unfamiliar to the subjects. Thus, a total of 87 subjects were included in the major analyses.

Of the 87 subjects, 31 were male and 56 were female. The median age of the subjects was 20 years. The age range was from 19 years to 45 years. Seventy-two per cent of the subjects (n = 63) were native speakers of English. Eighty-three per cent of the subjects (n = 72) indicated that they normally underlined; only about half (n = 42 or 48%) said that they used outlines.

Design

The design was a 2 X 2 X 2 factorial (Outline X Underlining X Time of Testing) with repeated measures on the last factor. In addition, there were two control groups. One

was a "dangling control" group that was used in an "Irrelevant Text" condition to examine the effects of the outline itself on the criterion measures. The second was a "naive" control group. It was used to test the extent to which the subjects were familiar with the materials. The following variables were manipulated:

1. An outline presented in a spatially-blocked format. (Factor A)
2. Underlining by the subject. (Factor B)
3. Time of testing. (Factor C)

A schematic representation of the design is shown in Figure 4. There were 17 subjects in the outline/underlining group, 20 subjects in the no outline/underlining group, 12 subjects in the outline/no underlining group, 23 subjects in the no outline/no underlining group and 15 subjects in the dangling control group.

Materials

Outline. The outline that was used in this study is a hierarchical one. It was presented in tree form as shown in Figure 5. This method of presentation makes the relations among the components more obvious. The outline that was used is the word tree used by Bower et al. (1969), a highly modified version of which was used by Glynn and DiVesta. The outline is defined by the "class inclusion" relation. Three levels of classification are represented

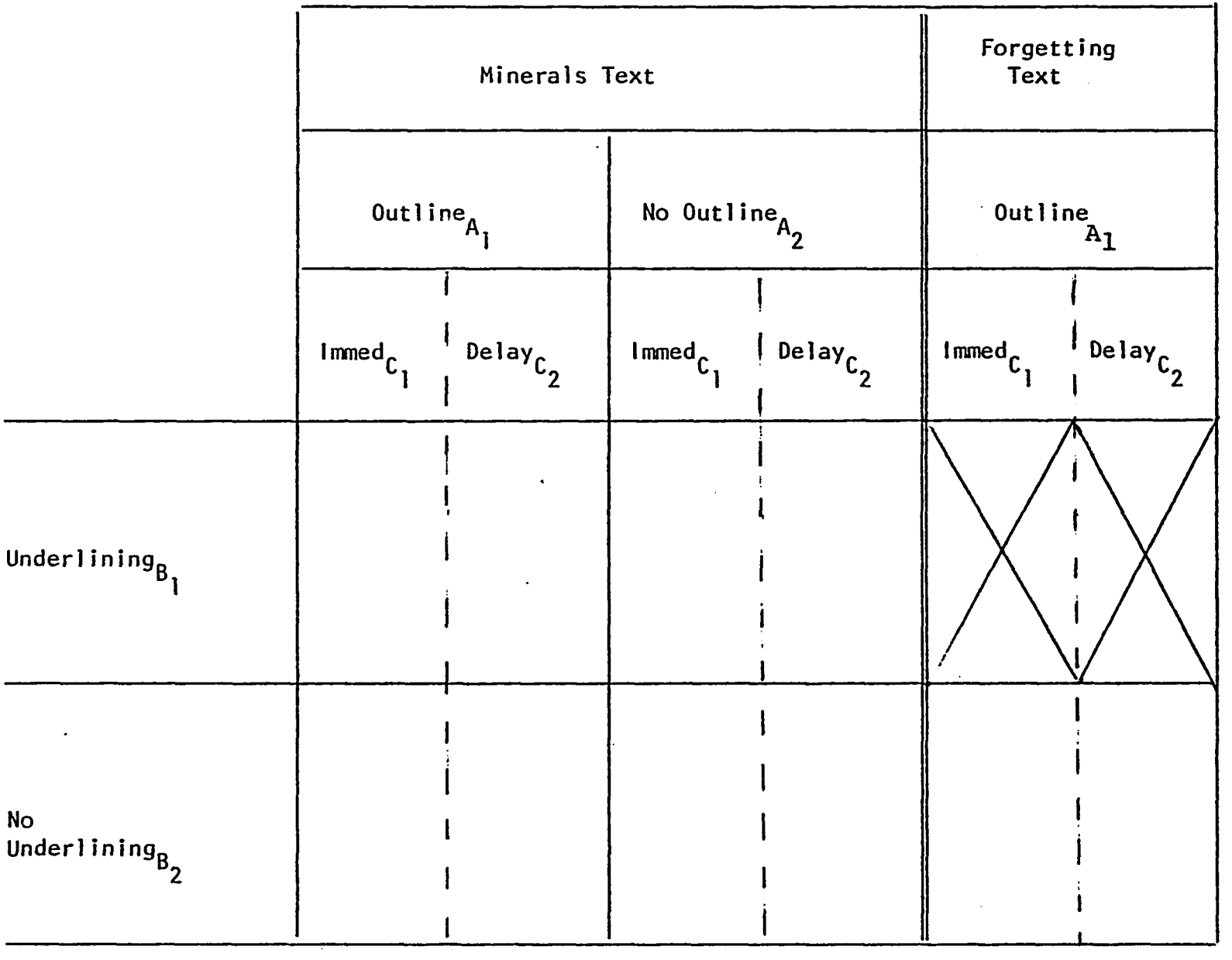

Figure 4. Experimental design, present study.

Level 1			MINERALS		
Level 2		METALS		STONES	
Level 3	RARE	COMMON	ALLOYS	PRECIOUS	MASONRY
Level 4	Platinum Silver Gold	Aluminum Copper Lead Iron	Bronze Steel Brass	Sapphire Emerald Diamond Ruby	Limestone Granite Marble Slate

Figure 5. Outline, present study.

in the outline, level 1 being the most general and level 4 the most specific. Level 4 consists of members of the classes. The levels are indexed by the left-hand column of numbers.

This outline follows a simple construction rule. The rule is to rewrite successive nodes in terms of class inclusion relations starting with the most general. For example, the node "Minerals" in Figure 5 can be rewritten as "Metals" and "Stones" since Minerals can be classified in this way.

Text. The text dealt with the early history of minerals and was constructed from a matrix of outline components (18) by topics (3). These 18 components are the level 4 entries in the outline and include: platinum, silver, gold, aluminum, copper, lead, iron, bronze, steel, brass, sapphire, emerald, diamond, ruby, limestone, granite, marble, and slate. The three topics are: Purpose for which the component was used, when it was used, and where it was used. A portion of the matrix is presented in Table 3. One or two attribute values were chosen for each cell of the matrix. The attribute values were selected so that they could be subsumed under a main idea in the paragraph in which they appear. Table 3 illustrates a section of the matrix dealing with the level 3 category, Precious Stones.

Table 3

Outline Component and Topic Matrix
Present Study

Outline Component	Topics		
	Purpose for Use	When Used	Where Used
Diamond	Cutting tool	Before 480 B.C.	Egypt
Emerald	Jewelry	2000 B.C.	Egypt
Ruby	Burial vestments	500 B.C.	Egypt
Sapphire	Church regalia	12th century	France

The passage consisted of five independent paragraphs, one for each of the level 3 categories of the outline. The sentences for the paragraph were constructed from the attribute values in the relevant cells. Each paragraph also contained two organizing statements, only one of which reflected the structure of the outline (i.e., was "outline-related"). In addition, there were several sentences about the components that represented irrelevant information vis a vis the outline. The passage can be found in Appendix A.

The passage was presented in booklet form with one paragraph for each page. The sequence followed the order in which the hierarchy was presented in the outline. The materials were extensively pilot tested prior to their use in the present study.

Procedure

The task was administered in a classroom setting with subjects being randomly assigned to one of the five conditions in the design. Subjects were given the materials appropriate to their assigned condition. The distribution was controlled by the experimenter. Each section was timed. As each section was completed, the subject put it in an envelope provided. This was done so that a subject could not look back at an earlier section. The exper-

imenter was able to easily identify the condition of each subject because all of the materials were color coded.

In the initial phase of the experiment, subjects were either taught the outline or irrelevant data on forgetting. This initial phase contained three parts. The first part consisted of directed learning of the outline by means of questions for which written responses were required. Ten minutes were allowed for this part. (The materials can be found in Appendix B.) Two study-test trials followed. Each study part was two minutes in length; each test part was allotted three minutes. The third part asked the subject to reproduce the outline from memory once more. Three minutes was allowed for this. The materials for the study-test trials can be found in Appendix C; instructions to reproduce the outline from memory can be found in Appendix D. Accuracy on the last reproduction of the outline was a precondition for the subject to be included in the data analyses. A criterion of no more than one error was used.

In the second phase of the experiment, text materials were distributed appropriate to subjects in the various conditions. Subjects were allowed eight minutes to complete this section. Those who finished earlier were asked to evaluate the materials they had just read for use in a sixth-grade class.

The third phase of the experiment involved testing. The order of testing was as follows: Free recall, inference measure, recognition measure. Eight minutes were allowed for the free recall and inference measures and two minutes for the recognition measure. The experimental session lasted on hour. The test materials used in the study are available in Appendix E.

The delayed retention tests were given 48 hours later. They were also administered in a classroom setting. The same materials and procedures were followed for delayed testing as had been followed in the initial testing.

All subjects, with the exception of those in the dangling control group, received the text on Minerals. They were requested to read the passage thoroughly at their normal rate, with the provision that once they had turned a page they were not allowed to turn back to it for further study. The instructions for all groups indicated that testing would follow at a later date. The control group received text on causes of forgetting with similar instructions.

Recall Measures

Two separate factual free recall measures were used: (1) Topic relevant facts, and (2) Topic irrelevant facts. They were scored for accuracy. Topic relevant facts were defined to be statements that paired a level 4 component of

the outline with an attribute value for one of the outline topics. An example of a topic relevant fact would be:

A sapphire was used in church regalia.

Topic irrelevant facts were defined to be statements that paired a level 4 component of the outline with text information that could not be subsumed under one of the outline topics. An example of a topic irrelevant fact would be:

A diamond is the hardest substance.

Each protocol was scored for accuracy of topic relevant facts in free recall and accuracy of topic irrelevant facts in free recall. A scoring key was provided for each measure in order to standardize scoring. The scoring key for topic relevant facts provided both verbatim and closely synonymous terminology that was accepted for pairing outline components with attribute values for the outline topics. The scoring key for topic irrelevant facts provided acceptable pairings of outline components with non-outline topics. The scoring keys can be found in Appendix F.

Recognition Measure

To test for recognition of topic relevant facts, this investigator constructed a 15-item multiple-choice test that was outline-related. The recognition measure contained items such as the following:

Steel was first made in (a) Crete (b) Africa (c) Rome (d) France.

The recognition measure has a test-retest reliability of r = .80 based on the scores of the subjects in this study within a time interval of 48 hours. Copies of this measure can be found in Appendix E. A scoring key for the recognition measure is available in Appendix F.

Inference Measures

To test for inference constructions, this investigator developed a 25-item completion test. Items on the test tapped the extent to which the subject constructed inferences at level 3 of the hierarchical outline. Inferences at other levels were not tested. The inference measure contained such items as the following:

> Two uses of alloys in ancient times were for _____ and _____.

An answer key was provided for scoring the inference measure. It contained both verbatim and closely synonymous terminology which was acceptable. The inference measure has a test-retest reliability of r = .81 based on the scores of the subjects in this study within a time interval of 48 hours. A copy of the measure is included in Appendix E. The scoring key for the measure can be found in Appendix F.

Clustering Measures

Two clustering measures were collected: (1) number of clusters, and (2) maximum cluster length. Because the prose

text was highly structured, the second measure was expected to be more sensitive to the organizational effects of the outline. The clustering measures were computed from the data on total topic-related factual recall. For these purposes, a cluster was defined as a sequential output of at least two topic-relevant facts for a given level 3 category. The following pairings of level 4 components of the outline with attribute values are examples of clusters:

a. Gold - 18,000 B.C.
   Gold - casket

b. Gold - 18,000 B.C.
   Silver - Babylonia

c. Gold - 18,000 B.C.
   Platinum - ornamentation

Underlining Measure

Subjects were given one point for each level 4 statement that was underlined if it was outline-related. The maximum score was 34.

Data Analysis

Data-text programs (Armor and Couch, 1972) were used to analyze the data on the computer. The unweighted means ANOVA program for repeated measures with unequal numbers of subjects in cells was used.

CHAPTER VIII

Results

Four experimental groups were involved in the present study. These were: (1) outline/underlining, (2) outline/no underlining, (3) no outline/underlining, and (4) no outline/no underlining. In addition, two special control groups were included. The first "dangling control" group studied the outline but did not receive the text on Minerals. The second "naive" control group received neither the outline nor the text on Minerals. An analysis of scores on the inference measure for subjects in these two special control groups will be reported below.

There were unequal numbers of subjects in cells as a result of some subjects' failure either to complete all parts of the experiment or to learn the outline. Therefore, an unweighted means analysis of variance was used. The analysis of variance source tables can be found in Appendix G.

For each dependent measure, the summary analysis of variance results will be presented first. Next, the results of the specific hypothesis tests will be discussed.

Measure of Amount of Factual Recall (Hypotheses 1-3)

Two dependent measures of amount of factual recall were analyzed: (1) free recall of topic relevant facts,

and (2) free recall of topic irrelevant facts. The statistical model, a 2 X 2 X 2 factorial (Outline X Underlining X Time of Testing) with repeated measures on the last factor, was used to analyze separately each set of free recall scores. The individual cell means can be found in Table 4. The means by factor can be found in Table 5 (Outline and Underlining) and Table 6 (Time of Testing).

The analysis of variance of scores for free recall of topic relevant facts yielded a significant main effect for Time of Testing, F (1,68) = 7.37, $p < .01$). The analysis of variance failed to show significant main effects for the Outline and Underlining manipulations (for the Outline, F (1,68) = 0.20, $p > .50$; for Underlining, F (1,68) = 0.96, $p = .33$). There were no significant two-way or three-way interactions between these variables.

The analysis of variance of scores for free recall of topic irrelevant facts also yielded a significant main effect for Time of Testing, F (1,68) = 20.48, $p < .001$. The Outline and Underlining did not create significant main effects (for the Outline F (1,68 = 0.02, $p > .50$; for Underlining, F (1,68) = 0.01, $p > .50$). None of the interactions were significant.

Hypothesis one. The first hypothesis stated that the number of facts recalled differ for the outline and the no outline conditions. This assumes that the outline would

Table 4

Mean Performance on Processing and Retention Measures, by Cell

Measure	Cell[a] Outline/ Underln n = 17	Outline/ No Underln n = 12	No Outline/ Underln n = 20	No Outline/ No Underln n = 23
Processing				
No. "outline-related" sentences underlined	14.82	-	10.40	-
Retention				
Free Recall: Topic Relevant Facts (I)	3.77	3.92	3.75	4.30
Free Recall: Topic Relevant Facts (D)	1.94	3.67	3.10	3.35
Free Recall: Topic Irrelevant Facts (I)	4.13	3.17	3.59	4.60
Free Recall: Topic Irrelevant Facts (D)	2.06	2.33	2.41	2.55
Recognition: Topic Relevant Facts (I)	6.65	6.75	5.95	6.96
Recognition: Topic Relevant Facts (D)	6.00	6.58	5.75	6.74
Free Recall: Number of Clusters (I)	1.12	1.33	1.30	1.44
Free Recall: Number of Clusters (D)	0.83	1.75	1.00	1.35
Free Recall: Maximum Cluster Length (I)	2.82	2.75	2.40	2.83
Free Recall: Maximum Cluster Length (D)	1.47	3.58	1.90	2.48
Inference Constructions (I)	10.35	10.33	8.20	8.04
Inference Constructions (D)	11.71	9.92	7.60	8.30

Note. I = Immediate Retention; D = Delayed Retention

[a]There was also a dangling control and a naive control. Mean performance for inference constructions for these groups are:
Dangling control, M = 5.93 (n = 15)
Naive control, M = 4.33 (n = 18)

Table 5

Mean Performance on Retention Measures, by Outline and Underlining Factors

Measure	Outline Factor		Underlining Factor		Total
	Outline n=29	No Outline n=43	Underline n=37	No Underline n=35	
Free Recall: Topic Relevant Facts (I)	3.84	4.03	3.76	4.11	3.93
Free Recall: Topic Relevant Facts (D)	2.80	3.22	2.52	3.51	3.01
Free Recall: Topic Irrelevant Facts (I)	3.67	4.09	3.38	3.33	3.35
Free Recall: Topic Irrelevant Facts (D)	2.20	2.48	2.24	2.44	2.34
Recognition: Topic Relevant Facts (I)	6.70	6.45	6.30	6.35	6.58
Recognition: Topic Relevant Facts (D)	6.29	6.25	5.38	6.66	6.27
Free Recall: Number of Clusters (I)	1.23	1.37	1.21	1.38	1.30
Free Recall: Number of Clusters (D)	1.32	1.17	0.94	1.55	1.25
Free Recall: Maximum Cluster Length (I)	2.79	2.61	2.61	2.79	2.70
Free Recall: Maximum Cluster Length (D)	2.53	2.19	1.69	3.03	2.36
Inference Constructions (I)	10.34	8.12	9.23	9.19	9.23
Inference Constructions (D)	10.31	7.95	9.65	9.11	9.38

Note. I = Immediate Retention; D = Delayed Retention

Table 6

Mean Performance on Retention Measures, By Time of Testing Factor

Measure	Time of Testing: Immediate	Time of Testing: Delayed	Totals
Free Recall: Topic Relevant Facts	3.93	3.01	3.47
Free Recall: Topic Irrelevant Facts	3.88	2.34	3.11
Recognition: Topic Relevant Facts	6.58	6.27	6.42
Free Recall: Number of Clusters	1.30	1.25	1.27
Free Recall: Maximum Cluster Length	2.70	2.36	2.53
Inference Constructions	9.23	9.38	9.31

enhance factual recall. Hypothesis one was not supported. The number of topic relevant facts recalled for the outline condition and the no outline condition from Table 5 were, respectively, $\underline{M}$ = 3.84 and $\underline{M}$ = 4.03. Similar data were recorded for the mean number of topic irrelevant facts recalled. The outline condition recalled an average of 3.67 topic irrelevant facts, the no outline condition, 4.09 facts.

Hypothesis two. The second hypothesis stated that the number of facts recalled would differ for the underlining and the no underlining conditions. This assumes that the activity of underlining facilitates factual recall. Hypothesis two was not confirmed. The mean number of topic relevant facts recalled was 3.76 for the underlining condition and 4.11 for the no underlining condition. For topic irrelevant facts, both the underlining and the no underlining conditions recalled an average of 3.88 facts.

Hypothesis three. The third hypothesis stated that more facts would be recalled at immediate retention than at delayed retention. This assumes that with the passage of time, facts would become less readily accessible. Hypothesis three was supported. Subjects recalled more topic relevant facts at immediate retention ($\underline{M}$ = 3.93) than they did at delayed retention ($\underline{M}$ = 3.01). Subjects also recalled more topic irrelevant facts at immediate retention ($\underline{M}$ = 3.88) than they did at delayed retention ($\underline{M}$ = 2.34).

In summary, both factual free recall measures were significantly affected by Time of Testing, thus confirming hypothesis three.

Recognition Measure

Scores on a recognition measure of topic relevant facts were also analyzed using a 2 X 2 X 2 repeated measures analysis of variance. The factors were Outline X Underlining X Time of Testing with repeated measures on the last factor. The individual cell means can be found in Table 4. The means for the Outline and Underlining factors can be found in Table 5 and for Time of Testing in Table 6. There were no significant sources of variance. Neither the Outline, F (1.68) $< 1.$, nonsignificant, nor Underlining, F (1.68) = 1.25, p = .27, nor Time of Testing, F (1.68) = 2.27, p = .14, were significant. These results generally are in agreement with free recall measures since the outline and underlining failed to affect recognition scores. However, delay in time did not affect recognition scores as it did free recall scores.

Measures of Clustering in Recall (Hypotheses 4 and 5)

Two other dependent measures, the number of clusters in free recall protocols and the maximum cluster length in these protocols were analyzed. The analysis used a 2 X 2 X 2 factorial design (Outline X Underlining X Time of

Testing) with repeated measures on the last factor. Table 4 contains the individual cell means for each measure. Tables 5 and 6 contain the means for each of the factors.

The analysis of variance of the number of clusters in the recall protocols showed neither the Outline, F (1,68) $< 1.$, nonsignificant, nor Underlining, F (1,68) = 2.37, $p = .13$, nor Time of Testing, F (1,68) = 0.10, $p > .50$, were significant. There were no significant two-way or three-way interactions.

The analysis of variance of maximum cluster length in the free recall protocols also yielded nonsignificant main effects. Neither the Outline, F (1,68) = 0.28, $p > .50$, nor Underlining F (1,68) = 2.50, $p = .12$, nor Time of Testing, F (1,68) = 1.38, $p = .24$, were significant sources of variance. However, the Underlining X Time interaction was significant, F (1,68) = 4.05, $p = .05$.

A graph of this interaction is presented in Figure 6. Newman-Keuls post hoc tests (Winer, 1962) were used to determine differences in means among the four conditions: (1) underlining, immediate retention, (2) underlining, delayed retention, (3) no underlining, immediate retention, and (4) no underlining, delayed retention. A post hoc comparison of the means for maximum cluster length ($p < .05$) revealed the following:

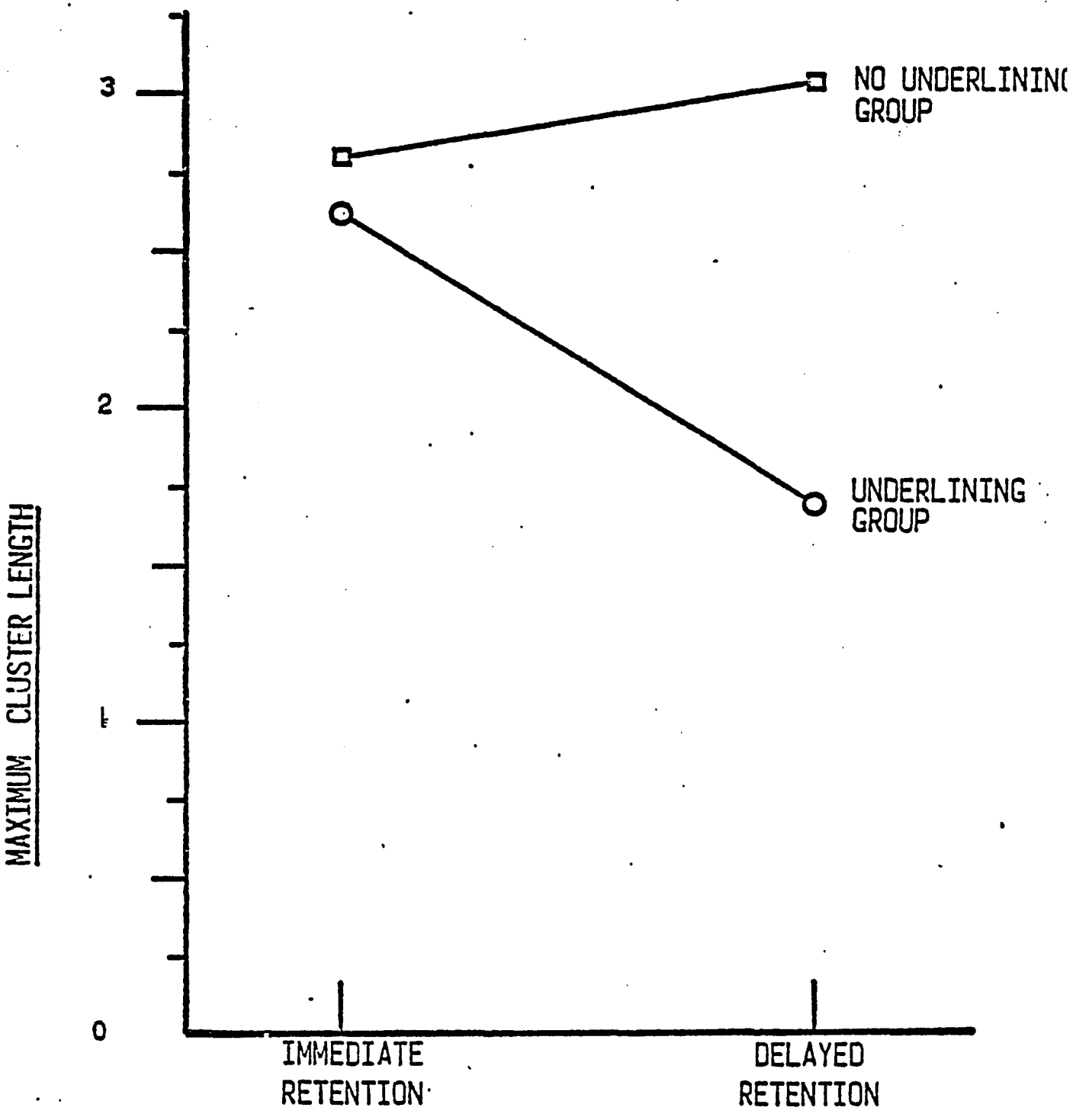

Figure 6: Underlining X Time Interaction For Maximum Cluster Length

1. The maximum cluster length for the underlining group was significantly greater at immediate retention (I) than at delayed retention (D)

   ($\underline{M}_{I}$ = 2.61; $\underline{M}_{D}$ = 1.69)

2. The maximum cluster length for the no underlining (NU) group in immediate retention is significantly greater than for the underlining group (U) in delayed retention

   ($\underline{M}_{NU,I}$ = 2.79; $\underline{M}_{U,D}$ = 1.69)

3. The maximum cluster length for the no underlining group in delayed retention is significantly greater than for the underlining group in delayed retention

   ($\underline{M}_{NU,D}$ = 3.03; $\underline{M}_{U,D}$ = 1.69)

Newman-Keuls tests of the significant Underlining X Time interaction, particularly findings one and three above, indicated that the no underlining group showed more evidence of conceptual organization than the underlining group.

Hypothesis four. The fourth hypothesis stated that the amount of clustering in recall would differ for the outline and the no outline conditions. This assumes that the outline would influence organization in free recall. Hypothesis four was not confirmed. The mean number of clusters in immediate recall protocols was 1.23 for the outline condition and 1.37 for the no outline condition. The

mean number of clusters in delayed recall protocols was 1.32 for the outline condition and 1.17 for the no outline condition. (See Table 5.)

Hypothesis five. The fifth hypothesis stated that maximum cluster length in free recall protocols would differ for the outline and the no outline conditions. This hypothesis was based on the assumption that the outline would influence organization in recall. Hypothesis five was not confirmed. Maximum cluster length means in immediate recall protocols were 2.79 for the outline condition and 2.61 for the no outline condition. Maximum cluster length means in delayed recall protocols were 2.53 for the outline condition and 2.19 for the no outline condition.

Inference Construction Measure (Hypotheses 6 and 7)

Scores on the inference test were analyzed using a 2 X 2 X 2 factorial (Outline X Underlining X Time of Testing) with repeated measures on the last factor. The individual cell means can be found in Table 4. The means for the Outline and Underlining factors can be found in Table 5 and for Time of Testing in Table 6.

The analysis of variance of inference scores showed that the Outline was a significant source of variance F (1,68) = 7.76, $p < .01$. There were no other significant main effects. Neither Underlining, F (1,68) = 0.12, $p > .50$, nor Time of Testing, F (1,68) = 0.24, $p > .50$,

were significant sources of variance. There were no significant two-way interactions, but there was a significant triple interaction of Outline X Underlining X Time of Testing, F (1,68) = 4.58, $p < .05$. A graph of the simple interactions is presented in Figure 7.

Newman-Keuls tests ($p < .05$) were used to determine differences in means that were significant among the four conditions. The first set of findings related to changes over time. They are the following:

1. Subjects who were given the outline and also underlined scored significantly higher on a delayed inference measure than on an immediate inference measure

   (M_I = 10.35; M_D = 11.71)

2. Subjects who were not given the outline but who underlined scored significantly lower on a delayed inference measure than on an immediate inference measure

   (M_I = 8.20; M_D = 7.60)

3. Delays in time did not affect inference scores for subjects who did not underline. For the outline/no underlining group, M_I = 10.33 and M_D = 9.92. For the no outline/no underling group, M_I = 8.04, M_D = 8.30.

The second set of findings are related to differences in immediate retention between groups. The comparisons include the following:

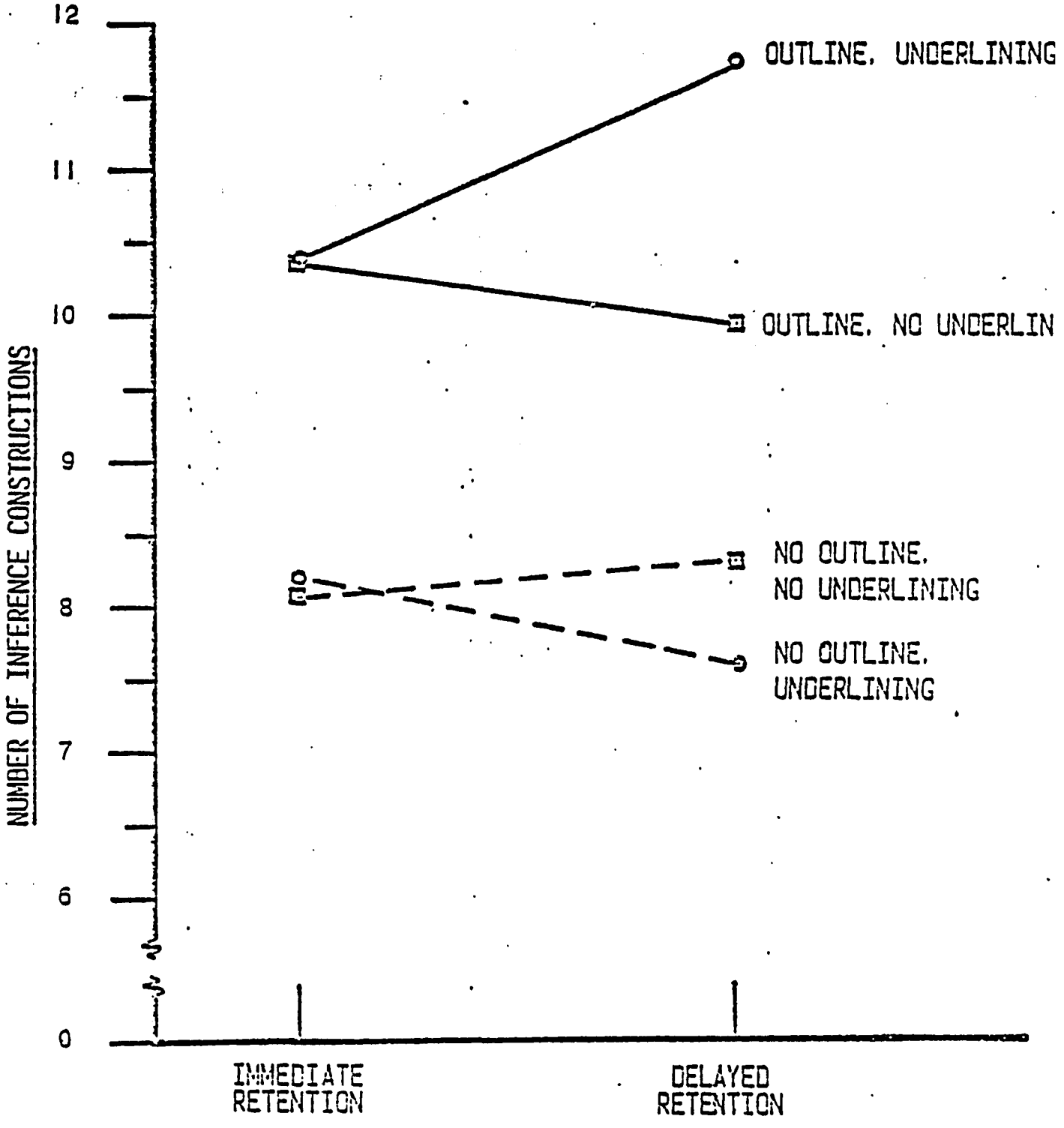

Figure 7: Simple Interactions for Inference Scores

4. Subjects who were given the outline (O) and also underlined scored significantly higher on the immediate inference measure than subjects who were not given the outline (NO) but underlined

   ($\underline{M}_{O} = 10.35$; $\underline{M}_{NO} = 8.20$)

5. Subjects who were given the outline and also underlined scored significantly higher on the immediate inference measure than the group who were not given the outline and also did not underline

   ($\underline{M}_{O,U} = 10.35$; $\underline{M}_{NO,NU} = 8.04$)

6. Subjects who were given the outline but did not underline scored significantly higher on the immediate inference measure than the group who were not given the outline and also did not underline

   ($\underline{M}_{O,NU} = 10.33$; $\underline{M}_{NO,NU} = 8.04$)

7. Subjects who were given the outline but did not underline scored significantly higher on the immediate inference measure than subjects who were not given the outline but under lined

   ($\underline{M}_{O,NU} = 10.33$; $\underline{M}_{NO,U} = 8.20$)

8. For the outline group, the presence or absence of underlining made no significant difference in the amount recalled at immediate retention

   ($\underline{M}_{NU} = 10.35$; $\underline{M}_{U} = 10.33$)

9. For the no outline group, the presence or absence of underlining made no significant difference in the amount recalled at immediate retention

($\underline{M}_U$ = 8.20; $\underline{M}_{NU}$ = 8.04)

The last set of findings related to differences in delayed retention within the outline and no outline groups. They include:

10. In the outline group, subjects who underlined scored significantly higher than subjects who did not underline

($\underline{M}_U$ = 11.71; $\underline{M}_{NU}$ = 9.92)

11. In the no outline group, subjects who underlined scored significantly lower on the delayed inference measure than the group which did not underline

($\underline{M}_U$ = 7.60; $\underline{M}_{NU}$ = 8.30)

Prior to discussing the support that the analysis of variance of the inference scores provided for the hypotheses in this study, two additional analyses will be presented. These are: (1) a comparison of means between the outline/no underlining experimental group and the dangling control group, and (2) a comparison of means between the dangling control group and a "naive" group. This study assumed that the outline would not appreciably affect inference scores without a subject's exposure to the text passage. The possibility existed, however, that the outline alone

improved performance. If this were true, then there should have been no difference between the mean of the "dangling control" group and the mean of the experimental group which received the outline and did not underline. Subjects in the experimental outline/no underlining group constructed more inferences at immediate retention, $\underline{M}$ = 10.33, than subjects in the "dangling control" group, $\underline{M}$ = 5.93. The difference between the means was significant, $\underline{t}$ (25) = 2.86, $\underline{p} < .01$.

A second comparison of means was made to test the possibility that the outline alone improved performance. This comparison was between the two groups which did not receive the text: the dangling control group and the naive control. The naive group of subjects had a mean inference score of $\underline{M}$ = 4.33 compared to a mean inference score of $\underline{M}$ = 5.93 for the dangling control which had received the outline. The differences between the means was not significant. Clearly, the outline did not contain any information that would provide a direct advantage in answering the inference test.

Hypothesis six. Hypothesis six stated that the number of inferences constructed would differ for the outline and the no outline conditions. This hypothesis is based on the assumption that the outline provides the optimal structure for generating inferences. Hypothesis six was supported.

Subjects in the outline condition constructed more inferences at immediate and delayed retention ($\underline{M}_I$ = 10.34, $\underline{M}_D$ = 10.81) than subjects in the no outline conditions ($\underline{M}_I$ = 8.12, $\underline{M}_D$ = 7.95).

Hypothesis seven. Hypothesis seven stated that more inferences would be constructed at immediate retention than at delayed retention. This hypothesis was based on the assumption that with the passage of time, inferences would become less readily accessible. Hypothesis seven was not supported. The mean number of inferences constructed was 9.23 for immediate retention and 9.38 for delayed retention (see Table 6).

Underlining Measure (Hypothesis 8)

The eighth hypothesis stated that the number of "outline-related" sentences underlined would differ for the outline and no outline conditions. Hypothesis eight was confirmed. A statistical comparison of the means for the dependent variable, number of "outline-related" text sentences underlined was made for the outline/underlining group and the no outline/underlining group. The outline/underlining group underlined significantly more "outline-related" text sentences, $\underline{t}$ (35) = 2.03, $\underline{p}$ = .05. The outline clearly influenced underlining behavior.

Correlational Analysis (Hypotheses 9-11)

A correlation matrix was computed for all dependent measures. Scores for the processing measure, the retention measures, and the organization measures were intercorrelated to explore possible relationships among the variables. The correlations are shown in Table 7. The correlations fall into three distinct groups. There are 7 correlations that are equal to or greater than .70; these have been designated as "high" correlations. There are 23 correlations which range between .40 and .70; these are considered to be "moderate" correlations. The remaining 48 correlations are deemed to be "low".

For each comparison to be discussed below, the general findings will be discussed first. Next, the results of the hypothesis testing will be presented.

Correlations Among Recall Measures

Two recall measures were used: (1) free recall of topic relevant facts, and (2) free recall of topic irrelevant facts. Correlations were computed between these two measures. For immediate and delayed retention, these correlations were $r = .36$, $p < .01$ and $r = .35$, $p < .05$, respectively. The low relationships between the measures, despite the fact that about the same number of facts were recalled (for topic relevant facts, $M_I = 3.93$; for topic

Table 7

Intercorrelations of All Dependent Measures Both in Immediate (I) and Delayed (D) Retention

Dependent Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. No. "outline-related" sentences underlined		.03	-.37*	.06	-.22	-.04	.02	.14	-.27	-.03	-.26	.33	.29
2. Free Recall: Topic Relevant Facts (I)			.60***	.36**	.19	.48***	.51***	.86***	.53***	.84***	.55***	.31**	.38**
3. Free Recall: Topic Relevant Facts (D)				.33**	.35**	.49***	.47***	.50***	.87***	.42***	.77***	.25*	.29*
4. Free Recall: Topic Irrelevant Facts (I)					.65***	.25*	.15	.32**	.39***	.27*	.22	.19	.17
5. Free Recall: Topic Irrelevant Facts (D)						.19	.11	.09	.44***	.11	.24*	.13	.16
6. Recognition: Topic Relevant Facts (I)							.80***	.40***	.45***	.33**	.33**	.46***	.42***
7. Recognition: Topic Relevant Facts (D)								.47***	.42***	.38***	.29*	.42***	.45***
8. Free Recall: Number of Clusters (I)									.45***	.66***	.40***	.28*	.31**
9. Free Recall: Number of Clusters (D)										.32**	.72***	.32**	.37**
10. Free Recall: Maximum Cluster Length (I)											.45***	.14	.23*
11. Free Recall: Maximum Cluster Length (D)												.25	.35
12. Inference Constructions (I)													.81***
13. Inference Constructions (D)													

Note. I = Immediate Retention; D = Delayed Retention

$n = 37$ for dependent variable 1, and $n = 72$ for all others.

*$p < .05$

**$p < .01$

***$p < .001$

irrelevant facts, $\underline{M}_I$ = 3.88), suggests that different schemata were engaged in processing the materials.

Correlations Among Recall and Process Measures

Correlations were computed between the process measure, number of "outline-related" sentences underlined, and the two free recall measures. Three of the four correlations were not significantly greater than zero. The correlation between number of "outline-related" sentences underlined and the delayed retention measure of free recall of topic relevant facts was significant and low ($\underline{r}$ = -.37; $\underline{p} < .05$). Subjects who underlined extensively tended to recall about as much or a little less than subjects who underlined little. These results suggest that amount of underlining does not determine how much is recalled.

Correlations Among Recall and Recognition Measures

Correlations were computed between free recall of topic relevant facts and recognition. These correlations were: for immediate retention, $\underline{r}$ = .48, $\underline{p} < .001$; for delayed retention, $\underline{r}$ = .47; $\underline{p} < .001$. Subjects who did well on the free recall of topic relevant facts were likely to do well on the recognition measure.

Correlations were also computed between the free recall of topic irrelevant facts and the recognition measure. For immediate retention, the correlation was low ($\underline{r}$ = .25,

$p < .05$); for delayed retention, the correlation was non-significant. There appears to be little association between free recall of topic irrelevant facts and a recognition measure which measures topic relevant facts. This again supports the belief that different schemata were evoked in processing the prose passage.

Correlations Among Clustering Measures

Two clustering measures were used: (1) the number of clusters in free recall protocols, and (2) the maximum cluster length in free recall protocols. Correlations were computed between these two measures. They were found to be high, $r = .66$; $p < .001$ for immediate retention and $r = .72$, $p < .001$ for delayed retention. Subjects who produced more clusters in their output tended to have longer clusters.

Correlations Among Recall and Clustering Measures

Correlations were computed between the free recall of topic relevant facts and the number of clusters in free recall protocols. These correlations were: for immediate retention, $r = .86$, $p < .001$; for delayed retention, $r = .87$, $p < .001$.

Correlations were also computed between the free recall of topic relevant facts and the maximum size of the cluster in free recall protocols. These correlations were: for immediate retention, $r = .84$, $p < .001$; for delayed re-

tention, $r = .77$, $p < .001$. Subjects who did particularly well on the free recall of topic relevant facts were likely to recall the information in a highly organized fashion. This conclusion is based on the findings from the two clustering measures. It appears that materials which can be well organized are recalled better.

Correlations were also computed between the free recall of topic irrelevant facts and the two clustering measures. Three of the four correlations were low. There was one moderate correlation between the free recall of topic irrelevant facts and the number of clusters in free recall protocols at delayed retention ($r = .44$, $p < .001$). No conclusions can be drawn, however, since the difference between the correlation at immediate retention and the correlation at delayed retention was not significant.

Hypothesis nine. The ninth hypothesis stated that there would be a positive correlation between factual recall and clustering. This hypothesis was based on the assumption that organization aids recall. Hypothesis nine was confirmed. Correlations between free recall of topic relevant facts and number of clusters in free recall protocols were high and positive. Correlations between free recall of topic relevant facts and maximum cluster length were also high and positive. The same correlations using topic irrelevant facts were low to moderate. The differential correlational results suggest that the amount

of clustering is partially dependent on the ease with which given facts can be fitted into an organizational framework.

Correlations Among Recognition and Clustering Measures

Correlations were computed between the recognition measure and the two clustering measures. Correlations between recognition and number of clusters were moderate (immediate retention, $r = .40$; $p < .001$; delayed retention, $r = .42$, $p < .001$). Correlations between recognition and maximum cluster length were significant but low. These results suggest that recognition performance is not as dependent on organization as is free recall. It may be that free recall and recognition engage different mechanisms in storage and/or retrieval.

Correlations Among Recall and Inference Measures

Correlations were computed between the two recall measures and the inference measure. The correlations between free recall of topic relevant facts and the inference measure were significant but low ($r = .31$, $p < .01$ for immediate retention; $r = .29$, $p < .05$ for delayed retention). There was no significant relationship between free recall of topic irrelevant facts and the inference measure. The implication of these results when considered with the major finding of this study (i.e., that an outline enhances inferencing) is that factual knowledge alone is not a good predictor of inferencing.

Hypothesis ten. The tenth hypothesis stated that there would be a positive correlation between factual recall and inference construction. This assumes that inferencing depends on factual knowledge. Hypothesis ten was supported. Correlations between the free recall of topic relevant facts and the inference measures were significant but low implying that factual knowledge is not the sole determinant of inferencing.

Correlations Among Recognition and Inference Measures

Correlations were computed between the recognition and the inference measures. The correlations between the recognition and the inference measure were moderate. For immediate retention, $r = .46$, $p < .001$; for delayed retention, $r = .45$, $p < .001$. Factual knowledge, when measured by recognition, is a fair predictor of inferencing.

Correlations Among Clustering and Inference Measures

Correlations were computed between the two clustering measures and the inference measure. For number of clusters in the protocols, the relationship between clustering and the inference measures was low ($r = .28$, $p < .05$); for maximum cluster length it was nonsignificant. These results imply that clustering is not a good predictor of inferencing.

Hypothesis eleven. The eleventh hypothesis stated that there would be a positive correlation between inference constructions and clustering. This assumes that inferencing and clustering are alternative forms of organization. Hypothesis eleven was confirmed. Correlations between inferencing and number of clusters in free recall protocols were generally positive and low: For number of clusters in immediate retention, $r = .28$, $p < .05$.

CHAPTER IX

Discussion

Basic Concepts and Inferencing

This study investigated the effects of outlines on learning and retention from prose. The most significant finding of this study is that an outline facilitates inferencing at immediate retention and 48 hours later. This result is the first empirical demonstration that an outline enhances inferencing. The failure of previous researchers to report significant inference effects for an outline (Glynn and DiVesta, 1977) is probably due to their reliance on a free recall paradigm. Data from the present study support this contention. When using Glynn and DiVesta's procedures for assessing inferences from the recall data in the present study, it was found that the mean number of inferences was less than one (M = .08). This represented only 8% of the total number of statements in the protocols (M = 9.9). Also, 30% of the inferences that were generated could be errors since they couldn't be substantiated from information explicitly stated in the text. Thus, there was little evidence of inferencing in the free recall data from the present study.

However, the present study examined inferencing by a more direct approach using a series of specially devised questions. The questions that were constructed tapped

inferences at level 3 of the hierarchical outline used in this study (see Figure 5). For example, if an early use for bronze was described in the text, the inference measure asked for an early use for alloys. Level 3 of the outline is comparable to what researchers who study categorization (see e.g., Rosch and Mervis, 1975, Rosch, Mervis, Gray, Johnson and Boyes-Braem, 1976) have referred to as the "basic" level of abstraction or inclusiveness. It is the level at which the categories are most differentiated from each other. It is also the category level whose members share many attributes in common. Rosch et al. (1976) have suggested that, "basic objects are the categories which best mirror the correlational structure of the environment" (p. 385). It is for this reason that the present study chose to tap inference constructions at this basic level of abstraction and inclusiveness.

It is appropriate in future research to examine whether the outline facilitates other types of inferencing. For example, inferences such as the following, which were not examined in the present study, might be considered:

1. Early man used gold before he used silver. (An inference generated between concepts within the same category.)

2. Egyptians were the first people to use rare metals, but not the first to use alloys. (An inference generated across categories.)

Prose Structure

The present study failed to find that either an outline or underlining improved factual recall. The lack of significant findings for the outline are contrary to the Glynn and DiVesta findings. The present study differs from the Glynn and DiVesta investigation in two ways. First, factual recall is defined differently in this study. Glynn and DiVesta defined factual recall as statements associated with level 3 as well as level 4 components of the outline. The present study limited factual recall to only level 4 statements. The latter would appear to be a more realistic definition of the kinds of facts that are learned in a school setting. Bloom's taxonomy of educational objectives in the cognitive domain (1956) has a hierarchical order and places facts at the lowest level of the hierarchy. Since level 4 is the most specific in the outline, i.e., it contains instances of particular level 3 categories, it is at this level that educational materials and textbooks introduce factual knowledge.

Second, paragraphs were constructed somewhat differently in the two studies. For the Glynn and DiVesta study, the statements for each level 4 component were contained in separate paragraphs. The text paragraphs of the present study were more comprehensive and integrative. Each paragraph was devoted to a "basic" level 3 component. The

factual information for all of the component members subsumed under that component was included. An example may help illustrate the difference. Glynn and DiVesta constructed separate paragraphs for diamonds and rubies. In the present study, both sets of information were included in one paragraph devoted to precious stones, a level 3 component.

The paragraph structure in the present study may have provided the organization needed for factual recall. This may also have been the reason for the lack of significant findings for underlining as well. Support for the contention that the text structure was the significant variable in factual recall comes from the fact that the number of clusters in free recall protocols was statistically equivalent for the different treatments. Since the structure of prose has been shown to be a powerful variable in determining recall of prose (Meyer, 1977), further investigation of the facilitating effect of outlines and underlining should be directed at varying the nature of the text structure.

Forgetting

The present study investigated the effect of time of testing on the major dependent variables. Retention was measured immediately following the reading of the text materials and after a 48-hour delay. The primary finding

is that forgetting curves for different kinds of materials are dissimilar. For factual recall, as measured by the recall of topic relevant facts and the recall of topic irrelevant facts, 48-hour delayed recall was significantly lower than at immediate retention. Recall of topic relevant facts showed a loss of 23.4% over the two-day period; recall of topic irrelevant facts showed a loss of 39.8%. These findings are roughly in agreement with those given by McLeish (see Gage and Berliner, 1975, p. 144) who reported a drop of 58.5% for the recall of facts presented in a lecture after a one-week delay.

In the present study, the 48-hour delay did not affect recognition scores for topic relevant facts or inference constructions as it did the free recall of topic relevant facts. There are no difference in scores on a recognition measure between immediate and 48-hour delayed retention. There are also no differences in scores on an inference measure between immediate and 48-hour delayed retention. One plausible explanation of these findings is that memory traces are relatively permanent (Penfield, 1969). This view of memory holds that the long-term memory storage system of man is cue dependent. That is, given the correct cue for proper retrieval, information in long-term storage can almost always be retrieved. Both the recognition measure, which was a multiple-choice test, and the inference measure, which was a fill-in test, provided cues.

Underlining and Segregated Memory Representations

The present study indicates that unrestricted student underlining depresses memory organization. This conclusion is drawn from two sets of data. The first set of data relates to maximum cluster length in free recall protocols. For the underlining group, maximum cluster length was significantly less at delayed retention than for the no underlining group. For the underlining group, also, maximum cluster length was significantly less at delayed retention than at immediate retention. The second set of data relates to inference constructions. The underlining group scored significantly lower on the delayed measure than the no underlining group.

Hayes-Roth and Hayes-Roth (1978) have recently proposed a theory that provides a rationale for the finding of the present study that underlining depresses memory organization. They suggest that memory representation may be either structurally segregated or structurally integrated. The critical feature distinguishing the two representations is the extent to which individual propositions share common sub-representations in memory. If separate sub-representations are involved for sets of propositions, the memory representation is said to be segregated. If common sub-representations are involved for sets of propositions, the memory representation is said to be integrated. Each

kind of memory representation is useful for certain objectives. Integrated memory representations are useful for inferencing. Segregated memory representations are adaptive for the remembering of specific propositions.

In this study, unrestricted underlining may result in segregrated memory representations. This possibility implies that underlining may be a viable variable for investigating memory representation in future research.

Evidence of Outline Utilization

The present study assumed that the outline would be evoked during the processing of the prose text. An outline serves two functions for readers. First, it highlights for readers what they should attend to during the processing. Second, the outline provides them with an organizational framework for internalizing the information. In the present study, evidence of outline utilization was sought from two sources: underlining and clustering behaviors. It was expected that underlining would reflect the highlighting function of the outline and that clustering would reflect the organizational function of the outline.

The underlining data indicate that the outline was used in the processing of the prose text. The mean number of "outline-related" sentences underlined by the subjects in the outline/underlining group was 14.82 or about 3 sentences per paragraph. Subjects in the no outline/under-

lining group underlined an average of 10.40 sentences in all, or about 2 statements per paragraph. A statistical comparison of the means indicated that the outline/underlining group underlined a significantly greater number of "outline-related" sentences. These data suggest that subjects underline those portions of the text that they want to become more familiar with or as Shepherd (1979) put it in his study-skills text, the things they want to learn. Topics from the outline thus become additional text portions to be isolated or highlighted for learning purposes. Underlining used for this purpose is a perceptual aid which highlights the points to be learned. It may or may not have integrative effects as well. In conclusion, evidence of outline utilization provided by the underlining measure documents the highlighting function of the outline.

In the present study, it was expected that the organizational component of the outline would be evident in clustering in the free recall protocols. A significant difference between the outline and no outline groups would have indicated that the organizational structure of the outline influenced recall. A comparison of the clustering data, however, indicated nonsignificance. This result probably can be attributed to the limited way in which clustering was defined and measured in this study. Clustering was measured by a sequential output of level 4

information for each of the level 3 categories. This was also the way in which the text paragraphs were constructed. Each of the individual paragraphs contained factual information for level 4 concepts from one of the level 3 categories.

Further research is needed to document the organizational aspects of outline utilization. There are several ways of addressing the issue. One way is to use a longer delay measure of retention. Better organized material has been shown to be remembered longer. A second way is to randomize the sentences in each of the paragraphs. A third way is by constructing paragraphs with a greater proportion of outline-irrelevant text propositions.

Educational Implications

Constructing inferences plays an important role in the comprehension of prose passages (Thorndyke, 1976). Evidence obtained in the present study indicates that a pre-induced outline (i.e., an available task-specific schema) influences the number of inferences constructed during the processing of a prose text. This finding has several interesting implications for education.

First, it may be that many reading comprehension problems result from impoverished and irrelevant schemata being used in text processing. Such reading problems also arise when tangential or less task-specific schemata are

evoked. For both reasons, therefore, the introduction of a suitable outline prior to the reading of text materials, making explicit the relevance of the outline to the learning task and requiring the student to learn the outline, should result in greater reading comprehension.

Second, the lack of a proper schema may lead students to process the materials in a piece-meal fashion. Such tangential schemata if evoked, would minimize the number of appropriate inference constructions. To counteract this loss, the prior learning of an outline which takes into account the kinds of misconceptions exhibited by the student, might substantially enhance the construction of accurate inferences.

Third, this study has relevance for the sequencing of textbook prose. The findings indicate that textbook writers should provide a schematic outline for the reader at the beginning of a textbook. This outline should interrelate the topics to be presented in subsequent chapters. It would provide the relational network that ties principles and specific information together. Providing the outline at the beginning of the text would make it more likely that the outline becomes an integral part of a student's cognitive structure that would probably be evoked in the text processing of subsequent chapters.

Finally, training in outlining could be provided in courses that teach study skills. One of the goals of such a course should be to focus on how people use outlines to construct inferences. Making an outline requires that students find the major thoughts in a passage and show the relationships among them. Once they have identified the main ideas and their interrelations, they would be ready to use the outline to generate inferences from a particular prose passage.

APPENDICES

Appendix A: Learning Passages

YOU MAY UNDERLINE

Rare metals of the earth have been used by kings and commoners alike. Gold was discovered by man as early as 18,000 B.C. Native gold usually occurs as lumps or nuggets. Gold was used mainly for ornamentation in ancient civilizations. King Tut, the Egyptian boy king, was buried in a solid gold casket, wearing a solid gold funeral mask. Silver was treasured in Babylonia. The vaults of Babylonian kings from the 4th millenium B.C. have yielded silver jewelry. It is difficult to use pure silver because of its lack of hardness. Platinum, another valuable resource, was used by Egyptians as early as 700 B.C. Platinum usually occurs in nature with other minerals of the platinum group. Platinum was used for ornamentation. Over a long period of time, early man gradually became aware of the valuable resources around him.

GO TO THE NEXT PAGE

YOU MAY UNDERLINE

Common metals were used in ancient times. Copper was probably the first metal worked by man in the Middle East, about 6,000 B.C. Nuggets were hammered into knives, axes, charms and ornaments. Copper needs to be combined with other substances to make it usable for industry. Iron beads were worn by Egyptians as early as 4,000 B.C. The source of this iron was meteorites. Lead is another metal with a long history. It is a soft metal which modern man extracts from the ore galena. The Babylonians used lead before 3,000 B.C. for writing tablets. Aluminum being less easy to extract, especially in quantity, has only been used in more recent times. The first object ever made of aluminum was a toy rattle made in 1850 A.D. Our current supply of aluminum comes from the rock bauxite. The minerals which are the backbone of our industrial civilization evolved over many millenia.

GO TO THE NEXT PAGE

YOU MAY UNDERLINE

Alloys were produced by early man in several parts of the globe. They are the result of combining common metals with other substances. Bronze is an alloy that is a refinement of copper. Bronze is made by alloying copper and tin. It was widely used in the Mediterranean countries - Crete, Greece and Turkey - as early as 2500 B.C. It was used as the chief material for tools and weapons. Brass is another refinement of copper. Brass is a mixture of copper and zinc. The first use of brass was in Roman coins at the time of Augustus, 60 B.C. Iron was refined by "steeling" it. It was recently discovered that the Haya people of Africa knew how to make steel as long as 2,000 years ago. Sophisticated treatment of copper and iron permitted the metals to be used for durable goods.

GO TO THE NEXT PAGE

YOU MAY UNDERLINE

Precious stones have an interesting history. Diamond as jewelry dates back to 480 B.C. However, diamonds were known to have been used Egypt before this time. Diamond is the hardest naturally occurring substance known to man. Diamond was used as a drilling tool and cutting tool to work other precious stones. Emerald mines in Egypt were worked as early as 2000 B.C. Legend has it that Cleopatra had an emerald engraved with her own picture. Emerald is a deep green variety of beryl and makes lovely jewelry. Ruby, a vivid red corundum is another stone that attracted the Egyptians. By 500 B.C., rubies were included in the burial vestments. Sapphire is a serene blue variety of corundum. A French Bishop, in the 12th century, praised the virtues of the sapphire and started the long history of the use of this gem in church regalia. Gems have been admired for their beauty and usefulness.

GO TO THE NEXT PAGE

YOU MAY UNDERLINE

Masonry stone was used by the ancient civilizations to construct magnificent edifices for the living as well as the dead. Ancient man constructed his buildings of materials close at hand. Limestone is a relatively hard rock which may take different forms. In Egypt, at about 2500 B.C., the tombs or pyramids were faced with limestone. The limestone was available north of Cairo. Granite was the principle stone used for building the great Egyptian obelisks and monuments about 1500 B.C. The granite was available nearby at Thebes. Granite is the hardest stone used for structural purposes. Marble, the most beautiful of all rocks, is relatively soft and easily workable. It was used by the ancient Greeks at about 1000 B.C. The main temple of the Acropolis was made of the finest colored marble. It came from north of Athens. Slate was used in prehistoric times for burial purposes and has been found in tombs in the French Alps. Its use was determined by the fact that it splits into thin but broad slabs.

GO TO THE NEXT PAGE

How interesting do you think that the materials you have just read would be for sixth graders? Please explain.

WHEN YOU ARE FINISHED TURN YOUR BOOKLET OVER

1/2/3/4/5

MAKE NO MARKS ON THIS PAGE

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4/5

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4/5

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GO TO THE NEXT PAGE

4/5

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GO TO THE NEXT PAGE

4/5

MAKE NO MARKS ON THIS PAGE

Masonry stone was used by the ancient civilizations to construct magnificent edifices for the living as well as the dead. Ancient man constructed his buildings of materials close at hand. Limestone is a relatively hard rock which may take different forms. In Egypt, at about 2500 B.C., the tombs or pyramids were faced with limestone. The limestone was available north of Cairo. Granite was the principle stone used for building the great Egyptian obelisks and monuments about 1500 B.C. The granite was available nearby at Thebes. Granite is the hardest stone used for structural purposes. Marble, the most beautiful of all rocks, is relatively soft and easily workable. It was used by the ancient Greeks at about 1000 B.C. The main temple of the Acropolis was made of the finest colored marble. It came from north of Athens. Slate was used in prehistoric times for burial purposes and has been found in tombs in the French Alps. Its use was determined by the fact that it splits into thin but broad slabs.

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MAKE NO MARKS ON THIS PAGE

Forgetting is a problem for student and teacher alike. Right now you are bedeviled by forgetting every time you take an exam. When you begin to teach, the amount of forgetting that you encounter in your pupils may make you wonder whether teaching is worth the trouble. Unless you make a well-organized attack on forgetting, it can wipe out much that you have accomplished. In plotting preventive measures, it is important to consider <u>why</u> we forget. On the pages that follow, some of the causes are described. (Biehler, p. 254)

GO TO THE NEXT PAGE

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Disuse is a cause of forgetting. The idea this word denotes is that people forget when the brain trace, which is the physical record of memory, fades away. The fading is analogous to the atrophy of a muscle which is not used. It does seem logical to assume that a thought or idea or bit of knowledge which is used frequently becomes more strongly implanted than something which is only briefly considered, that an idea is made more permanent in individual consciousness every time it is activated. Suppose you are able to learn the names of all the pupils in 5 different classes the first week of a new year. By the end of the report period, you will probably remember only the names of those pupils who ask to be called on quite often. Frequent repetition of names strengthens the brain trace; disuse, on the other hand, appears to cause names to fade quickly from memory

GO TO THE NEXT PAGE

MAKE NO MARKS ON THIS PAGE

Reorganization is a factor in forgetting. Reorganization (sometimes called distortion) is more a description of what happens to memories than a cause of forgetting, but it merits attention. Quite frequently we don't forget things completely; a residue remains. When you are asked to supply an answer to a question about some rarely used idea, you may generalize and fill in the gaps with stray bits of related ideas you happen to remember. A good illustration of this would be what a typical high school student remembers ten years after graduating from school. An example taken from European history reads like this: "Joan of Ark was a French descendant of Noah, who, after hearing angel voices singing Do Re Mi, became inspired, thus unfairly defeating the English in several battles."

GO TO THE NEXT PAGE

MAKE NO MARKS ON THIS PAGE

Repression is also a cause of forgetting. Some things are forgotten because they are unpleasant. The tendency to repress, or resist remembering, disagreeable experiences is a key concept in Freud's theory of psychoanalysis. To combat repression, make your room and your teaching pleasant and enjoyable. Other things being equal, pupils learn more and remember more in an agreeable atmosphere. The obvious way to avoid the negative influence of repression is to make life in your classroom as enjoyable as possible.

GO TO THE NEXT PAGE

3

MAKE NO MARKS ON THIS PAGE

Retroactive inhibition and proactive inhibition are causes of forgetting. Perhaps the most common cause of forgetting in school situations is the displacement of "old" material by new. This phenomenon is called <u>retroactive inhibition</u>. You will tend to forget the names of former students when a new report period begins and you learn another set of names. A related factor in learning and forgetting is called <u>proactive inhibition</u>, in which the old interferes with the new. You may have difficulty remembering new names because the old ones are still cluttering up your memory. Such interference is most likely to occur when similar material is involved. Remembering names is just one example. Memorizing spelling words is another; learning Spanish and French at the same time is another; studying for final exams in Psychology and Sociology at the same time is still another. Interference is one of the major complicating factors in the learning of verbal associations.

GO TO THE NEXT PAGE

3

Appendix B: Introductory Materials, Directed Learning

Fall, 1978

Dear Education Student:

The materials that you will be working with today have been prepared especially for college students taking education courses. They are designed to investigate the effectiveness of outlines in helping students learn and remember new and difficult text. Your instructor knows about the nature of these materials and thinks that your involvement with them will be a rewarding experience for each of you. As in any sort of research, you are free to withdraw if you so choose.

As a result of working with these materials, we think that:

- You will understand the nature of cognitive learning strategies
- You will be able to organize better lesson plans for your students
- You will become a more proficient and productive learner in your own studies.

Thank you for being willing to work with us.

WAIT FOR THE SIGNAL BEFORE BEGINNING.

1/4

1. Social Security Number _____

2. Date of Birth _____ _____ _____
Month Day Year

3. Course _____ 4. Instructor _____

5. Sex _____ Male _____ Female

6. Status _____ Freshman
_____ Sophomore
_____ Junior
_____ Senior
_____ Other _____

7. Major Field of Study _____

8. Do you use an outline when you study? _____ Yes _____ No

9. Do you underline when you study? _____ Yes _____ No

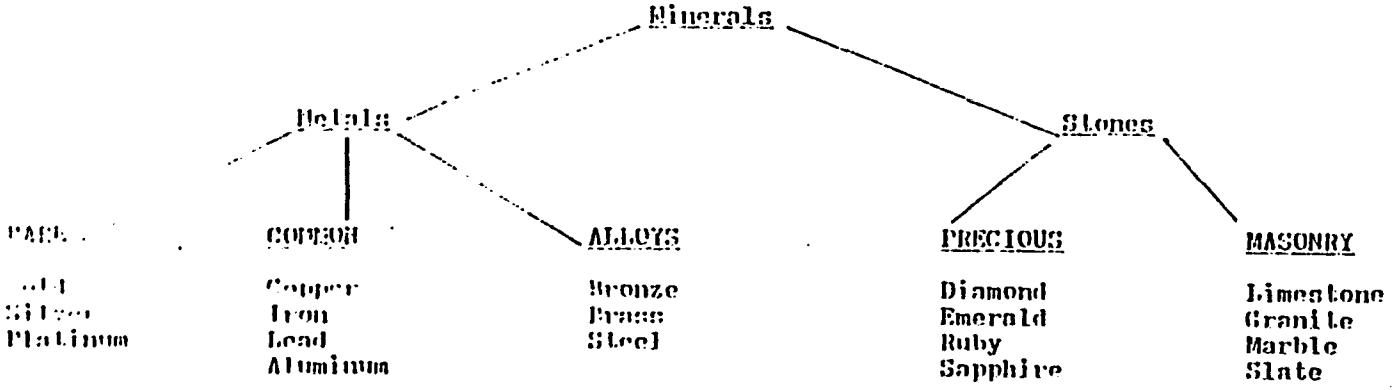
10. Is English your first language? _____ Yes _____ No

WAIT FOR THE SIGNAL BEFORE TURNING THE PAGE

1/2/3/4/5

This task deals with OUTLINES. It is important that you follow instructions carefully. First, READ the outline below. Then, try to "understand it. The organization that has been used should make sense to you

I. Structure



II. Topic

For what "Purpose"?

"When"?

"Where"?

After you understand how the outline was developed, turn the page and answer some questions about it.

1/1/1

The questions that follow refer to the outline that you just studied. Try to answer them from memory.
If you don't know an answer you MAY look back at the outline

1. The two major classifications of Minerals are _____ and _____.

2. The three metal groups are _____, _____, and _____.

3. _____ and _____ are the two groups of stones.

4. _____, _____, and _____ make up the category of RARE metals.

5. The category COMMON metals includes: _____, _____, _____, and _____.

6. _____, _____, and _____ are three examples of the category ALLOYS.

7. There are four examples of the category Precious stones. They are: _____, _____, _____, and _____.

GO ON TO THE NEXT PAGE

You MAY look back at the outline if you need to.

8. _____, _____, _____, and _____ are 4 types of MASONRY stones.

9. Information about the RARE metal gold can be discussed under 3 topics. They include _____, _____ and _____.

10. Platinum, silver and gold are the three _____ metals.

11. Aluminum, copper, lead and iron are the 4 _____ metals.

12. Bronze, steel and brass are _____.

13. Sapphire, emerald, diamond and ruby are _____ stones.

14. Limestone, granite, marble and slate are the 4 _____ stones.

15. "Purpose", "When" and "Where" are topics that describe the metal categories _____, _____, and _____. These topics also describe the stone categories _____, and _____.

GO ON TO THE NEXT PAGE

16

a. In writing the outline from top to bottom, you would first write:

_____

b. You would then write:

_____ _____ __

c. The next step would be:

_____ _____ _____ _____ _____

d. Followed by:

_____ _____ _____ _____ _____
_____ _____ _____ _____ _____
_____ _____ _____ _____ _____
_____ _____ _____ _____

e. Finally, the three topics under each of the groups are: _____
_____
_____

(If you don't remember, you MAY look back for this time only)

Fall. 1978

Dear Education Student:

The materials that you will be working with today have been prepared especially for college students taking education courses. They are designed to investigate the topic of "Forgetting". Your instructor knows about the nature of these materials and thinks that your involvement with them will be a rewarding experience for each of you. As in any sort of research, you are free to withdraw if you so choose.

As a result of working with these materials, we think that:

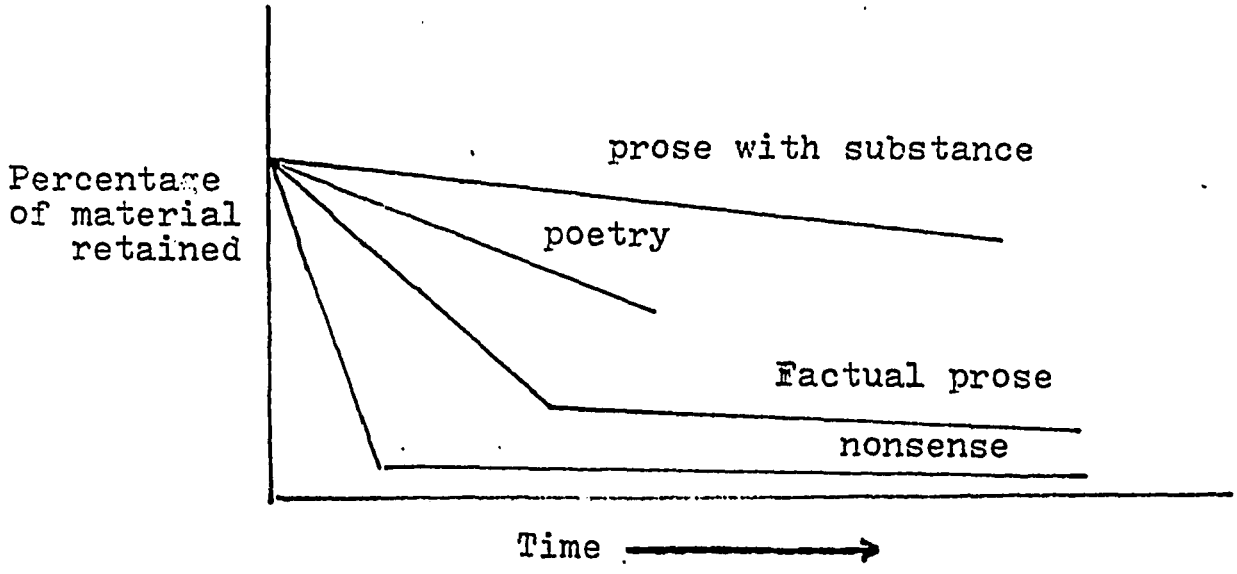
- You will understand the nature of cognitive learning strategies
- You will be able to organize better lesson plans for your students
- You will become a more proficient and productive learner in your own studies

Thank you for being willing to work with us.

WAIT FOR THE SIGNAL BEFORE BEGINNING

2/3/5

As a teacher you should know that most of the specific facts you teach will be forgotten. That is the reality of the situation. Guilford (1952) provided the data for the graph below. It shows the retention over time for various kinds of material. For nonsense material, the ability to recall words declines extremely rapidly, often within minutes. "Well," you may say, "but we don't teach nonsense words in school." But we should realize that terms like algorithm, mores, evolution, radium, quadratic, or sodium are often, on first encounter, merely nonsense words for many students. Note also that considerable declines in retention occur even when the material is factual prose or poetry.



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Other data on forgetting were provided by R.W. Tyler (1934) who measured various kinds of knowledge and skill of college students before, immediately after, and a year after a course in zoology. The table below shows some of his data.

Immediate and Long-Term Recall
For School Learning

Type of Examination Exercise	Mean Scores At: Start of Course	Time of Course Exams	One Year Later	Percent of Gain Lost One Year Later
Naming animal structure	22.2	61.8	31.4	74.3
Identifying technical terms	19.7	83.1	66.5	24.2
Recalling structures performing functions	13.3	39.3	33.9	20.8
Recalling other facts	21.4	62.6	54.1	20.6
Applying principles	35.2	64.9	65.1	Gain (0.7)
Interpreting new experiments	30.3	57.3	64.0	Gain (24.8)

Try to understand the table. The data should "make sense" to you. After you understand the table, turn the page and answer some questions about it.

The questions below refer to the table that you just studied. If you don't remember an answer you MAY look back at the table.

1. During the semester, student knowledge, in all categories _____.

2. The greatest gain in knowledge during the semester was for _____.

3. The increase in knowledge during the semester was about the same for _____ and _____.

4. After one year, most of the loss of knowledge was for _____.

5. Of the gain in the ability to identify technical terms, _____% was lost in a year.

6. After a year, students' ability to _____ _____ showed no loss.

GO ON TO THE NEXT PAGE

2/5

You may look back at the table for the answers.

7. After a year, students' ability to _____ _____ showed a substantial gain.

8. Which is remembered longer, factual material or principles? Why?

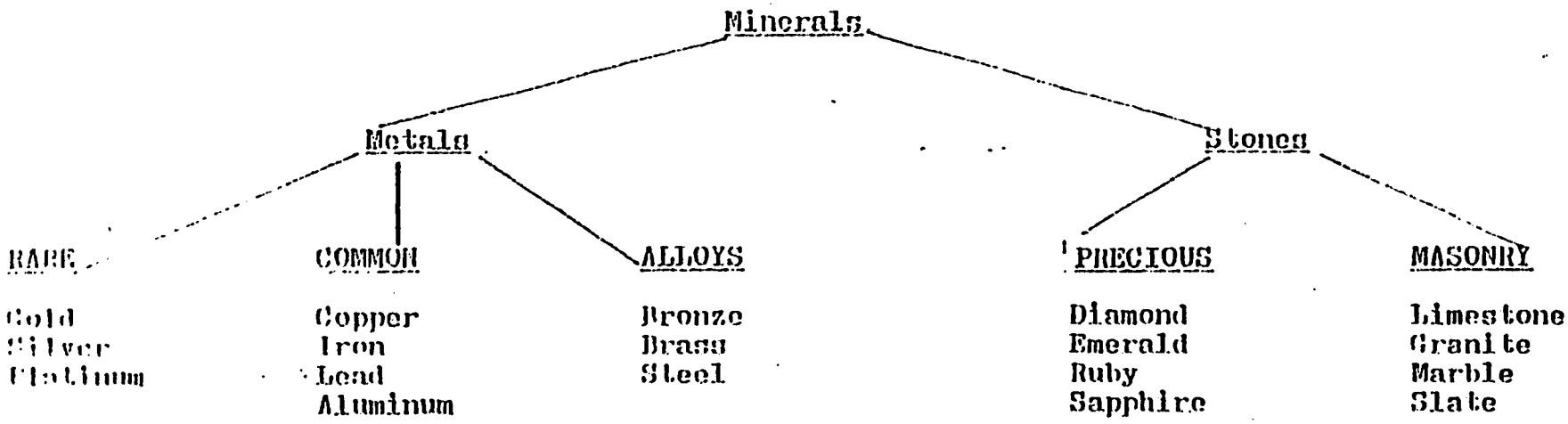
9. Write down all the things you can remember about the War of 1812.

2/5

Appendix C: Introductory Materials, Study-test Trials

Social Security Number _____

The OUTLINE that you just studied is a road map to help guide you through the text that you will shortly be reading. It should prove useful for what you read by alerting you to the topics that will be discussed as well as ways of grouping the information.. We ask that you memorize the outline so that you will have it available.



For what "Purpose"?

"When"?

"Where"?

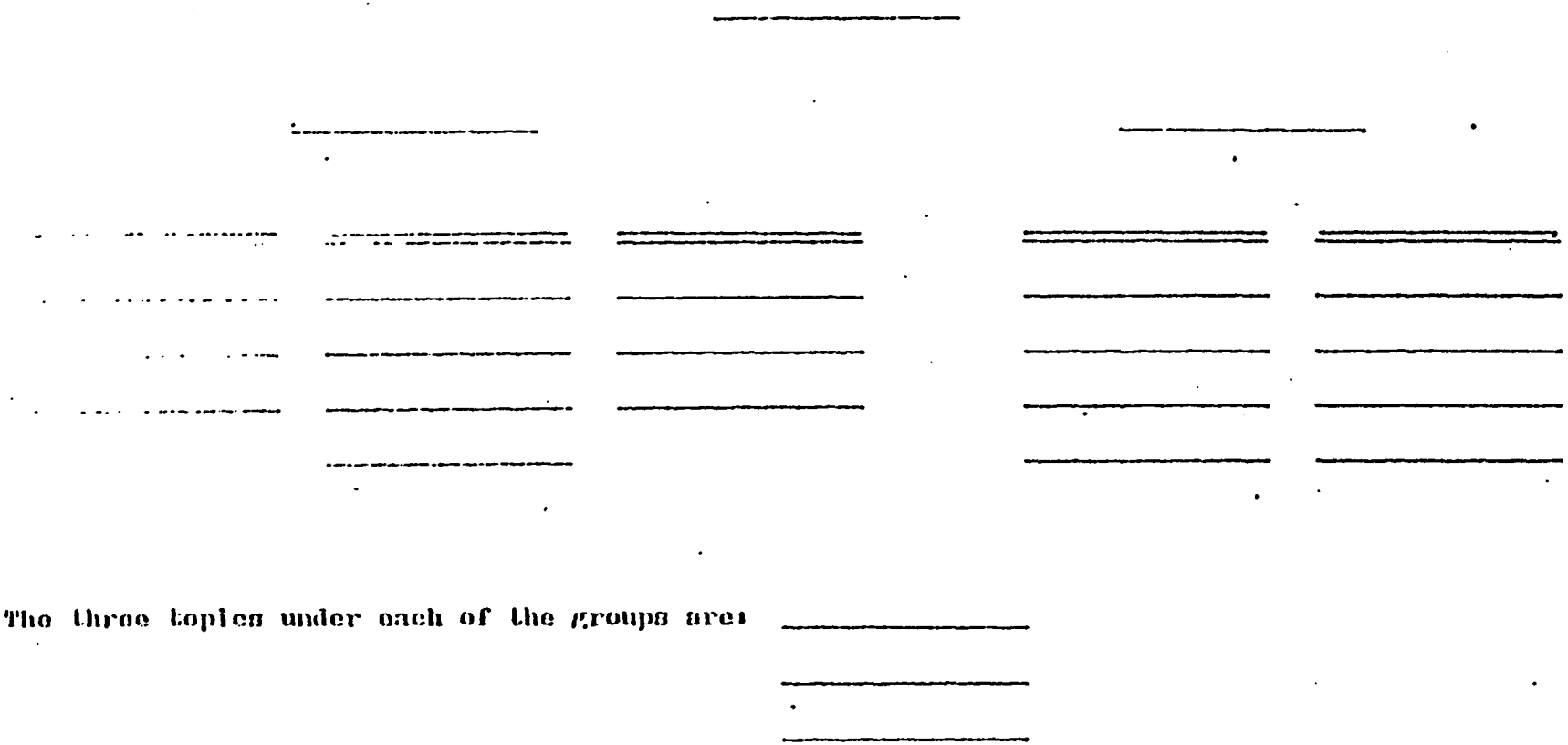
DO NOT TURN THE PAGE UNTIL TOLD TO DO SO

Reproduce the OUTLINE that you have just memorized. DO NOT LOOK BACK

The three topics under each of the groups are:

You will have a second chance to memorize the categories that you didn't remember. However,

Reproduce the OUTLINE that you have just memorized again. DO NOT LOOK BACK



The three topics under each of the groups are:

We ask that you memorize the following table.

Immediate and Delayed Recall of Lecture Material

	Presentation of Lecture Material			
	First 25 Min.	Next 15 Min.	Final 15 Min.	Total 55 Min.
Immediate Recall	44%	25%	48%	41%
Recall After One Week	14	17	20	17

Source: McLeish (1968)

Reproduce the TABLE that you have just memorized. DO NOT LOOK BACK.

DO NOT TURN THE PAGE UNTIL TOLD TO DO SO

Appendix D: Introductory Materials, Reproduction From Memory

Reproduce the outline that you have just studied.

The three topics under each of the groups are:

Reproduce the TABLE that you have just studied.

Appendix E: Test Materials

Free Recall Test
Inference Test
Recognition Test

Write down in any order you wish, all of the information you can recall from the paragraphs you read. Report your information in the form of sentences and not as isolated words.

1/2/3/4/5

Social Security Number _____

DIRECTIONS

The questions on the following pages test your knowledge of the material that you have studied recently.

These questions are all of the fill-in type. Answer all questions even if you don't feel completely certain of your answers in a particular case.

ANSWERS SHOULD BE BASED ONLY ON THE MATERIALS THAT YOU HAVE READ

WAIT FOR THE SIGNAL BEFORE BEGINNING

1/2/4/5

Social Security Number _____

DIRECTIONS

The questions on the following pages test your knowledge of MINERALS

These questions are all of the fill-in type. Answer all questions even if you don't feel completely certain of your answers in a particular case.

WAIT FOR THE SIGNAL BEFORE BEGINNING

3

1. Two countries which used rare metals in ancient times were _____ and _____.

2. The earliest rare metal known to man was _____.

3. Ancient man used rare metals for _____ purposes.

4. The first common metal worked by man was _____.

5. Ancient man used common metals for _____ and _____ purposes.

6. Two countries that used common metals in ancient times were _____ and _____.

7. The earliest alloy used was _____.

8. Two uses of alloys in ancient times were for _____ and _____.

9. Countries or geographic areas that made use of alloys in ancient times were _____ and _____.

GO TO THE NEXT PAGE

1/2/3/4/5

10. Precious stones have been used in early times for _____ and _____.

11. Two countries in which precious stones were first used were _____ and _____.

12. The first precious stone to be used was _____.

13. Masonry stones were used in ancient times for _____ and _____.

14. Two ancient sources of masonry stones were near the cities of _____ and _____.

15. The two masonry stones used at about the same time were _____ and _____.

WHEN YOU ARE FINISHED TURN YOUR PAPER OVER

1/2/3/4/5

Social Security Number _____

DIRECTIONS

The questions on the following pages test your knowledge of the facts that you have studied recently.

These questions are all of the multiple-choice type. For each question, choose the lettered alternative that is most appropriate. If two or more answers seem appropriate, choose the one that seems most correct to you. Answer all questions even if you do not feel completely certain of your answer in a particular case. Write your answer in the space provided to the right of the question.

WAIT FOR THE SIGNAL BEFORE BEGINNING

1/2/4/5

Social Security Number _____

DIRECTIONS

The questions on the following pages test your knowledge of MINERALS.

These questions are all of the multiple-choice type. For each question, choose the lettered alternative that is most appropriate. If two or more answers seem appropriate, choose the one that seems most correct to you. Answer all questions even if you do not feel completely certain of your answer in a particular case. Write your answer in the space provided to the right of the question.

WAIT FOR THE SIGNAL BEFORE BEGINNING

3

1. Silver was first used by the (a) Greeks (b) Egyptians (c) Babylonians (d) French

_____

2. Gold was first discovered by man as early as (a) 1000 B.C. (b) 4000 B.C. (c) 3000 B.C. (d) 18000 B.C.

_____

3. Platinum was used by the Egyptians for (a) weapons (b) writing tablets (c) ornamentation (d) tools

_____

4. Copper was worked by man in the Middle East about (a) 4000 B.C. (b) 6000 B.C. (c) 3000 B.C. (d) 1850 A.D.

_____

5. The Babylonians used lead for (a) writing (b) coinage (c) plumbing (d) ornamentation

_____

6. Iron was used for beads by (a) Babylonians (b) French (c) Egyptians (d) Chaldeans

_____

7. Steel was first made in (a) Crete (b) Africa (c) Rome (d) France

_____

8. Bronze was widely used as early as (a) 2500 B.C. (b) 60 B.C. (c) 6000 B.C. (d) 1000 B.C.

_____

GO TO THE NEXT PAGE

9. Brass was first used for (a) musical instruments (b) jewelry (c) coins (d) ornamentation

_____

10. The earliest recorded use of diamond was about (a) 480 B.C. (b) 60 A.D. (c) 2000 B.C. (d) 12th century

_____

11. A country in which the church used sapphires was (a) Italy (b) Russia (c) Greece (d) France

_____

12. Rubies were used by ancient Egyptians for (a) drilling and cutting tools (b) burial vestments (c) engraving (d) ornamentation

_____

13. Limestone was used by the ancient Egyptians for (a) temples (b) pyramids (c) obelisks (d) statues

_____

14. Granite was found near (a) Rome (b) Cairo (c) Athens (d) Thebes

_____

15. The Greeks used marble about (a) 4000 B.C. (b) 400 B.C. (c) 1000 B.C. (d) none of these

_____

WHEN YOU ARE FINISHED, TURN YOUR PAPER OVER

1/2/3/4/5

Appendix F: Scoring Keys

Free Recall: Topic Relevant Facts
Free Recall: Topic Irrelevant Facts
Inference Measure
Recognition Measure

Scoring Key
Free Recall
Topic Relevant Facts

Gold:	Burial Funeral mask Ornamentation Casket King Tut Adorn Decorative	18,000 B.C.	Egypt
Silver:	Jewelry	4th millenium B.C.	Babylonia
Platinum:	Ornamentation	700 B.C.	Egypt
Copper:	Knives Axes Charms Ornaments	6,000 B.C.	Middle East
Iron:	Beads	4,000 B.C.	Egypt
Lead:	Writing tablets	Before 3,000 B.C.	Babylonia
Aluminum:	Toy rattle	1,859 A.D. More recent times	
Bronze:	Tools Weapons	2,500 B.C.	Mediteranean Crete, Greece, Turkey
Brass:	Coins Currency	60 B.C. Time of Augustus	Rome
Steel:		2,000 years ago	Africa (Haya)
Diamond:	Drilling tool Cutting tool Work other stones Jewelry	Before 480 B.C. 480 B.C.	Egypt
Emerald:	Jewelry Engraving Etching Cleopatra's picture	2,000 B.C.	Egypt
Ruby:	Burial	500 B.C.	Egypt
Sapphire:	Church	12th century	France
Limestone:	Tombs Pyramids	2,500 B.C.	Cairo Egypt

Granite:	Obelisks Monuments	1,500 B.C.	Thebes Greece
Marble:	Temple Acropolis	1,000 B.C.	Athens Greece
Slate:	Burial	Prehistoric	France

Scoring Key
Free Recall
Topic Irrelevant Facts

Gold:	Lumps Nuggets
Silver:	Difficult to use pure silver Lack of hardness
Platinum:	Found with other minerals in platinum group
Copper:	Needs to be combined to make usable
Iron:	Meteorites, a source
Lead:	Long history Soft Extracted from galena
Aluminum:	Comes from bauxite Less easy to extract in quantity
Bronze:	Refinement of copper Alloy of copper and tin
Brass:	Refinement of copper Mixture of copper and zinc
Steel:	Refined by "steeling"
Diamond:	Hardest substance
Emerald:	Deep green variety of beryl
Ruby:	Vivid red corundum
Sapphire:	Serene blue corundum
Limestone:	Relatively hard Takes different forms
Granite:	Hardest stone for strutural purposes
Marble:	Most beautiful rock Soft Easily workable
Slate:	Splits into thin, broad slabs.

Scoring Key
Inference Measure

1. Egypt, Babylonia
2. Gold
3. Ornamentation, burial, jewelry, coffin, funeral, tomb
4. Copper
5. Knives, axes, charms, ornaments, writing tablets, beads
6. Egypt, Babylonia
7. Bronze
8. Tools, weapons, coins, money
9. Crete, Greece, Turkey, Italy (Rome) Mediterranean, Africa (Haya)
10. Jewelry, drilling tools, cutting tools, engraving, burial, church
11. Egypt, France
12. Diamond
13. Obelisks, tombs, temples, monuments
14. Cairo, Thebes, Athens
15. Granite, Marble

Scoring Key

Recognition Measure

1. c
2. d
3. c
4. b
5. a
6. c
7. b
8. a
9. c
10. c
11. d
12. b
13. b
14. d
15. c

Appendix G. ANOVA Tables

UNWEIGHTED MEANS ANALYSIS OF VARIANCE TABLE FOR MEASURE(1)
Inference Measure

CLASSIFYING FACTORS

OUTLINE	OUTLINE
UNDERLIN	UNDERLINING ALLOWED
TIME	TIME OF TESTING
UNIT	SUBJECTS OR UNITS OF ANALYSIS

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F-TEST	SIGNIFICANCE	PERCENT OF TOTAL SUM OF SQUARES
OUTLINE	219.080	1	219.080	7.764**	0.007	9.16
UNDERLIN	3.374	1	3.374	0.120	OVER 0.500	0.14
OUTLINE X UNDERLIN	11.785	1	11.785	0.418	OVER 0.500	0.49
* UNIT	1918.812	68	28.218	NOT TESTED		80.23
TIME	0.757	1	0.757	0.236	OVER 0.500	0.03
OUTLINE X TIME	3.452	1	3.452	1.077	0.304	0.14
UNDERLIN X TIME	1.752	1	1.752	0.547	0.463	0.07
OUTLINE X UNDERLIN X TIME	14.682	1	14.682	4.580*	0.036	0.61
* TIME X UNIT	218.017	68	3.206	NOT TESTED		9.12
TOTAL	2391.710	143	16.725			100.00

AN ASTERISK (*) MARKS THE EFFECT USED IN TESTING THE PRECEDING EFFECTS

157 UNITS WERE READ IN FOR THIS ANALYSIS.

72 UNITS WERE USED IN THIS ANALYSIS.
65 THROWN OUT DUE TO BLANKS ON CLASSIFYING VARIABLES
20 THROWN OUT DUE TO BLANKS ON DEPENDENT VARIABLES

NOTE: THE SUMS OF SQUARES ARE CALCULATED ASSUMING ALL CELL COUNTS EQUAL 16.98 (THE HARMONIC MEAN OF CELL N'S)

UNWEIGHTED MEANS ANALYSIS OF VARIANCE TABLE FOR MEASURE(2)
Recognition Measure

CLASSIFYING FACTORS

OUTLINE	OUTLINE
UNDERLIN	UNDERLINING ALLOWED
TIME	TIME OF TESTING
UNIT	SUBJECTS OR UNITS OF ANALYSIS

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F-TEST	SIGNIFICANCE	PERCENT OF TOTAL SUM OF SQUARES
OUTLINE	0.726	1	0.726	0.059	OVER 0.500	0.08
UNDERLIN	15.262	1	15.262	1.246	0.269	1.60
OUTLINE X UNDERLIN	3.638	1	3.638	0.297	OVER 0.500	0.38
* UNIT	832.813	68	12.247	NOT TESTED		87.36
TIME	3.216	1	3.216	2.270	0.137	0.34
OUTLINE X TIME	0.333	1	0.333	0.235	OVER 0.500	0.03
UNDERLIN X TIME	0.455	1	0.455	0.321	OVER 0.500	0.05
OUTLINE X UNDERLIN X TIME	0.526	1	0.526	0.371	OVER 0.500	0.06
* TIME X UNIT	96.331	68	1.417	NOT TESTED		10.11
TOTAL	953.299	143	6.666			100.00

AN ASTERISK (*) MARKS THE EFFECT USED IN TESTING THE PRECEDING EFFECTS

157 UNITS WERE READ IN FOR THIS ANALYSIS.

72 UNITS WERE USED IN THIS ANALYSIS.
65 THROWN OUT DUE TO BLANKS ON CLASSIFYING VARIABLES
20 THROWN OUT DUE TO BLANKS ON DEPENDENT VARIABLES

NOTE: THE SUMS OF SQUARES ARE CALCULATED ASSUMING ALL CELL COUNTS EQUAL 16.98 (THE HARMONIC MEAN OF CELL N'S)

UNWEIGHTED MEANS ANALYSIS OF VARIANCE TABLE FOR MEASURE(4)
Free Recall: Topic Relevant Facts

CLASSIFYING FACTORS

OUTLINE	OUTLINE
UNDERLIN	UNDERLINING ALLOWED
TIME	TIME OF TESTING
UNIT	SUBJECTS OR UNITS OF ANALYSIS

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F-TEST	SIGNIFICANCE	PERCENT OF TOTAL SUM OF SQUARES
OUTLINE	3.122	1	3.122	0.196	OVER 0.500	0.22
UNDERLIN	15.236	1	15.236	0.957	0.332	1.08
OUTLINE X UNDERLIN	2.453	1	2.453	0.154	OVER 0.500	0.17
* UNIT	1082.108	68	15.913	NOT TESTED		76.85
TIME	28.737	1	28.737	7.371**	0.009	2.04
OUTLINE X TIME	0.463	1	0.463	0.119	OVER 0.500	0.03
UNDERLIN X TIME	3.406	1	3.406	0.874	0.354	0.24
OUTLINE X UNDERLIN X TIME	7.500	1	7.500	1.924	0.170	0.53
* TIME X UNIT	265.114	68	3.899	NOT TESTED		18.83
TOTAL	1408.138	143	9.847			100.00

AN ASTERISK (*) MARKS THE EFFECT USED IN TESTING THE PRECEDING EFFECTS

157 UNITS WERE READ IN FOR THIS ANALYSIS.

72 UNITS WERE USED IN THIS ANALYSIS.
65 THROWN OUT DUE TO BLANKS ON CLASSIFYING VARIABLES
20 THROWN OUT DUE TO BLANKS ON DEPENDENT VARIABLES

NOTE: THE SUMS OF SQUARES ARE CALCULATED ASSUMING ALL CELL COUNTS EQUAL 16.98 (THE HARMONIC MEAN OF CELL N'S)

UNWEIGHTED MEANS ANALYSIS OF VARIANCE TABLE FOR MEASURE(9)
Free Recall: Number of Clusters

CLASSIFYING FACTORS

OUTLINE	OUTLINE
UNDERLIN	UNDERLINING ALLOWED
TIME	TIME OF TESTING
UNIT	SUBJECTS OR UNITS OF ANALYSIS

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F-TEST	SIGNIFICANCE	PERCENT OF TOTAL SUM OF SQUARES
OUTLINE	0.000	1	0.000	VERY SMALL		0.00
UNDERLIN	5.203	1	5.203	2.366	0.129	2.41
OUTLINE X UNDERLIN	0.766	1	0.766	0.348	OVER 0.500	0.35
* UNIT	149.515	68	2.199	NOT TESTED		69.14
TIME	0.090	1	0.090	0.105	OVER 0.500	0.04
OUTLINE X TIME	0.685	1	0.685	0.804	0.374	0.32
UNDERLIN X TIME	1.588	1	1.588	1.861	0.177	0.73
OUTLINE X UNDERLIN X TIME	0.409	1	0.409	0.479	0.492	0.19
* TIME X UNIT	58.001	68	0.853	NOT TESTED		26.82
TOTAL	216.256	143	1.512			100.00

AN ASTERISK (*) MARKS THE EFFECT USED IN TESTING THE PRECEDING EFFECTS

157 UNITS WERE READ IN FOR THIS ANALYSIS.

72 UNITS WERE USED IN THIS ANALYSIS.
65 THROWN OUT DUE TO BLANKS ON CLASSIFYING VARIABLES
20 THROWN OUT DUE TO BLANKS ON DEPENDENT VARIABLES

NOTE: THE SUMS OF SQUARES ARE CALCULATED ASSUMING ALL CELL COUNTS EQUAL 16.98 (THE HARMONIC MEAN OF CELL N'S)

UNWEIGHTED MEANS ANALYSIS OF VARIANCE TABLE FOR MEASURE(16): Free Recall: Topic Irrelevant Facts

CLASSIFYING FACTORS

OUTLINE	OUTLINE
UNDERLIN	UNDERLINING ALLOWED
TIME	TIME OF TESTING
UNIT	SUBJECTS OR UNITS OF ANALYSIS

	SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F-TEST	SIGNIFICANCE	PERCENT OF TOTAL SUM OF SQUARES
	OUTLINE	0.289	1	0.289	0.015	OVER 0.500	0.02
	UNDERLIN	0.113	1	0.113	0.006	OVER 0.500	0.01
	OUTLINE X UNDERLIN	3.261	1	3.261	0.166	OVER 0.500	0.19
*	UNIT	1333.065	68	19.604	NOT TESTED		77.91
	TIME	84.769	1	84.769	20.476***	UNDER 0.001	4.95
	OUTLINE X TIME	0.372	1	0.372	0.090	OVER 0.500	0.02
	UNDERLIN X TIME	1.776	1	1.776	0.429	OVER 0.500	0.10
	OUTLINE X UNDERLIN X TIME	5.804	1	5.804	1.402	0.241	0.34
*	TIME X UNIT	281.520	68	4.140	NOT TESTED		16.45
	TOTAL	1710.968	143	11.965			100.00

AN ASTERISK (*) MARKS THE EFFECT USED IN TESTING THE PREDEDING EFFECTS

115 UNITS WERE READ IN FOR THIS ANALYSIS.

72 UNITS WERE USED IN THIS ANALYSIS.
43 THROWN OUT DUE TO BLANKS ON CLASSIFYING VARIABLES

NOTE THE SUMS OF SQUARES ARE CALCULATED ASSUMING ALL CELL COUNTS EQUAL 16.98 (THE HARMONIC MEAN OF CELL N'S)

UNWEIGHTED MEANS ANALYSIS OF VARIANCE TABLE FOR MEASURE(18)
Free Recall: Maximum Cluster Length

CLASSIFYING FACTORS

OUTLINE	OUTLINE
UNDERLIN	UNDERLINING ALLOWED
TIME	TIME OF TESTING
UNIT	SUBJECTS OR UNITS OF ANALYSIS

	SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F-TEST	SIGNIFICANCE	PERCENT OF TOTAL SUM OF SQUARES
	OUTLINE	2.221	1	2.221	0.283	OVER 0.500	0.29
	UNDERLIN	19.656	1	19.656	2.500	0.119	2.53
	OUTLINE X UNDERLIN	2.272	1	2.272	0.289	OVER 0.500	0.29
*	UNIT	534.633	68	7.862	NOT TESTED		68.79
	TIME	3.968	1	3.968	1.384	0.244	0.51
	OUTLINE X TIME	0.229	1	0.229	0.080	OVER 0.500	0.03
	UNDERLIN X TIME	11.603	1	11.603	4.049*	0.049	1.49
	OUTLINE X UNDERLIN X TIME	8.790	1	8.790	3.063	0.085	1.13
*	TIME X UNIT	194.883	68	2.866	NOT TESTED		25.04
	TOTAL	776.244	143	5.442			100.00

AN ASTERISK (*) MARKS THE EFFECT USED IN TESTING THE PRECEDING EFFECTS

157 UNITS WERE READ IN FOR THIS ANALYSIS.

72 UNITS WERE USED IN THIS ANALYSIS.
65 THROWN OUT DUE TO BLANKS ON CLASSIFYING VARIABLES
29 THROWN OUT DUE TO BLANKS ON DEPENDENT VARIABLES

NOTE: THE SUMS OF SQUARES ARE CALCULATED ASSUMING ALL CELL COUNTS EQUAL 16.98 (THE HARMONIC MEAN OF CELL N'S)

Reference Notes

1. Tobias, S. Interaction between achievement and instructional method. Paper presented at the meeting of the American Educational Research Association, Toronto, Canada, March, 1978.

References

Abramson, T., & Kagen, E. Familiarization of content and different response modes in programmed instruction. Journal of Educational Psychology, 1975, 67, 83-88.

Anderson, R. C. Schema-directed processes in language comprehension. In A. M. Lesgold, J. W. Pellegrino, S. D. Fokkema, & R. Glaser (Eds.), Cognitive psychology and instruction. New York: Plenum Press, 1978.

Anderson, R. C., Reynolds, R. E., Schallert, D. L., & Goetz, E. T. Framework for comprehending discourse. American Educational Research Journal, 1977, 14, 367-381.

Armor, D. J., & Couch, A. S. Data-text primer: An introduction to computerized social data analysis. New York: The Free Press, 1972.

Atkinson, R. C., & Raugh, M. R. An application of the mnemonic keyword method to the acquisition of a Russian vocabulary. Journal of Experimental Psychology: Human Learning and Memory, 1975, 1, 126-133.

Balser, E. The free recall and category clustering of factual material presented in complex sentences. Psychonomic Science, 1972, 27, 327-328.

Barclay, J. R. The role of comprehension in remembering sentences. Cognitive Psychology, 1973, 4, 229-254.

Bartlett, F. C. Remembering. Cambridge, Mass.: The University Press, 1932.

Baumrin, J. M. Aristotle's empirical nativism. American Psychologist, 1975, 30, 486-495.

Bloom, B. S. (Ed.) Taxonomy of educational objectives, Handbook 1: Cognitive domain. New York: David McKay, 1956.

Bower, G. H. Experiments in story understanding and recall. Quarterly Journal of Experimental Psychology, 1976, 28, 511-534.

Bower, G. H., & Clark, M. C. Narrative stories as mediators for serial learning. Psychonomic Science, 1969, 14, 181-182.

Bower, G. H., Clark, M. C., Lesgold, A. M., & Winzenz, D. Hierarchical retrieval schemes in recall of categorized word lists. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 323-343.

Bransford, J. D., & Franks, J. J. The abstraction of linguistic ideas. Cognitive Psychology, 1971, 2, 331-350.

Bransford, J. D., & Johnson, M. K. Contextual prerequisites for understanding: Some investigations of comprehension and recall. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 717-726.

Bransford, J. D., & McCarrell, N. S. A sketch of a cognitive approach to comprehension: Some thoughts about what it means to comprehend. In W. B. Weimer & D. S. Palermo (Eds.), Cognition and symbolic processes. Hillsdale, N. J.: Lawrence Erlbaum Associates, 1974.

Bransford, J. D., Barclay, J. R., & Franks, J. J. Sentence memory: A constructive versus interpretive approach. Cognitive Psychology, 1972, 3, 193-209.

Bruner, J. S. Going beyond the information given. In H. Gruber (Ed.), Contemporary approaches to cognition. Cambridge, Mass.: Harvard University Press, 1957.

Christensen, C. M., & Stordahl, K. E. The effect of organizational aids on comprehension and retention. Journal of Educational Psychology, 1955, 46, 65-74.

DiVesta, F. D., Schultz, C. B., & Dangel, T. R. Passage organization and imposed learning strategies in comprehension and recall of connected discourse. Memory and Cognition, 1973, 1, 471-476.

Dooling, D. J., & Lachman, R. Effects of comprehension on retention of prose. Journal of Experimental Psychology, 1971, 88, 216-222.

Fowler, R. L., & Barker, A. S. Effectiveness of highlighting for retention of text material. Journal of Applied Psychology, 1974, 59, 358-364.

Franks, J. J., & Bransford, J. D. The acquisition of abstract ideas. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 311-315.

Frase, L. T. Paragraph organization of written materials: The influence of conceptual clustering upon the level and organization of recall. Journal of Educational Psychology, 1969, 60, 394-401.

Gage, N. L., & Berliner, D. C. Educational Psychology. Chicago: Rand McNally, 1975.

Glynn, S. M., & DiVesta, F. J. Outline and hierarchical organization as aids for study and retrieval. Journal of Educational Psychology, 1977, 69, 89-95

Haber, R. N. Introduction In R. N. Haber (Ed.), Information-processing approaches to visual perception. New York: Holt, Rinehart & Winston, 1969.

Hayes-Roth, B., & Hayes-Roth, F. The prominence of lexical information in memory representations of meaning. Journal of Verbal Learning and Verbal Behavior, 1977, 16, 119-136.

Honeck, R. P. Interpretive versus structural effects on semantic memory. Journal of Verbal Learning and Verbal Behavior, 1973, 12, 448-455.

Idstein, P., & Jenkins, J. R. Underlining versus repetitive reading. Journal of Educational Research, 1972, 65, 321-323.

Johnson, R. E. Meaning in complex learning. Review of Educational Research, 1975, 45, 425-459.

Johnson, M. K., Bransford, J. D., & Solomon, S. K. Memory for tacit implications of sentences. Journal of Experimental Psychology, 1973, 98, 203-205.

Kastrinos, W. A study of the retention of biological facts by high-school biology students. Science Education, 1965, 49, 487-491.

Magoon, A. J. Constructivist approaches in educational research. Review of Educational Research, 1977, 47, 651-693.

Mathews, C. O. Comparison of methods of study for immediate and delayed recall. Journal of Educational Psychology, 1938, 29, 101-106.

Meyer, B. J. F. The organization of prose and its effects in memory. Amsterdam, The Netherlands: North-Holland, 1975.

Meyer, B. J. F. What is remembered from prose: A function of passage structure. In R. O. Freedle (Ed.), Discourse production and comprehension. Norwood, New Jersey: Ablex, 1977.

Meyer, B. J. F., & McConkie, G. W. What is recalled after hearing a passage? Journal of Educational Psychology, 1973, 65, 109-117.

Mischel, W. Personality and assessment. New York: Wiley, 1968.

Myers, J. L., Pezdek, K., & Coulson, D. Effect of prose organization upon free recall. Journal of Educational Psychology, 1973, 65, 313-329.

Neisser, U. Cognitive psychology. New York: Appleton-Century-Crofts, 1967.

Penfield, W. Consciousness, memory and man's conditioned reflexes. In K. H. Pribram (Ed.), On the biology of learning. New York: Harcourt, Brace, Jovanovich, 1969.

Piaget, J. The language and thought of the child. New York: Harcourt Brace, 1926.

Raugh, M. R., & Atkinson, R. C. A mnemonic method for learning a second-language vocabulary. Journal of Educational Psychology, 1975, 67, 1-16.

Reitman, J. S., & Bower, G. H. Storage and later recognition of exemplars of concepts. Cognitive Psychology, 1973, 4, 194-206.

Rickards, J. P., & August, G. J. Generative underlining strategies in prose recall. Journal of Educational Psychology, 1975, 67, 860-865

Rosch, E., & Mervis, C. B. Family resemblances: Studies in the internal structure of categories. Cognitive Psychology, 1975, 7, 573-605.

Rosch, E., Mervis, C. B., Gray, W. D., Johnson, D. M. & Boyes-Braem, P. Basic objects in natural categories. Cognitive Psychology, 1976, 8, 382-439.

Rumelhart, D. E., & Norman, D. A. Accretion, tuning, and restructuring: Three modes of learning. In J. W. Cotton & R. L. Klatzky (Eds.), Semantic factors in cognition. Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1978.

Rumelhart, D. E., & Ortony, A. The representation of knowledge in memory. In R. C. Anderson, R. J. Spiro, & W. E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1977.

Sachs, J. Recognition memory for syntactic and semantic aspects of connected discourse. Perception and Psychophysics, 1967, 2, 437-442.

Salisbury, R. Some effects of training in outlining. English Journal, 1935, 24, 111-116.

Schultz, C. B., & DiVesta, F. J. Effects of passage organization and note taking on the selection of clustering strategies and on recall of textual materials. Journal of Educational Psychology, 1972, 63, 244-252.

Shepherd, J. F. College study skills. Boston: Houghton Mifflin, 1979.

Shimmerlik, S. H. Organization theory and prose memory. Review of Educational Research, 1978, 48, 103-120.

Singer, M. Context inferences in the comprehension of sentences. Canadian Journal of Psychology, 1976, 30, 39-46.

Stordahl, K. E., & Christensen, C. M. The effect of study techniques on comprehension and retention. Journal of Educational Research, 1956, 49, 561-569.

Sullin, R. A., & Dooling, D. J. Intrusion of a thematic idea in retention of prose. Journal of Experimental Psychology, 1974, 2, 255-262.

Thorndyke, P. W. The role of inferences in discourse comprehension. Journal of Verbal Learning and Verbal Behavior, 1976, 15, 437-446.

Thorndyke, P. W., & Bower, B. H. Storage and retrieval processes in sentence memory. Cognitive Psychology, 1974, 6, 515-543.

Tyler, R. W. Some findings from studies in the field of college biology. Science, 1934, 18, 133-142.

Voss, J. F. Cognition and instruction: Toward a cognitive theory of learning. In A. M. Lesgold, J. W. Pellegrino, S. D. Fokkema, & R. Glaser (Eds.), Cognitive psychology and instruction. New York: Plenum Press, 1978.

Weimer, W. B. Psycholinguistics and Plato's paradoxes of the "Meno." American Psychologist, 1973, 28, 15-33.

Weiss, W., & Fine, B. J. Stimulus familiarization as a factor in ideational learning. Journal of Educational Psychology, 1956, 47, 118-124.

Winer, B. J. Statistical principles in experimental design. New York: McGraw-Hill, 1962.

Wittrock, M. C. The cognitive movement in instruction. Educational Psychologist, 1978, 13, 15-29.