GOLDBERG, ELLEN S.

THE EFFECTS OF THREE QUESTION PROPERTIES ON PROSE MEMORY AND FORWARD TEXT PROCESSING

City University of New York PH.D. 1980

THE EFFECTS OF THREE QUESTION PROPERTIES ON PROSE MEMORY AND FORWARD TEXT PROCESSING

by

ELLEN GOLDBERG

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.

Aug 1, 1980
date

Barry J Zimmerman
Chairman of Examining Committee

Aug 1, 1980
date

Shirley C Feldmann
Executive Officer

Dr. Barry J. Zimmerman

Dr. Shirley Feldmann

Dr. Alan Gross
Supervisory Committee

The City University of New York

Abstract

THE EFFECTS OF THREE QUESTION PROPERTIES ON PROSE MEMORY AND FORWARD TEXT PROCESSING

by

Ellen Goldberg

Advisor: Professor Barry J. Zimmerman

The purpose of this study was to explore how adjunct questions function to modify reading outcomes, and to interpret question effects in the context of attentional and processing models of reading behavior. The study examined effects of three question properties: (1) Specificity-multiple Specific prequestions asked for verbatim recall of text facts; (2) Organizing property-Concept Organizer prequestions provided superordinate topic information (concepts) and asked for related subordinate content (facts); (3) Constructive property-Concept Construction prequestions asked for derivation of superordinate concepts implicit but not stated in text. Questions were inserted before related paragraphs in the first half of the text sequence to measure the effects of each question property on immediate and delayed learning of text. The second half of the text sequence was presented

without questions to examine the forward influence of each property on retention and processing of unquestioned text. Specific learning effects were hypothesized and tested by measuring immediate and delayed recall of facts from questioned paragraphs. It was hypothesized that all prequestions would facilitate learning relative to a reading-only control. Hypotheses were confirmed for multiple Specific questions, but higher-level questions did not significantly affect the level of text learning. As hypothesized, multiple Specific questions resulted in greater immediate learning than that produced by higher-level questions. This result is consistent with previous research on verbatim prequestions, and demonstrates that the direct effect of specific questions may produce greater factual learning than the effect of general questions when amount of question-relevant text is controlled. As predicted, immediate learning was greater than delayed learning for all subjects. Delayed learning showed no significant differences among question groups. Forward effects were examined by measuring immediate and delayed recall of facts from unquestioned paragraphs. Comparisons with a control failed to demonstrate positive transfer for any prequestion. The finding that all prequestions resulted in less factual recall than a control on immediate transfer resembles the depression of incidental learning reported frequently in the literature. The unanticipated outcome that all subjects recalled more facts from unquestioned paragraphs was clarified by results of analyses of

recall from each paragraph. These analyses confirmed that recency and content-specific effects mediated effects of question treatment. Additional analyses of delayed data demonstrated that only Concept Organizer questions promoted representation of conceptual content in memory. These questions produced more concepts than a control on a delayed completion test which measured availability of concepts implicit in text. Subjects given Concept Organizer questions were more likely to recall conceptual content than factual content from questioned paragraphs, they freely recalled more concepts than any other group, and they outperformed a control in total recall from questioned paragraphs. An attentional model of question effects accounts fully for observed effects of specificity on factual text learning and for observed effects of higher-level questions. Concept Organizer questions influenced encoding strategies and subsequent recall strategies, but Concept Construction questions were not efficient in clarifying reading objectives so that they failed to promote use of a question-relevant strategy for encoding text content. Questions in this study did not demonstrate effects of organizational variables, and inconsistencies in question-level research do not warrant generalizable conclusions about the effect of questioning on level of text processing. Research on goal-directed reading has major applications for educational practice. Accordingly, continued research needs to be directed to a more precise understanding of how and when different types of questions

influence reading outcomes. Research efforts should examine how question effects are mediated by subject-generated activities and content-related variables, and how questions can be used to produce transferable learning from text.

ACKNOWLEDGEMENTS

I am deeply grateful to Professor Barry Zimmerman for his continual support, encouragement and counsel throughout this research effort. I also thank Dr. Lawrence T. Frase for his invaluable contributions as teacher and advisor, and Professors Shirley Feldmann and Alan Gross for their guidance during the course of this research.

Special thanks are due to my family. My husband, Irving, and my children, Elizabeth and Michael, know what they did to help. I gratefully acknowledge that their efforts made mine possible. Thanks also to my mother and sister for their encouragement and faith in me. To the memory of my father, I dedicate this dissertation in the certain knowledge that he, more than anyone, would take pride in its accomplishment.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

INTRODUCTION

Prose learning research is concerned with study of the behaviors involved in learning from text, and with how reading behavior can be directed toward specified learning goals. A principal area of prose learning research examines the interaction between reader and text by asking questions about what is being read.

Research on question effects has produced several major findings. It is well-established that asking questions about text enhances text retention, and manipulation of question variables modifies retention effects in a consistent and predictable manner.

The current study is concerned with how questions function to modify reading outcomes. It is designed to accomplish the following purposes:

1. To compare text recall produced by higher-order prequestions versus multiple verbatim prequestions.
2. To measure how three salient question properties contribute to recall.
3. To examine whether prequestions exert a forward influence on subsequent reading through transfer of an inspection and/or processing strategy.

Before the study is described in detail, the pertinent literature and interpretations of question effects will be reviewed.

CHAPTER I

REVIEW OF QUESTION EFFECTS RESEARCH

This chapter has four parts. The first part provides a brief historical perspective of prose learning research. The second part summarizes research on verbatim question effects. It describes major variables investigated in question research, and defines the principal terms used. The third part reviews question level research. It defines types of higher-order question studies, describes studies of particular importance to the current research, and summarizes findings about question levels. The last part summarizes findings about question position.

Historical Perspective

Experimental investigation of prose learning processes and variables dates back to the beginning of this century. In 1937, Welborn and English reviewed 83 different experiments in which the learning of meaningful verbal materials was studied. Researchers investigated such issues as serial effects (Dell, 1912; Jersild, 1929), retroactive interference effects (McGeoch & McKinney, 1933; Newman, 1939), and the effects of adjunct questions on prose learning (Distad, 1927; Germane, 1920; Holmes, 1931; Washburne, 1929).

In Washburne's (1929) study, children read 3000 words of social science text in which adjunct questions were used. Questions were inserted before or after the passage, or at

various positions within the text. The study examined the relationship between question position and subjects' ability to recall facts and make generalizations.

Research on prose learning was virtually abandoned in the 1930's as researchers became increasingly concerned with more exact control of verbal learning variables. For approximately two decades, most verbal learning researchers focused on paired word relationships which could be examined in laboratory situations (see Goss, 1971). Only a few isolated studies of prose learning appeared during this period (for example, Golden, 1942; Postman & Senders, 1946). It was not until the mid-1950's that interest shifted back to the complex processes assumed to be involved in learning from written prose.

This renewed interest in prose learning was a response to criticism of verbal learning research and to the recognition that verbal learning theories had to be extended to account for the acquisition of knowledge and language (see Ausubel, 1963; Carroll, 1968; Chomsky, 1959; Miller, Galanter & Pribram, 1960). Numerous attempts were made to apply verbal learning theory and research findings to the study of prose learning (Hall, 1955; Musgrave & Cohen, 1971; Newman & Saltz, 1960; Slamecka, 1960), and to examine the relationship between isolated verbal units and connected discourse (Deese, 1961; Goss, 1971; Johnson, 1971). For example, the retroactive and proactive inhibition studies conducted by Ausubel and his associates (Ausubel & Blake, 1958; Ausubel, Robbins

& Blake, 1957; Ausubel, Stager & Gaite, 1968; Ausubel, Stager & Gaite, 1969) were an effort to test the generality of traditional verbal learning research conclusions on meaningful prose learning.

Since the mid-1960's, a large body of prose learning research has emerged that has been concerned with the influence of asking questions about text. The current literature on questions effects is reviewd in the following sections.

Verbatim Question Research

Verbatim question research derives from the work of Rothkopf in the 1960's (see Rothkopf, 1963; 1965; 1966). In formulation of his "mathemagenic hypothesis", Rothkopf proposed that manipulation of reading behaviors would modify reading outcomes. Various studies to test this hypothesis followed. Researchers manipulated reading behavior by asking for verbatim recall or recognition of specific text items while the text was being read. Verbatim questions were inserted in text to immediately precede or follow text portions containing the questioned information. Prequestions and postquestions were presented on separate pages, preceding or following text pages, so that subjects could be prevented from simultaneously inspecting the questions and content which they asked about.

Retention tests were used to measure reading outcomes. Tests consisted of the same adjunct questions asked during

reading, plus new questions about the text just read. Performance on repeated adjunct questions measured intentional learning--the direct effect of instruction on those questions. Performance on new test items measured incidental learning--the indirect effect of asking questions about the text. Since performance on new items could not be directly attributed to transfer of learning from adjunct questions (Rothkopf, 1971), it was considered to be evidence of mathemagenic effects.

In his germinal study of verbatim question effects, Rothkopf (1966) showed that asking questions facilitates text retention in comparison to reading the text with no questions. In more than 10 years of subsequent research, this general influence of questioning has been demonstrated using a wide variety of experimental materials and procedures. In addition, different effects of questioning have been demonstrated for different question treatments.

Two question treatments have been shown to exert a particularly strong influence on text retention. These relate to the level of adjunct questions and to their position in text. Research on question level is discussed next; a summary of findings for question position follows.

Question Level Research

Question level refers to the type of response required by verbatim versus higher-order questions. Verbatim questions typically are constructed by deleting a key word or phrase from a text statement; the reader is required to supply the

deleted text element. All higher-order questions are constructed to require comprehension of text. They may require that readers additionally perform operations on the text, such as making inferences, applying principles or deriving concepts.

Two main categories of higher-order question studies are described next. The particular question properties examined in the current study are drawn from this research and discussed in Chapter II.

Treatment X Question Type Studies

One kind of higher-order question study is concerned with investigating Treatment X Question Type interactions. In such studies, two or more types of questions are developed to represent lower and higher order question levels. Each subject receives only one type during reading, but subjects receive all types on a criterion posttest. A Treatment X Question Type interaction is observed when practice on a particular type of adjunct question influences performance on certain types of posttest items, and practice with a different type of question results in a different posttest performance pattern.

Watts and Anderson (1971) conducted a study of this kind with higher-order questions which required the application of text content to new problems. All subjects received one type of multiple-choice question after reading each passage. For Application questions, the correct multiple-choice alternative was a new example of the principle

explained in that passage. For lower-order Repeated-Example (RE) questions, the correct multiple-choice alternative was an example repeated from the text. Accordingly, Application questions required a constructive use of text content, while RE questions required only recognition of text content. Another type of lower-order question just asked for the proper name in each passage, and control subjects read all passages with no questions.

Watts and Anderson found a Treatment X Question Type interaction on their comprehensive posttest. Subjects given Application questions scored as well on new test items (RE and Name questions) as lower-order question groups which had received these items as adjunct questions. And they showed significantly greater performance than other groups on both repeated Application questions and a new set of Application questions.

Recall Studies

The second category of higher-order question studies examines memory of text for evidence of higher versus lower order question effects. As in most verbatim question research, the influence of question variables is separately examined for retention of relevant versus incidental text.

Frase conducted a series of studies which examined memory for factual and inferential text under orienting directions which questioned varying levels of factual and inferential text content. Frase (1969, 1970) found that recall of text was specific to text items targeted by questions at each

level. Although both reproductive and productive recall increased when more text items were targeted, memory for inferential material was generally very poor.

In a third study, Frase (1971) developed passages which included four experimental text sentences embedded in other material. Each experimental sentence expressed a relationship between two logical classes. A lower-order Fact group was asked questions involving logical classes from the same text sentence. An Inference group had to combine information from three text sentences.

Recall data showed that the Inference group remembered facts from the passages nearly as well as subjects questioned explicitly on those facts. Exposure to Inference questions only slightly facilitated recall of inferential content.

Results of these studies are important to understanding how particular question properties contribute to text retention. Findings are reviewed in Chapter II as they relate to interpretation of question effects.

The two studies described next are also recall studies. They are of particular importance to the current study and are reviewed in greater detail. Experimental materials and procedures from the 1976 Rickards study were adapted for use in the current study. Higher-order (ML) questions from the 1974 Rickards and DiVesta study were used in conjunction with the 1976 version of text passages.

Meaningful-Learning Questions

Rickards and DiVesta (1974) constructed text materials and adjunct questions for a study designed to distinguish between rote and meaningful learning effects (according to Ausubel, 1968).

An 800-word passage about a fictitious country, Mala, was divided into eight text segments; each segment included one paragraph to which adjunct questions were related (Related paragraph) and one which was not questioned (Unrelated paragraph). Text paragraphs were hierarchically organized, with a topic sentence followed by three sentences containing related factual information.

Questions requiring literal recall of discrete text items were intended to promote rote text processing. A Rote-Learning-of-Fact (RLF) question required verbatim recall of information in one subordinate sentence. A Rote-Learning-of-Ideas (RLI) question required recall of the idea in a topic sentence. Meaningful-Learning (ML) questions required organization of facts in subordinate sentences under the idea in a topic sentence. Control subjects read the text with Task-Irrelevant questions. All questions were interspersed as postquestions.

A free recall test was scored separately for relevant facts, ideas and subsumed facts in Related paragraphs, and for incidental facts and ideas in Unrelated paragraphs. ML questions resulted in significantly more total recall than

any other type question.[1] The ML group produced the highest recall of relevant facts and incidental facts, and was not exceeded by any other group in recall of relevant ideas and subsumed facts. The only measure on which ML questions were not superior to the control was recall of incidental ideas.

Conceptual Questions

More recently, Rickards (1976) conducted an investigation of whether position effects are the same for verbatim and higher-order questions. He developed a type of higher-order question which required "the learner to abstract concepts from whole paragraphs of text" (p. 210). According to Rickards, these Conceptual questions differed from verbatim questions in the number of sentences targeted (4 versus 1, respectively) and in the level of processing elicited by question requirements.

Materials were a modification of those used in the 1974 Rickards and DiVesta study. A fourth subordinate sentence replaced the topic sentence in each paragraph, so that paragraph content in the modified (1976) version consisted entirely of subordinate facts. As in the 1974 study, the prose passage consisted of eight segments, each with a Related and Unrelated paragraph. Subjects received either

---

[1] Rickards and DiVesta varied question frequency and ML questions were more effective in the more frequent condition. Since other similar results are reported for postquestions (for example, Frase, 1968a), findings are summarized only for ML questions presented after each text segment.

a Verbatim or Conceptual question before or after reading each text segment.

Subjects in the Rickards (1976) study were given 30 seconds to read each text segment and 10 seconds for each question. Text segments were presented on separate pages from questions, and subjects were instructed not to take any notes nor to turn back to any page.

A free recall test was conducted immediately after reading and again one week later. At the time of delayed recall testing, a fill-in completion test also was administered. Analyses of variance were used to analyze free recall data for five dependent measures: (1) intentional concepts--implicit in the text and solicited by Conceptual questions; (2) intentional statements--targeted by Verbatim questions; (3) mediating statements--all statements other than intentional statements in Related paragraphs; (4) incidental concepts--implied concepts in Unrelated paragraphs; and (5) incidental statements--facts in Unrelated paragraphs. An analysis of variance was conducted on completion test scores for the same five dependent measures.

For total recall, only the Verbatim postquestion group was superior to the control on immediate testing. Only Conceptual prequestions exceeded the control on delayed testing. Relative to the control group, overall recall with Conceptual prequestions deteriorated less over one week than recall with verbatim postquestions. Similarly, Conceptual prequestions was the only treatment exceeding the control on

completion test performance.

Analysis for intentional statements showed a main effect regardless of time or position, with Verbatim questions resulting in greater recall than Conceptual questions. Both positions were equivalent for Verbatim questions, but the before-reading position was superior to post-reading for Conceptual questions. Control comparisons showed an expected direct instructional effect for both Verbatim-question groups. Less predictably, Conceptual questions also exceeded the control on this measure.

Conceptual questions were most effective on recall of intentional concepts, and only these questions exceeded the control on both immediate and delayed recall of concepts. Again, prequestions were superior to postquestions, and only Conceptual prequestions exceeded the control on the completion test.

Both Conceptual prequestions and Verbatim postquestions exceeded the control on immediate recall of mediating statements. Only Conceptual prequestions retained an advantage on delayed testing.

The finding that prequestions resulted in less incidental recall than postquestions is consistent with effects generally observed for prequestions. Apparently no experimental group in Rickards' study recalled more information from Unrelated paragraphs than the control; incidental learning with verbatim postquestions was confined to Related paragraphs.

Summary of Question Level Research

Question level research compares recall or posttest performance of questions which vary in the level of response required. Some researchers (Allen, 1970; McConkie, Rayner, & Wilson, 1973; Shavelson, Berliner, Ravitch, & Loeding, 1974) have classified question level according to Bloom et al.'s (1956) taxonomy, with lower-order questions at the Knowledge level and higher-order questions at any of the five higher levels. Other researchers (Anderson & Biddle, 1975; Andre & Sola, 1976; Andre & Womack, 1978; Felker & Dapra, 1975; Watts & Anderson, 1971) have used Anderson's (1972) classification which identifies three question levels--verbatim factual, paraphrased factual, and application. Finally, some researchers (Frase, 1969a, 1969b, 1970, 1971, 1972; Rickards, 1976; Rickards & DiVesta, 1974; Rickards & Hatcher, 1978; Watts, 1973) have constructed inference or integrative questions which mapped onto text in a highly specified relationship.

Results of question level research provide substantial evidence that retention and learning of text information is influenced by the level of response requirements. Level effects observed on retention measures (for example, Frase, 1971; Rickards & Hatcher, 1978; Watts, 1973) support that higher-order questions produce increased recall of factual content. Frase's results suggest that these questions only slightly influence retention of inferential content. And Rickards (1976) showed that level effects may be modified by

question position and time of testing, with the superiority of higher-order prequestions demonstrated on delayed recall measures.

Watts and Anderson's (1971) posttest scores demonstrated a Treatment X Question Type interaction with a different pattern of performance for different question levels. Application-question subjects achieved best overall test performance because they were successful at answering all types of test items. New test items for these subjects included lower-order questions and a new set of Application questions. Performance on the latter items is of particular interest to the current study because it measures positive transfer from adjunct questions to new questions of the same type.

Higher-order questions have produced transferable knowledge in several other investigations (Andre & Sola, 1976; Andre & Womack, 1978; Felker & Dapra, 1975). Forward transfer in Treatment X Question Type research has been interpreted as evidence that questions shape appropriate reading strategies. This research is described at the end of Chapter II in a discussion of forward effects of verbatim and higher-order questions.

Question Position Research

The current study examines effects of prequestions based on Rickards' results for Conceptual questions. His finding was a reversal of the typical results for question position. Results of question position research are summarized next.

Position Effects of Verbatim Questions

In his 1966 study, Rothkopf found that verbatim postquestions produced superior performance on both repeated and new test items. Verbatim prequestions were superior to the control only on repeated items. Subsequent studies replicated Rothkopf's results for immediate retention (Bruning, 1968; Frase, 1967, 1968a; Rothkopf & Bisbicos, 1967) and for delayed retention (Boker, 1974). Some researchers (for example, Frase, Patrick, & Schumer, 1970; Peeck, 1970) have found that verbatim prequestions may produce mathemagenic negative effects, depressing incidental learning below control performance.

In their review of adjunct question research, Anderson and Biddle (1975) concluded that verbatim prequestions consistently have a direct effect, but more frequently inhibit rather than facilitate performance on new test items. Watts and Anderson's finding that verbatim Name postquestions produced a mathemagenic negative effect is unusual but not unique (see Hiller, 1974). Apparently, depression of incidental learning may occur with highly specific postquestions as with prequestions.

Position Effects of Higher-Order Questions

Position effects demonstrated for higher-order questions are generally consistent with those demonstrated for verbatim questions (see Rickards & Denner, 1978, for a review). Studies have shown a direct effect on retention for higher-order prequestions (Rickards, 1976; Shavelson et al., 1974) and post

questions (for example, Rickards, 1976; Rickards & DiVesta, 1974; Shavelson et al., 1974; Watts & Anderson, 1971). Indirect effects of higher-order postquestions have not been nearly as consistent or strong as their direct effects (Rickards & DiVesta, 1974). And, not surprisingly, even less incidental recall has been observed for prequestions (Rickards, 1976).

Comparison of Position Effects

Two studies (Felker & Dapra, 1975; Shavelson et al., 1974) which compared position effects for higher-order questions found greater mean test performance with postquestions--although differences in these studies were not statistically significant.

Rickards' (1976) comparison demonstrated an exceptional finding in position effects research. Typical results were produced by verbatim-level questions, with postquestions superior to prequestions. But position effects were reversed for Conceptual-level questions. Conceptual prequestions exceeded postquestions on retention of intentional concepts and statements, and mediating statements. And only prequestions facilitated delayed recall compared to the control.

Rickards' study clearly demonstrates that principal question variables may interact to significantly affect how well--and for how long--text is remembered. His results imply that different question properties account for differences in level and position effects. This implication provides the basis for the interpretation of question effects proposed

in the following chapter.

The interpretation in the following chapter emphasizes the contribution to text retention of particular question properties rather than level and position variables. It examines what question properties influence what reading behaviors, and how differences in text processing relate to differences in text retention.

CHAPTER II

INTERPRETATION OF QUESTION EFFECTS

This chapter presents the theoretical background and rationale for problems, variables and effects investigated in the present study. It includes four parts. The first part describes attentional and processing models of question effects. The second part provides theoretical and historical perspectives for three salient question properties. The third part reviews a forward transfer explanation of question effects. The fourth part defines purposes and hypotheses for the present research.

Models of Question Effects

Throughout the literature on question effects, reading outcomes are interpreted in the context of attentional and processing models. Effects of verbatim questions typically are interpreted as effects on attentional responses to text. Differences observed for questions at different levels typically are attributed to effects on depth of text processing. Attentional interpretations are reviewed next, followed by discussion of processing effects.

Attentional Models of Verbatim Question Effects

Rothkopf's mathemagenic hypothesis proposed that adjunct questions function as discriminative stimuli for attentional responses to text, and that effects of selective attention account for observed differences in reading outcomes. Tests

of this hypothesis were directed to identify the processes initiated by various question treatments, and to show how such processes modified attentional responses. Verbatim questions have been shown to influence general attention to text and to mediate selective attention to particular text features.

Inspection time data and eye movement studies (see, for example, Corrozi, 1970; Morasky, 1972) provide objective indicators that questions generally modify attentional response to text. Numerous findings support the conclusion that mathemagenic positive and negative outcomes with verbatim prequestions are consistent with effects of selective attention.

In 10 of 14 prequestion studies reviewed by Anderson and Biddle (1975), prequestion groups scored higher than a control, provided that information tested was directly related to adjunct questions. Apparently, verbatim prequestions function to simultaneously heighten attention to questioned items and inhibit responses to incidental content (see Frase et al., 1970).

Verbatim postquestions are associated with general facilitation of text retention (see Rickards & Denner, 1978, for a review). They are considered to function as "test-like events" which heighten attention to text and initiate both backward and forward processes (see also Rickards, 1979). Frase proposed (1968b, 1970) that backward review is initiated in order to answer a postquestion. Since the question confirms the use of appropriate reading activities, it also

exerts a forward influence on subsequent reading.

Research on backward review is not relevant to interpretation of prequestion effects and will not be discussed here. Pertinent findings for forward effects of verbatim questions relate directly to the present study. The last part of this chapter is concerned with forward effects of questions at lower and higher levels.

Processing Models of Question Level Effects

Research on processing effects of questions is concerned with how question treatments modify the representation of text in semantic memory. Levels-of-processing models provide a theoretical framework for studying prose acquisition processes. According to such models (see Andre, 1979), depth of text processing varies along a continuum. For example, superficial processing of information results in acquisition of perceptual features. Information processed to a greater depth results in acquisition of meaning.

Further, these models hypothesize that depth of processing has direct consequences for retention. The greater the depth of processing, the higher the probability that information will be retained. Verbal learning research confirms depth-of-processing hypotheses for varying levels of information processing. In general, this research has compared effects of superficial levels of processing to effects of processing for meaning. For example, experiments in rating sentences have shown (Andre, 1979) that subjects who process information for more meaning (imagery) retain that information

better than subjects who process for less meaning (pronounceability).

Question effects research extends these findings to comparison of effects for different levels of semantic processing. It is proposed by processing models that questioning influences semantic encoding of text in short-term memory, and has consequences for transfer of text to long-term memory. Accordingly, researchers have manipulated question level to test whether "... questions that demand more than verbatim recall will promote deeper processing of the instructional materials" (Watts & Anderson, 1971, p. 387). Evidence of processing effects of question level has been sought in Treatment X Question Type interactions (Andre & Sola, 1976; Duell, 1974; Felker & Dapra, 1975; Mayer, 1975; McConkie et al., 1973; Sanders, 1973; Shavelson et al., 1974; Watts & Anderson, 1971) and in measures of text retention (Frase, 1971; Rickards, 1976; Rickards & DiVesta, 1974).

Analysis of questions and retention data from question level research identifies three question properties associated with differential retention outcomes. These properties are discussed next.

Question Properties

Research on retention effects of question level identifies three salient question properties. These properties define:

1. whether the question relates to specific

versus more general text content

2. whether it functions as an organizer for text content
3. whether it requires a constructive use of text content

The importance of specificity, organizing and constructive properties to question effects are each considered separately in the following sections. Findings for each property are interpreted as evidence of attentional and/or processing effects on text retention. The relevance of each property to the current study is defined.

Effects of Question Specificity on Text Retention

Various studies of memory of prose indicate that specificity facilitates recall--a finding which contradicts the widely accepted principle that generalizations are remembered better than specific facts. Higher levels of specificity have been associated with superior recall in paired-associate learning (for example, Paivio & Olver, 1964), and study of abstractive memory (Johnson, 1974) has found that passage subunits rated high in specificity are more likely to be recalled.

Substantial evidence from prose learning and memory research confirms that highly specific adjunct aids--learning directions, objectives and similar text treatments--are effective in directing reading activity to specific text

features. Research on question effects offers an ambiguous and sometimes confusing definition of the role of question specificity in determining memory of prose. In verbatim question research, a specific question which targets one text item may be compared to a general question which asks for verbatim recall of more than one text item. In question level research, a specific question may be compared to a general, higher-order question which requires comprehension of more than one text item. Whether a specific question produces an advantage over a more general question appears to depend on two critical conditions:

1. How efficiently each question identifies to-be-remembered text
2. How much text content is relevant to each question

Tulving's encoding specificity principle (see, for example, Tulving & Thomson, 1973) is directly relevant to the first condition. It predicts that questions which efficiently guide encoding will facilitate retention, since only those text features included in encoding are available as retrieval cues for passage information. Question research shows that Tulving's prediction applies to the retention effects of specific questions.

Frase (1968b) varied question specificity and found highest recall with the most specific questions. Subsequent studies (Frase, 1971; Watts, 1973) have demonstrated that general questions produce recall superior to specific

questions when they are equally efficient in identifying to-be-remembered text. Frase (1971) concluded that his general Inference questions facilitated recall because they subsumed factual information, promoting active attention to text features. Facilitation was limited, however, to the recall of those particular items questioned during reading. Similarly, McConkie, Rayner and Wilson (1973) observed that their general questions served primarily to shape attentional responses to specific facts.

These findings support the conclusion that effects of specificity on retention may be duplicated with general questions which identify question-relevant text. They imply that an apparent facilitating effect of general questions may be due to their direction of attention to questioned information. And if general questions function in the same way as specific questions, an explanation of their effects in terms of deeper processing may not be necessary.

The second condition proposed as a determinant of effects of specificity relates to the amount of text targeted by general versus specific questions. According to Tulving's encoding model, questions which lead to semantic encoding of more text items will produce greater text retention. Current research on question level does not make clear whether greater recall with more general, higher-order questions results from additional requirements for active attention to text, or from effects of these questions on level of text processing.

Retention data from higher-order question studies are inconclusive on this issue. For example, Felker and Dapra (1975) found no effects of question level on retention with Verbatim and Comprehension questions which targeted equivalent amounts of information--even though the latter produced a significant advantage on a problem-solving criterion test. On the other hand, Rickards' (1976) recall data suggest that more general (Conceptual) questions have longer-lasting retention effects than specific (Verbatim) questions. A definitive test is needed to determine if general questions facilitate delayed retention more than specific questions when they target an equal amount of text information.

The current study addresses this issue. It compares immediate and delayed recall for general versus specific questions; each general question is compared to a number of specific questions which together target the same amount of text content as that general question. Multiple verbatim prequestions are used for the specific question condition; higher-order questions having organizing and constructive properties are used for the general question condition. The study separately examines effects on retention of (1) amount of relevant text, and (2) question specificity.

Effects of an Organizing Property

Meaningful-Learning (ML) questions in the Rickards and DiVesta study (1974) were intended to promote substantive encoding of text by requiring integration of related text

elements. These questions were mapped on hierarchical paragraph content to provide the organizing function of "ideational scaffolding" in Ausubel's (1968) model of meaningful prose learning. By repeating superordinate topic content, each ML postquestion served as an anchoring idea for memorial review and subsumption of topically related facts.

The importance of organizational factors to memory is emphasized in current research on sentence learning (Anderson & Bower, 1974; Tulving & Donaldson, 1972; Tulving & Thomson, 1973), propositional learning (White & Gagne, 1976) and learning of connected prose (Frase, 1975). A number of researchers (including DiVesta, Schultz, & Dangel, 1973; Myers, Pezdak, & Coulson, 1973; Perlmutter & Royer, 1973; Shimmerlik & Nolan, 1976) have demonstrated significant effects of various text organization factors on retention of prose content.

Questions with organizing properties correspond to the central role of "schemata" in constructivist theories of memory (Bartlett, 1932). In a recent study of memory for prose, Pichert and Anderson (1977) refer to a schema as an "abstract description (which) ...characterizes the relation among its components and contains a slot for each component that can be instantiated" (p. 314). To the extent that a question provides a schema for text content, it contains similar "slots" for component text features.

There is substantial evidence in prose learning research that organizational aids are effective schemas for related text content. For example, Glynn and DiVesta (1977) showed that receiving conceptual-category outlines before reading facilitates accessibility to concept-related facts. Dooling and associates (Dooling & Lachman, 1971; Dooling & Mullet, 1973) found that thematic prepassages function as a type of mnemonic device, primarily aiding text reconstruction. More recent research by Gardner and Schumacher (1977) demonstrated that these prepassages also aid initial comprehension of text.

Meaningful-Learning questions provide an example of how higher-order questions can aid text integration, thereby facilitating recall of passage information. Rickards and DiVesta (1974) performed correlational analyses on recall data. They found that subjects given ML questions recalled facts in association with superordinate ideas. Superior recall performance with these questions supports the conclusion that integrative activity produces stable representation of text in memory.

The current study examines the contribution of organizing question properties to text retention. ML questions are used as one type of higher-order question, but they are used as prequestions for paragraphs with no superordinate topic content. Accordingly, these questions both provide topic information and promote integration of facts not explicitly related in the text.

The importance of topic information to retention of related statements is substantiated by results of a series of studies conducted by Gagne and his associates (Gagne, 1969; Gagne & Wiegand, 1970; White & Gagne, 1976). In the most recent of these studies, greatest retention of individual statements occurred when they were nominally linked by common concepts, and when questions about the statements encouraged subjects to process them semantically.

It is proposed that the primary role of ML questions in the current study is to make explicit the link between related statements in questioned paragraphs. It is also proposed that the organizing function of these questions is strengthened by presenting them before reading. Previously cited research on organizational aids supports this position. An outline presented after reading did not increase recall in Glynn and DiVesta's (1977) study, and titles presented before versus after reading were superior in Dooling and Mullet's (1973) study. In addition, preobjectives were shown to be more effective than postobjectives in a recent study (Royer, 1977) of learning goals which parallels question research procedures. And Paraphrase questions were shown to be effective only when they were available to guide the subject's initial encoding of text (Andre & Sola, 1976).

Effects of a Constructive Property

Rickards' (1976) Conceptual questions combined two salient question properties. They served an organizing function by

identifying superordinate conceptual information for related subordinate facts in text. And they required constructive use of text content by asking subjects to abstract concepts implicit but not stated in text.

The significance of constructive question properties to retention effects relates to several major theoretical views of memory processes.

One position (see, for example, Meachem, 1972) views memory as a byproduct of appropriate cognitive activity. There is some evidence to support an "activity" model of prose processing. Researchers have shown that an increased requirement for cognitive activity produces increased text recall (DiVesta & Gray, 1973; Schumacher, Liebert, & Fass, 1975), and that retention is promoted by tasks requiring semantic interaction with the text (Arkes, Schumacher, & Gardner, 1976).

Levels-of-processing models referred to earlier also imply that constructive properties are involved in prose processing effects. This position (see Craik & Lockhart, 1972) views memory as a byproduct of perceptual analysis. Since orienting tasks can influence encoding operations, tasks requiring deeper analysis of text features should promote greater recall of those features.

Watts and Anderson's (1971) results with Application questions provide convincing evidence that task requirements have implications for depth of processing of critical text features. The superiority of these questions over Repeated

Example questions cannot be attributed to a requirement to read more of the text.

Watts and Anderson attribute effects of question level in their study to differences in the task associated with questions at each level. Tasks associated with lower-order questions required a simple attention-holding operation in short-term memory, while the Application task required active transformation of text in memory. Consistent with the level-of-processing model of question effects, deeper text processing with the latter task facilitated learning of the text.

This model also predicts that Conceptual questions in Rickards' (1976) study--combining organizing and constructive properties--would produce strong processing effects. Rickards provided evidence that representation of text in memory varied considerably for Conceptual versus Verbatim questions. Conceptual questions showed less deterioration of retention over one week, and produced highly-organized recall of related text information.

Clustering analyses were conducted to yield "a measure of the percentage of related paragraph information that was contiguously recalled in topic clusters" (Rickards, 1976, p. 215). These analyses confirmed correlational data, showing that Conceptual prequestions engendered significantly greater topic clustering than other questions.

The superiority of Conceptual questions in this study may be attributed to their organizing function, constructive

requirement, or to both these properties. In the current study, these two properties will be separated in order to assess the contribution of each to increased text recall.

Rickards' (1976) major finding that Conceptual questions were superior in the pre-reading position argues strongly for a processing interpretation which distinguishes question properties according to question position. Rickards interpreted this finding to indicate that Conceptual prequestions require less "memorial demands" than postquestions, with retrieval and recoding requirements for postquestions overtaxing processing capabilities.

But it is not clear if the task requirement associated with Conceptual questions accounts for their position effects. Watts and Anderson's higher-order questions were very effective in a post-reading position even though the Application task required review and transformation of text in memory.

It is proposed that the advantage of Conceptual prequestions relates to their organizational function. As described earlier for Meaningful-Learning questions, results of related research indicate that effects of organizational aids are strengthened if they are available to guide encoding activity.

A Conceptual prequestion may serve as a type of advance organizer (Ausubel, 1968) which assimilates new ideas to information in existing cognitive structure. The question guides encoding activity by providing the reader with an advance strategy for thinking about the text. It informs the reader that immediately subsequent text information

relates to a specified conceptual class. The reader anticipates what type of information will be read, and develops a forward strategy for integrating new information units during reading.

The last issue to be discussed is whether this type of forward strategy is generalized to similar text content--so that the reader employs a question-related strategy in the absence of the question itself.

Forward Effect of Prequestions on Text Retention

A forward effect occurs when exposure to questions modifies subsequent reading behavior. In the current study, a forward effect is considered to involve transfer of a generalizable strategy to passages which do not have questions. Experimental conditions permit observation of transfer for each prequestion property under study.

Verbatim Questions: Transfer of an Inspection Strategy

The influence of questioning on subsequent reading is assumed to vary for verbatim versus higher-order questions. Since verbatim questions primarily mediate attentional responses to text, they are associated with forward shaping of an appropriate inspection strategy. Treatment X Question Type studies (for example, McConkie, Rayner, & Wilson, 1973; Rothkopf & Bisbicos, 1967) have shown that questioning particular categories of information during reading selectively facilitates performance on posttest items which question the same type of information.

These studies have demonstrated a forward effect with verbatim questions which direct attention to highly identifiable types of information--such as quantities or proper names. With such questions, subjects can recognize and adapt quickly to a shift in type of questioned information (Quellmalz, 1972). Findings with common-word questions (Rickards, Anderson, & McCormick, 1976; Rothkopf & Bisbicos, 1967) indicate that questioning less identifiable types of information does not influence inspection strategies.

Although research on the forward effect of verbatim questions has replicated a number of findings, this literature includes a number of inconsistencies. For example, Number postquestions in the recent study by Rickards et al. (1976) did not produce a set to learn numbers. And three question level studies (Rickards, 1976; Rickards & DiVesta, 1974; Watts & Anderson, 1971) which included separate analyses for directional effects found no evidence of a forward effect for any verbatim questions.

Higher-Order Questions: Transfer of a Processing Strategy

It has been proposed by several investigators (see, for example, Frase, 1970; Watts & Anderson, 1971) that higher-order questions may influence subsequent reading by cueing the use of appropriate processing strategies, or by providing a guide for adjusting study behavior. Transfer with higher-order questions has been studied in a modification of the Treatment X Question Type design used to study verbatim question effects.

Posttests in the verbatim question studies repeat adjunct questions and include items which question different information from the same passages. Transfer is evident from response to types of content targetted by adjunct questions. In the modified design used in higher-order question studies, performance on new passages is tested to demonstrate transfer on types of content questioned in previous passages.

In the first major study of this kind, McConkie and associates (1973) used six unrelated passages. Subjects received only one type of lower-order or higher-order question after each of the first five passages. After the final sixth passage, all subjects received all types of questions given to the various experimental groups on previous passages. Performance on the final passage test was analyzed for main effects of question treatments and for Treatment X Question Type interactions.

Results of the McConkie et al. study indicated that transfer of a processing strategy operates like transfer of an inspection strategy. It did not occur when higher-order questions did not cue the use of appropriate strategies for answering those particular types of questions. Findings from other higher-order question studies (Shavelson et al., 1974) support the conclusion that higher-order questions which do not have a specific text processing requirement will not selectively facilitate subsequent performance on those particular types of questions. Rickards and DiVesta's (1974) recall data showed a forward effect for their Meaningful

Learning questions. These questions had a precise relationship to text content, and all passage content was related to the same subject matter. Results of non-specific transfer studies (LaPorte & Nath, 1976; Voss, 1974) indicate that transfer to successive unrelated passages does not occur.

Mayer (1975) examined the nature of forward effects using the Treatment X Question Type design used previously by McConkie et al. (1973). Questions were similar to those developed by Watts and Anderson (1971), with higher-order questions requiring application of a conceptual mathematical model to new problem situations. Mayer found a main effect of question treatment on two final transfer passages; all question groups were superior to the control and higher-order questions were superior to other questions. In addition, performance on final passages demonstrated transfer for all types of questions, with all subjects performing best on the kind of question received for six previous passages.

Mayer's hypotheses concerning the nature of a forward effect are of particular interest to the current research. Mayer distinguished between two models of acquisition that produce a forward effect on subsequent reading. In one model, questions influence the reader's "performance set" (Gagne, 1973). They act as cues to direct reading strategies according to the goals of instruction. In a less complex model, a forward effect is attributed to practice in particular question answering skills.

Mayer's study included a review condition which used typical postquestions and a preview condition which stated questions as instructional objectives before passages. Mayer proposed that practice effects produce an advantage only if subjects actually answer questions--so that forward effects from practice would produce transfer only for his review condition. Forward effects on performance set would result in no difference on transfer passages between preview and review conditions.

Mayer found an equivalent degree of transfer for his two question positions. He interpreted this finding as evidence that a learning set based on prior (testlike) events was transferred to new learning.

Mayer observed forward transfer of a reading strategy under conditions corresponding to typical prequestion conditions. The present study looks for evidence of forward transfer for each of the question properties under investigation. Forward effects of each question type are measured in recall of subsequent unquestioned text. Questioned and unquestioned paragraphs in the current study relate to the same subject matter, and are identical in context and structure. Transfer to passages dissimilar in one or more dimensions is not examined.

Purposes and Hypotheses

The present research is concerned with how questions function to modify reading outcomes. It has five purposes.

1. To examine the contribution of specific prequestions to retention and processing of text.
2. To examine the contribution of organizing prequestions to retention and processing of text.
3. To examine the contribution of constructive prequestions to retention and processing of text.
4. To compare retention and processing of text elicited by general prequestions with that elicited by multiple specific prequestions which target an equal number of text sentences.
5. To determine if the question properties under study exert a forward influence on retention and processing of unquestioned text.

In order to accomplish these purposes, three separate sets of dependent measures will be examined:

A. Learning Effects

B. Effects of Question Properties on Forward Text Processing

C. Memorial Effects of Questions

Hypotheses for each set are as follows.

A. <u>Learning Effects: Recall of facts from questioned paragraphs</u>

1. Questions accompanying the text will produce greater immediate and delayed recall than reading without questions.
2. The effects of different types of questions will vary according to time of testing. Immediate

recall will be greater for specific questions than for higher-order (general) questions. Delayed recall will be greater for higher-order questions than for specific questions.

3. Immediate recall of text content will be greater than delayed recall.

Confirmation of Hypotheses 1 and 3 would replicate Rickards' (1976) findings for Verbatim and Conceptual prequestions. It is expected that, consistent with previous research, both specific and higher-order questions will demonstrate a direct effect on retention of questioned text. It also is expected that effects of questioning will deteriorate over a retention interval.

Hypothesis 2 predicts that specific questions are more efficient than general questions in directing attention to questioned text. With amount of question-relevant text controlled, the direct effect of specific questions is expected to facilitate immediate recall of questioned facts. It is expected that specific questions will not facilitate delayed recall relative to general questions due to the greater deterioration of retention associated with specific questions.

B. Effects of Question Properties on Forward Text Processing: Recall of facts from unquestioned paragraphs

4. Prequestions will produce a forward effect on unquestioned text.

Hypothesis 4 predicts that the question properties under study will promote use of an appropriate inspection or processing strategy which is generalizable to new content. Comparisons of transfer performance between question groups and a no-question group will demonstrate whether prior exposure to questions facilitates retention in the absence of the questions themselves. Within-group comparisons of factual recall from questioned versus unquestioned paragraphs will allow detailed examination of forward transfer for each type of question.

C. Memorial Effects of Questions: Free and prompted delayed recall of concepts, and degree of text integration

5. Questions will produce differences in delayed recall of conceptual text content.
6. Differences in delayed recall will demonstrate effects of organizational variables.

In order to test Hypothesis 5, performance of treatment groups will be examined for differences in delayed recall of concepts implict (but not stated) in the text. Processing models of question effects propose that differences in question level result in different representations of text in memory. Accordingly, it is predicted that specific questions and higher-order questions will vary in the type of content recalled over a retention interval.

It is suggested that subjects not questioned about concepts may consider them to be irrelevant to a free recall task, so that concepts available during testing may not be spontaneously reported. A completion (cued-recall) test over concepts implicit in the text provides a measure of accessibility to concepts. Completion test performance will demonstrate whether concept availability is increased for subjects questioned about conceptual information at acquisition. It also will demonstrate whether previous questioning about concepts enhances availability of concepts from unquestioned paragraphs.

Hypothesis 6 predicts that integration of text in acquisition, storage and retrieval will be influenced by the type of question encountered during reading. Correlational and clustering analyses will reveal any differences in how text is organized in long-term memory under different question conditions.

CHAPTER III

METHOD

Research was conducted to accomplish the purposes and test the hypotheses specified in Chapter II.

Subjects

Ninety-six college students served as subjects. All subjects were first or second year students enrolled in introductory social science courses. Several different classes were randomly selected to serve as question groups or as a control group. Students within question-group classes were randomly assigned to question treatments. Experimental procedures were conducted during regularly scheduled class sessions, and subjects participated in the study as part of their class activities.

Materials

Text passages were a modification of the text sequence used by Rickards (1976) in his investigation of conceptual-level questions. Questions incorporated the three salient question properties identified for study. Text and question materials are described in detail below.

Text Paragraphs

Rickards' text materials were used with one modification. In Rickards' study, two paragraphs were presented together (on one page) with an adjunct question related to only one of

the paragraphs. In the present study, all sixteen paragraphs were presented one at a time, on separate pages, with a question inserted on a separate page before each of the first eight paragraphs.

Each paragraph consisted of four sentences providing factual information about a particular aspect of a fictitious country (Mala). Specific facts in each paragraph were topically related, but the paragraph topic was not explicitly stated.

A questioned paragraph is shown for illustrative purposes. Experimental materials are provided in Appendix A.

Example: Questioned Paragraph

> Rainfall is less than 2 inches per year in southern Mala. The soils in the southern area of Mala are either sandy or rocky. Vegetation covers only about 2 percent of the land area of southern Mala. In the summertime temperatures have been recorded as high as 135 degrees in southern Mala.

Questions

Three types of question properties were studied. These properties and the corresponding questions are defined as follows; examples for the questioned paragraph (above) are provided.

1. Specificity: A question is specific when it asks for a fact stated in one sentence of the text. In this study, such questions are labeled

Specific prequestions. They require verbatim recall of discrete text items.

Example: Specific Prequestions

How many inches of rain fall per year?
What are the soils like?
How much land has vegetation?
How high are summer temperatures?

2. Organizing property: A question functions as an organizer when it provides a superordinate idea, topic or concept-label for factual text content. In this study, such questions are called Concept Organizer prequestions. In contrast to Specific prequestions, they relate generally to all text content in a questioned paragraph.

   Example: Concept Organizer Prequestion

   Why is southern Mala considered a desert?

3. Constructive property: A question has a constructive requirement if the reader must perform an operation on the text to answer the question. In this study, such questions are labeled Concept Construction prequestions. Like Concept Organizer prequestions, they are general in relationship to text content. But they incorporate an additional property by requiring the reader to construct the concept implicit in each questioned paragraph.

   Example: Concept Construction Prequestion

   What geographical term best describes southern Mala?

Treatment Groups

There are four groups of subjects, as follows.

1. Specific question group: Subjects in this group received four Specific prequestions--one per each paragraph sentence--before each of the first eight paragraphs. This was a new condition using multiple verbatim prequestions.

   Specific prequestions were presented in bulleted form to minimize reading time requirements while retaining a verbatim match with the text. Multiple specific prequestions also matched the sequence of paragraph sentences, with the first question directed to a fact in the first sentence, the second question to the second sentence, and so on.

2. Concept Organizer question group: Subjects in this group received one Concept Organizer prequestion before each of the first eight paragraphs. This was a new condition. Concept Organizer questions were identical to Rickards and DiVesta's (1974) Meaningful Learning postquestions, but they were used in the present study as prequestions in conjunction with the modified version of text passages.

3. Concept Construction question group: Subjects in this group received one Concept Construction prequestion before each of the first eight paragraphs. This condition replicated Rickards' (1976) Conceptual

question treatment except for the text modification noted above.

4. Reading-only group: Subjects in this group served as a control and received all sixteen paragraphs with no interspersed questions.

Subjects in all treatment groups received the same sixteen paragraphs in the same sequence. For the first eight paragraphs, treatment conditions varied for question groups and the reading-only group which received no questions. For the remaining eight paragraphs (paragraphs 9-16), all subjects received the identical text materials with no questions.

Procedures

Subjects were given an instruction sheet along with a closed reading booklet. Booklets were randomly distributed and each was coded for an experimental condition. Subjects were instructed to write their names (or an anonymous label) on their booklet covers and to wait for taped instructions on how to proceed.

The tape advised subjects that a "Turn" signal would identify when to turn to each new page. Subjects were instructed to turn as soon as they heard the signal. They were told not to look back to any previous page, and not to write anything in their booklets.

On the first turn signal, subjects opened to the first page in their booklets. The turn signal was given on the tenth second after each question page; the signal was repeated

on the seventeenth second after each paragraph page. Two monitors were present during all experimental sessions to distribute and receive materials, and to ensure that all subjects followed instructions.

Immediately after reading, free recall tests were distributed to all subjects. The test asked subjects to write everything they could remember about Mala. Subjects were given as much time as they wanted to complete the test.

Delayed testing was administered in the week following immediate testing. All delayed testing was completed within seven to nine days after immediate testing; the variation in time of delayed testing was equally distributed among all treatment groups. Subjects were given the same free recall test as was given for immediate testing. When the free recall tests were completed, subjects were given a sixteen-item completion test.

Each completion test item corresponded to a particular paragraph, and asked for the implicit topic (superordinate concept) for that paragraph.

Immediate and delayed free recall protocols were scored for correct number of facts using detailed scoring procedures previously developed for the text materials. These scoring procedures are provided in Appendix B. In order to test for reliability, forty-eight recalls were selected randomly and were independently scored by two judges. The Pearson-Product correlation for the two sets of scores was $r = .97$.

In addition to number of facts, delayed free recalls were scored for number of correct concepts. For each paragraph, the correct concept was an acceptable statement of the topic for that paragraph. Completion tests also were scored for number of correct concepts. For all tests, separate sets of scores were obtained for questioned paragraphs (1-8) and unquestioned paragraphs (9-16).

CHAPTER IV

RESULTS

This chapter presents results for the three sets of dependent measures specified in Chapter II, and for unplanned analyses of paragraph-specific retention data. Results are provided for: Learning effects, effects of question properties on forward text processing, paragraph-specific effects, and memorial effects of questions.

Learning Effects

It was proposed that the question properties under study would have significant effects on text learning as measured by the number of facts recalled from questioned paragraphs (1-8). Specific hypotheses were advanced which predicted learning outcomes for the comparison of recall performance between treatment groups. In order to provide maximum power for directly testing each such hypothesis, immediate and delayed free recall data were analyzed according to a priori comparison procedures using one-tailed t-tests (Kirk, 1968, pp. 73-74).

It was further proposed that recall performance would be affected by time of testing. Accordingly, a repeated measures analysis of variance was performed to obtain summary statistics, and to examine any overall trends in the recall data.

Effects of Prequestions

It was hypothesized (Hypothesis I) that all prequestion groups would be superior to the reading-only group on both immediate and delayed learning measures. This hypothesis was confirmed for Specific questions but not for higher-order questions.

Table 1 shows that all prequestions produced more facts than reading with no questions. However, a significant advantage was demonstrated only for subjects who received multiple Specific prequestions. Immediate learning was significantly higher for these subjects than for the reading-only group, t (46) = 4.41, $p < .001$. Results for delayed learning paralleled those for immediate learning, with only Specific prequestions producing significantly higher recall than no questions, t (46) = 1.78, $p < .05$.

Table 1

Mean Number Facts Recalled from Questioned Paragraphs

Test Time	Treatments			
	Concept Construction	Concept Organizer	Multiple Specific	Reading Only
Immediate	4.21	4.96	6.46	4.08
Delayed	2.38	2.67	3.04	2.08

Concept Construction prequestions did not significantly increase immediate or delayed learning compared to a control.

Concept Organizer prequestions also failed to differ significantly from the reading-only group, although the advantage of these prequestions over no questions approached significance on immediate learning, t (46) = 1.63, $p < .10$.

Differential Effects of Question Properties

It was hypothesized (Hypothesis 2) that the effects of question properties on text learning would be modified by the effects of a retention interval. It was predicted that Specific questions would produce greater factual recall than general questions on immediate testing, but that general questions would produce greater factual recall than Specific questions on delayed testing.

As shown in Table 1, the hypothesis for immediate learning was confirmed; the hypothesis for delayed learning was not confirmed. Immediate recall was significantly higher for Specific questions than for either of the general questions: for Concept Construction questions, t (46) = 4.18, $p < .001$; for Concept Organizer questions, t (46) = 2.79, $p < .005$. Delayed recall showed no significant differences between question groups.

Time of Testing

A repeated measures analysis of variance (for Treatments X Time of Testing) showed that the effect of Time of Testing was highly significant, F (1.92) = 98.13, $p < .001$. Analysis of variance tables are provided in Appendix C. As hypothesized (Hypothesis 3), immediate learning (M = 4.93) was greater

than delayed learning ($\underline{M}$ = 2.54).

In summary, it was predicted that multiple specific prequestions would produce a direct effect on immediate and delayed learning such that these questions would significantly exceed the reading-only group on both measures. This effect was confirmed. It also was confirmed that multiple specific questions were superior to general questions in facilitating immediate recall of facts from questioned paragraphs.

Contrary to predictions, Concept Construction questions did not significantly exceed no questions in immediate or delayed recall of facts from questioned paragraphs. Concept Organizer questions were more effective than Concept Construction questions in facilitating immediate recall, but comparisons between these higher-order questions, and between Concept Organizer questions and the reading-only group, showed that neither difference reached statistical significance. These unanticipated learning outcomes will be discussed in Chapter V.

Effects of Question Properties on Forward Text Processing

It was hypothesized (Hypothesis 4) that prequestions would produce a forward effect on unquestioned text. This hypothesis was not confirmed for any question treatment.

A repeated measures analysis of variance (Treatments X Time of Testing) was performed on immediate and delayed recall data to test differences between question groups and the reading-only group. Dependent measures were the number

of facts recalled from unquestioned paragraphs. There was no main effect of Treatments, but the interaction between Treatments and Time of Testing was significant, F (3, 92) = 4.39, $p < .01$.

Table 2 shows that immediate transfer performance for all prequestion groups was depressed below performance of the reading-only group. Post hoc comparisons of group means using Tukey's method showed a significant difference between the reading-only group and Concept Organizer questions ($p < .05$). The advantage of Concept Construction questions over Concept Organizer questions also was noticeable, nearly reaching statistical significance.

Table 2

Mean Number Facts Recalled from Unquestioned Paragraphs

Test Time	Treatments			
	Concept Construction	Concept Organizer	Multiple Specific	Reading Only
Immediate	9.13	6.96	8.29	10.21
Delayed	4.79	4.21	4.21	4.29

All subjects recalled significantly fewer facts from unquestioned paragraphs on delayed than on immediate testing, F (1, 92) = 189.64, $p < .001$. Delayed transfer performance was virtually identical for all treatment groups.

In summary, comparisons of question treatments with the reading-only group provide conclusive evidence that positive transfer from questioned to unquestioned text did not occur. Results of within-group comparisons are presented next.

Learning Versus Transfer Performance

Two supplementary analyses were performed to examine within-group differences between learning and transfer paragraphs; each 4 X 2 analysis of variance included Treatments as a between-subject factor and Paragraph Set as a within-subject factor. In the first analysis, dependent measures were immediate recall data for paragraphs 1-8 ($M = 4.93$) and for paragraphs 9-16 ($M = 8.65$). In the second analysis, dependent measures were delayed recall data for paragraphs 1-8 ($M = 2.54$) and for paragraphs 9-16 ($M = 4.38$).

Analysis of immediate recall performance showed a highly significant effect of Paragraph Set, F (1, 92) = 77.91, $p < .001$. This effect was replicated in delayed recall, F (1, 92) = 36.69, $p < .001$. Contrary to expected outcomes, all subjects recalled more facts from unquestioned paragraphs (Transfer Paragraph Set) than from questioned paragraphs (Learning Paragraph Set).

This finding contradicts intuitive assumptions and previous research on the effects of questioning. In this study, unquestioned text was intended as a measure of transfer, and it was assumed that questions would produce less recall from unquestioned than from questioned text if transfer did not

occur. But the finding that questions produced recall of more facts from unquestioned text cannot be interpreted as evidence of positive transfer, since the reading-only group recalled as many or more of these facts. Furthermore, this finding contradicts previous research which has shown that questions consistently produce greater learning of questioned than of unquestioned (incidental) text.

A major difference between this study and previous research is the sequence in which questioned and unquestioned text was presented. In the design typically employed by previous researchers, questioned and incidental text are interspersed. For example, in Rickards' (1976) study, each prequestion immediately preceded two paragraphs about Mala, with one paragraph containing questioned text and one containing question-incidental text.

In contrast, the current study massed unquestioned paragraphs after questioned paragraphs. It was speculated that this design resulted in recency and/or content-specific effects which, in turn, resulted in greater retention of facts from unquestioned paragraphs. Accordingly, recall data were analyzed for each paragraph in the text sequence. Results of these analyses are described next.

Paragraph-Specific Effects

In order to test for recency and content-specific effects, a 4 X 16 analysis of variance was performed on immediate

recall data. The analysis included Treatments and Paragraphs (1-16) as the two factors, with number of facts as the repeated measure on the second factor. This analysis demonstrated a significant effect for Paragraphs, F (15, 1380) = 20.67, $p < .001$. No other effects were significant.

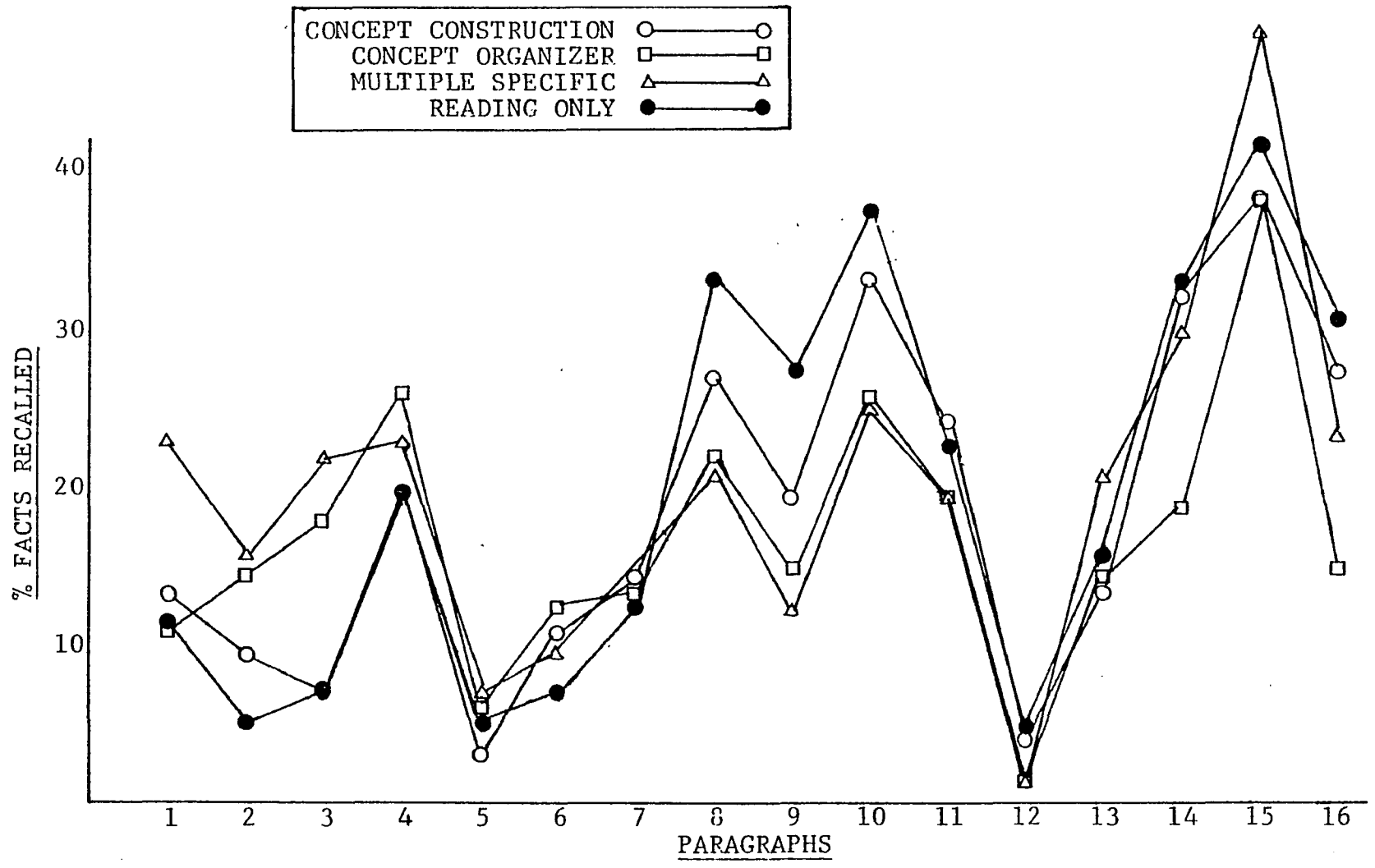
Figure 1 on the next page shows the amount of recall from each paragraph for each treatment group.

Amount of recall is expressed as a proportion of correct facts recalled to the total number of facts available in each paragraph. It was necessary to convert number of correct facts into percentages because the maximum number of available facts varied for some of the paragraphs. Detailed scoring protocols and procedures are provided in Appendix B.

As shown in Figure 1, all groups recalled more facts from more paragraphs in the second half of the text sequence (M = 23.06%) than from paragraphs in the first half of the text sequence (M = 15.40%). Performance of the reading-only group reflects a substantial relationship between amount of recall and position of paragraphs in the text sequence. Learning paragraphs, with the exception of paragraphs 4 and 8, were associated with less recall than any Transfer paragraphs, except for Paragraph 12.

This trend supports the hypothesis that recency effects contributed to recall. However, the reversals observed for

FIGURE 1. IMMEDIATE RECALL OF FACTS FROM EACH PARAGRAPH BY EACH TREATMENT GROUP



particular paragraphs (paragraphs 4, 8 and 12) are not compatible with a recency explanation. Thus, it is suggested that recall on any given paragraph also depended on content characteristics specific to that paragraph.

Text materials in this study were related to the same overall subject, and all paragraphs were identical in grammatical and organizational structure. It is speculated that paragraph information varied in at least one salient dimension--familiarity of the topical and factual content. Previous research on text treatments (for example, Tobias, 1976) has shown that familiarity of content may mediate treatment effects. Reading outcomes may be influenced by other content-related factors, such as the perceived importance of ideas and/or information (for example, Johnson, 1970; Kintsch, 1974).

No attempt has been made here to apply a formal content analysis to all paragraphs. But it is proposed that paragraphs 4 and 8 (about a "desert" and "communist nations") deal with relatively familiar information--thereby promoting relatively high recall of text content. Paragraph 12 (about the "Malan provinces") presents unfamiliar and detailed information--with the result that recall for this paragraph was lower than for any other paragraph.

Visual inspection of recall patterns in Figure 1 confirms that performance on each separate paragraph was similar for all treatments. Differences among treatments on many

paragraphs show less than 5% variation in performance. This means that differences in performance from paragraph to paragraph could be attributed more to paragraph-specific effects than to effects of treatment.

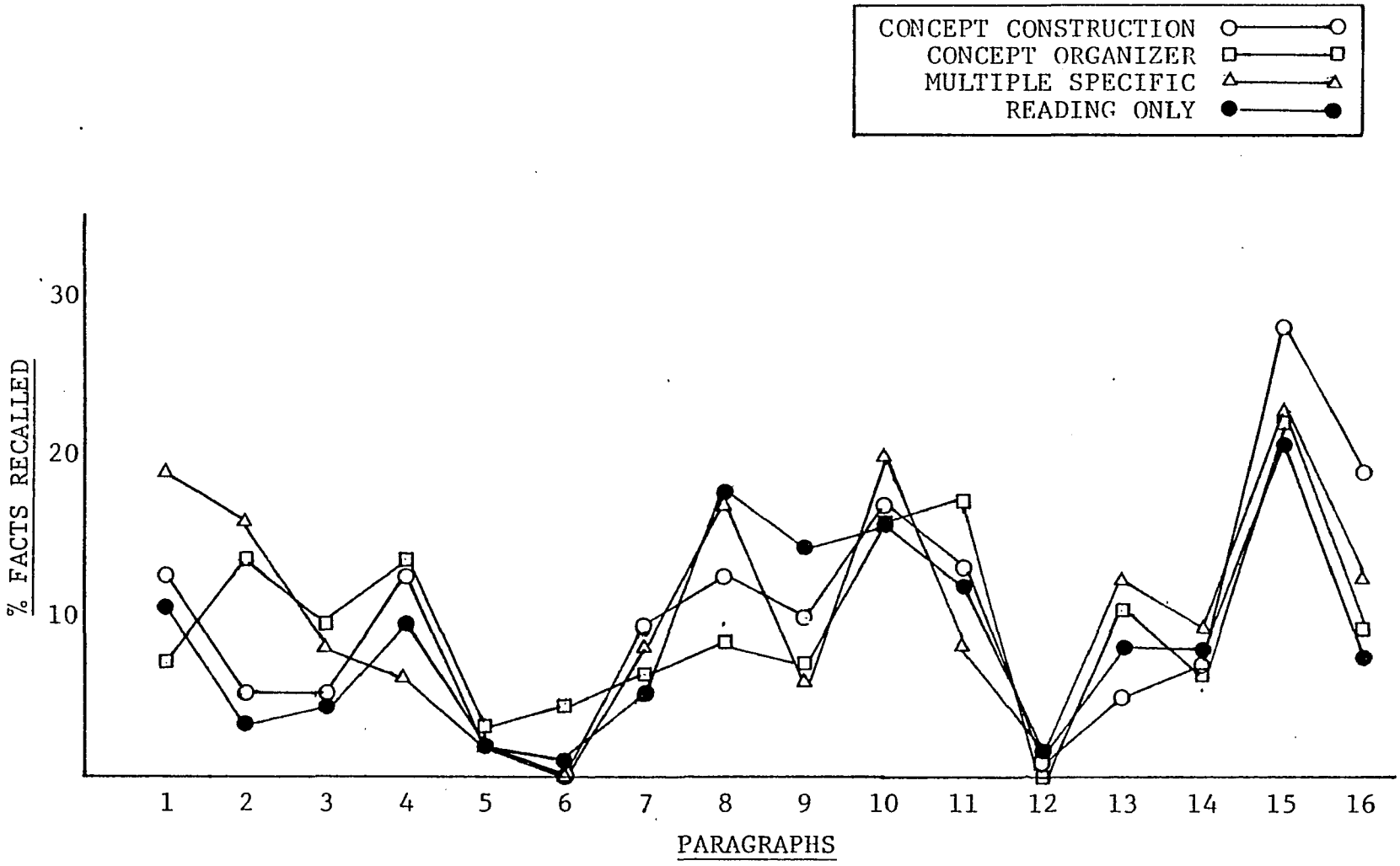
It also can be observed that some paragraphs show larger variations between group performance. This observation was verified using Dunnett's procedure for testing differences between treatments and a control.

Results of Dunnett's tests revealed significant differences only on paragraph 9, where the reading-only group outperformed Specific questions and Concept Organizer questions, t (92/4) = 2.89, $p < .01$ and t (92/4) = 2.43, $p < .05$, respectively. This finding that significant depression of recall was limited to the first unquestioned paragraph helps to clarify results of overall immediate transfer performance.

A 4 X 16 analysis of variance was performed on delayed recall data from each paragraph. This analysis also demonstrated a significant effect of Paragraphs, F (15, 1380) = 13.51, $p < .001$. Figure 2 on the next page shows the amount of recall from each paragraph for each treatment group.

Figure 2 reveals a pattern of delayed performance which replicates the paragraph-specific effects observed for immediate performance. Dunnett's tests on delayed recall

FIGURE 2. DELAYED RECALL OF FACTS FROM EACH PARAGRAPH BY EACH TREATMENT GROUP



data showed no significant differences. These results confirm that delayed recall of facts from each separate paragraph was equivalent for question treatments and the reading-only group.

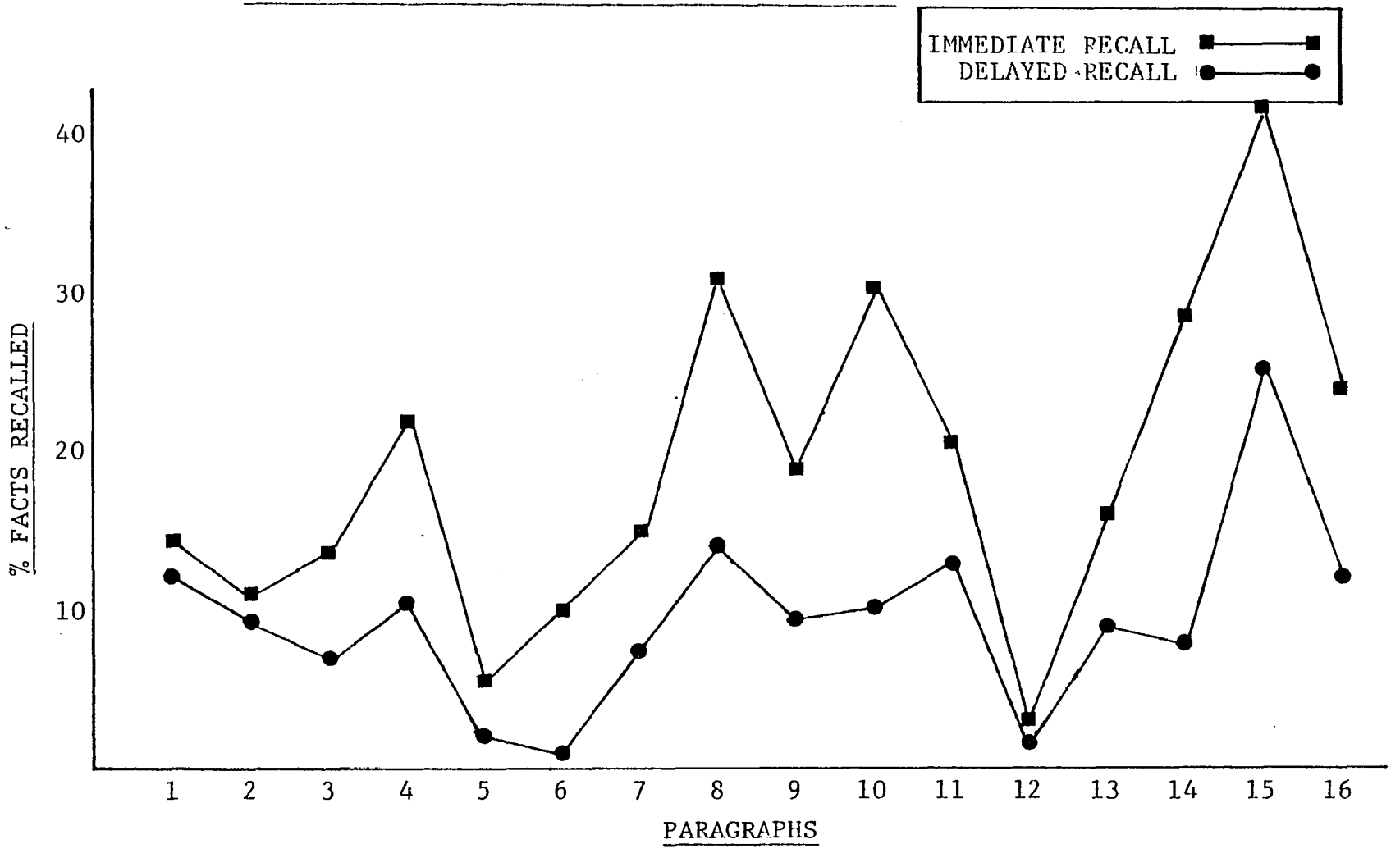
Figure 3 on the next page directly compares immediate recall from each paragraph to delayed recall from that paragraph. It compares performance by averaging over treatments for each paragraph.

The comparison in Figure 3 demonstrates highly consistent reading outcomes over a retention interval. Delayed recall from each paragraph is lower than immediate recall from that paragraph, but the general trends in performance are the same for both times of testing.

The similarity in performance in Figure 3 confirms that effects operating in immediate recall also account for outcomes observed in delayed recall. Recency effects are apparent at both times of testing. But the more dramatic outcome is the consistency of performance for each individual paragraph. This outcome is attributed to the strength of paragraph-specific variables such as familiarity of text content.

Analyses of paragraph-specific effects examined immediate and delayed recall of factual text content. Additional analyses were performed on only delayed recall data in order to examine differences in long-term memory of factual and conceptual text content. These analyses are described in the next section.

FIGURE 3. IMMEDIATE AND DELAYED RECALL OF FACTS FROM EACH PARAGRAPH AVERAGED OVER TREATMENTS



Memorial Effects of Questions

A processing model of question effects predicts that the representation of text in memory is affected by the type of question presented during reading. Consistent with this model, it was hypothesized that question properties would produce differences in delayed retention of factual versus conceptual text content, and that differences in recall would demonstrate effects of organizational variables.

Several post hoc analyses were performed on delayed data to test these hypotheses and to examine the long-term retention effects of the question properties under study. Results of each analysis are provided next.

Analysis of Cued-Recall of Conceptual Content

It was proposed that the delayed completion test provides a measure of concept availability over a retention interval. A repeated measures analysis of variance (Treatments X Paragraph Set) was performed on completion test data.

This analysis showed a highly significant effect of Paragraph Set, F (1, 92) = 144.97, $p < .001$. Table 3 shows that all subjects recalled more correct concepts from unquestioned than from questioned paragraphs. The interaction between Treatments and Paragraph Set also was significant, F (3, 92) = 3.61, $p < .05$. Simple effects analysis for questioned paragraphs demonstrated a significant difference between treatments, F (3, 92) = 4.12, $p < .01$. Tukey's procedure revealed that Concept Organizer questions were superior

to the reading-only group in producing correct concepts ($p < .05$). No other differences for questioned paragraphs reached significance, and performance on unquestioned paragraphs was virtually identical for all treatment groups.

Table 3

Mean Number Correct Concepts on the Delayed Completion Test

Paragraph Set	Treatments			
	Concept Construction	Concept Organizer	Multiple Specific	Reading Only
Learning	2.42	3.33	2.58	1.67
Transfer	4.46	4.63	4.58	4.54

The completion test was intended to examine differences in concept availability which might not be revealed in spontaneous, free recall data. Completion items were highly similar to higher-order questions, and correct answers to test items were provided in Concept Organizer questions.

Accordingly, the advantage observed for these questions may have been due entirely or in part to effects of testing. Delayed free recall data were also analyzed for differences in recall of conceptual content. Results of this analysis are presented next.

Analysis of Free Recall of Conceptual Content

It was hypothesized (Hypothesis 5) that prequestions would produce differences in delayed recall of conceptual

text content. This hypothesis was confirmed.

Delayed free recall protocols were scored for number of correct concepts, and repeated measures analysis of variance (Treatment X Paragraph Set) was performed on these data. The analysis showed a main effect of Treatment, F (3, 92) = 10.91, $p < .001$. Table 4 shows that Concept Organizer questions produced more concepts than any other group.

Table 4

Mean Number Correct Concepts in Delayed Recall

Paragraph Set	Treatments			
	Concept Construction	Concept Organizer	Multiple Specific	Reading Only
Learning	.46	2.17	.42	.25
Transfer	.58	.75	.42	.29

This main effect was modified by a significant interaction between Treatments and Paragraph Set, F (3, 92) = 8.16, $p < .001$. Simple effects analysis was significant for performance on questioned paragraphs, F (3, 92) = 18.71, $p < .001$. Comparisons of group means using Tukey's procedure showed that Concept Organizer questions were superior to all other treatments ($p < .05$). Differences between treatments were not significant for performance on unquestioned paragraphs.

The overall analysis also demonstrated a significant effect of Paragraph Set, F (1, 92) = 5.85, $p < .05$. This effect was due to the much higher performance of Concept Organizer questions on Learning Set (questioned) paragraphs. All other treatments produced equivalent recall from questioned and unquestioned paragraphs.

Analysis of delayed recall of concepts demonstrated a substantial advantage for Concept Organizer questions. In order to determine if this advantage significantly contributed to effects on total recall, an additional analysis was performed on delayed free recall data. Results of this analysis are presented next.

Analysis of Free Recall of Factual and Conceptual Content

This analysis was identical to previous analyses for recall of concepts. The dependent measure was total scores (number of facts plus number of concepts) on delayed free recalls.

The analysis demonstrated a significant main effect of Paragraph Set, F (1, 92) = 18.43, $p < .001$. Consistent with results for delayed recall of facts, this effect was due to the higher level of recall from unquestioned than from questioned paragraphs. As shown in Table 5, however, Concept Organizer questions produced virtually identical recall for questioned and unquestioned paragraphs.

Table 5

Mean Number Correct Facts and Concepts in Delayed Recall

Paragraph Set	Treatments			
	Concept Construction	Concept Organizer	Multiple Specific	Reading Only
Learning	2.83	4.83	3.46	2.33
Transfer	5.38	4.96	4.63	4.58

The interaction between Treatments and Paragraph Set approached significance, F (3, 92) = 2.42, $p < .10$. Simple effects were significant only for questioned paragraphs, F (3,92) = 2.94, $p < .05$. Inspection of group means shows that Concept Organizer questions outperformed all other treatments in total recall from questioned paragraphs. According to Tukey's test for differences, these questions were superior to the reading-only group, and their advantage over Concept Construction questions closely approached significance ($p < .05$).

These findings confirm that only Concept Organizer questions facilitated recall of total content from questioned paragraphs. The remaining issue is whether the advantage of these questions is associated with increased organization of text content. The final analyses performed on delayed free recall data examined effects of organizational variables. Results of these analyses are presented next.

Analysis of Effects of Organizational Variables

It was hypothesized (Hypothesis 6) that differences in delayed recall would demonstrate effects of organizational variables. This hypothesis was not confirmed.

It was proposed that correlations between conceptual and factual content in delayed recall would assess the degree of hierarchical organization associated with each question treatment. However, since only Concept Organizer questions produced a substantial number of concepts, delayed recall performance did not permit meaningful comparisons of correlational data.

Clustering procedures were used as a measure of text integration for each treatment group. For each group, a score was obtained from delayed recalls for the number of facts which were contiguously recalled in paragraph clusters; a "cluster" represented some number of facts related to the same paragraph topic. This cluster score for each group then was divided by the total number of facts (from all paragraphs) recalled by that group in any order. These procedures yielded the percent of facts clustered by each treatment group in delayed recall.

Table 6 presents the percent of clustered facts for each group. It provides the percent of clustered facts from all paragraphs, and provides separate percentages for clustered facts from questioned and from unquestioned paragraphs.

Appendix D provides complete clustering data.

Table 6

Percent of Clustered Facts in Delayed Recall

	Concept Construction	Concept Organizer	Multiple Specific	Reading Only
All Paragraphs (1-16)	52.3%	43.0%	39.6%	39.9%
Questioned Paragraphs (1-8)	28.0%	29.7%	26.0%	20.0%
Unquestioned Paragraphs (9-16)	64.3%	51.5%	49.5%	49.5%

Since clustering procedures yielded data in the form of percentages, an arcsin transformation of the data was required to stabilize the variances (Winer, 1971, pp. 399-400). Subsequently, t-tests were performed on the transformed data to examine treatment effects on text integration.

Table 6 shows that Concept Construction questions produced the greatest proportion of clustering from all paragraphs. However, t-tests showed no significant differences among treatments. All groups clustered more facts from unquestioned than from questioned paragraphs. In the absence of positive transfer, this degree of clustering cannot be attributed to question effects. It is suggested that subjects tended to spontaneously process text facts in the paragraph units presented during reading

In summary, analyses of effects of organizational variables did not reveal any significant differences between treatments.

Chapter V, next, provides a summary of results, followed by a discussion of major findings and their implications.

CHAPTER V

DISCUSSION

This chapter includes three major parts. The first part provides a summary and discussion of research results. The second part discusses results in the context of theoretical models of question effects. The final part considers the educational implications of the results and their implications for future research.

Summary and Discussion of Results

Results are summarized and discussed for each set of effects specified in Chapter IV.

Learning Effects

Text learning was measured by recall of facts from questioned paragraphs. Specific questions demonstrated increased recall of facts from questioned paragraphs, but general questions did not significantly affect the level of text learning.

As hypothesized, the direct effect of multiple Specific questions facilitated both immediate and delayed learning relative to reading with no questions. And this effect also resulted in greater immediate learning than that produced by general questions. These findings are consistent with previous research on the direct effect of verbatim prequestions. The direct effect of multiple Specific prequestions observed in this study is of particular importance because it resulted in greater overall learning than that produced by a control.

In contrast, Rickards' (1976) verbatim prequestions increased recall of intentional (questioned) facts, but the direct effect of these questions was not sufficient to increase overall factual recall relative to a control. Apparently, the amount of text targetted by verbatim prequestions is a primary determinant of the size of their direct effect on learning. Results of multiple Specific prequestions in this study further confirm that specific questions may produce greater factual learning than general questions when questioned text is identical for both question types.

Hypotheses relating to the learning effects of general questions were not confirmed. Concept Construction questions did not facilitate immediate or delayed learning relative to a reading-only group. Concept Organizer questions tended to outperform the reading-only group and Concept Construction questions on immediate learning, but these differences were not significant. Implications of these findings are considered in the next part of this chapter.

As predicted, immediate learning was greater than delayed learning for subjects in all treatment groups. Delayed recall showed no significant differences among the three types of questions. This means that Specific questions retained their advantage relative to the control over the retention interval, but did not retain a significant advantage over general questions. This finding provides some evidence that factual recall produced by specific questions may be subject to greater deterioration than recall produced by higher-order questions.

Effects of Question Properties on Forward Text Processing

Positive transfer was measured by recall of facts from unquestioned paragraphs. All prequestions failed to demonstrate a forward effect on text processing. This finding implies that the question properties under study are not associated with generalizable inspection and/or processing strategies.

Since Concept Construction and Concept Organizer questions did not result in significant learning effects, it is not surprising that these questions failed to produce positive transfer to unquestioned text. Specific questions showed significant effects on both immediate and delayed learning, but also failed to produce positive transfer.

A possible explanation of this result is provided by previous research which has shown that transfer occurs only when verbatim prequestions target highly identifiable categories of information. However, previous findings from Treatment X Question Type studies are based on tests of transfer which are not directly comparable to the measure of transfer employed in this study. The ambiguities and inconsistencies in the literature do not support generalizable conclusions regarding the question conditions under which transfer does or does not occur.

Perhaps the most important finding for immediate transfer performance in this study is that all prequestions resulted in less recall than a control. This finding bears a strong resemblance to the depression of incidental learning

("mathemagenic negative" effects) reported frequently in the literature on prequestion effects (see Anderson & Biddle, 1975). Consistent with this literature, the particular outcome for each type of prequestion may be explained in terms of the attentional and/or processing effects of each question property. Implications of transfer results are discussed in the next part of this chapter.

Immediate transfer was higher than delayed transfer for all subjects, and delayed performance showed no difference between treatments.

Comparisons for each treatment of the proportion of delayed recall to immediate recall support the conclusion that differences in treatments are associated with differences in the stability of recall over a retention interval. For the reading-only group, the number of facts recalled after a retention interval amounted to less than half (42%) of the facts recalled immediately after reading. For Specific and Concept Construction questions, delayed recall represented a greater proportion of immediate recall (50.7% and 52.5%, respectively), while Concept Organizer questions produced the highest proportion of immediate recall (60.5%) on delayed testing.

Finally, subjects recalled more facts from unquestioned than from questioned paragraphs on both immediate and delayed testing. This unanticipated outcome was clarified by results of analyses of recall from each paragraph.

Paragraph-Specific Effects

Paragraph analyses demonstrated recency and content-specific effects on immediate and delayed recall of factual content. Because all treatment groups performed similarly on most paragraphs, it was speculated that familiarity of paragraph content mediated effects of question treatments.

Of particular interest, immediate recall for the first unquestioned paragraph (9) represented the only instance where Specific and Concept Organizer questions were significantly depressed below the no-question group. This finding supports the conclusion that performance on unquestioned paragraphs is entirely consistent with incidental learning effects of prequestions.

Memorial Effects of Questions

On the delayed completion test, Concept Organizer questions produced more concepts from questioned paragraphs than the reading-only group. There were no effects of treatment on unquestioned paragraphs. These findings confirm that the type of question presented during reading influences long-term accessibility to conceptual content. All prequestion groups tended to outperform the reading-only group in promoting availability of concepts from questioned text. However, there was no difference in concept availability between subjects who were questioned about facts and subjects who were asked to construct concepts.

In contrast, Concept Organizer questions, which explicitly provided conceptual content, improved concept availability. Since these questions did not produce a forward effect, their advantage was limited to performance on questioned text.

The additional finding that all subjects supplied more correct concepts from unquestioned text is consistent with results for delayed recall of facts. Apparently, subjects were able to derive more concepts from the greater number of facts recalled from unquestioned paragraphs.

Only Concept Organizer questions produced substantial free recall of concepts from questioned paragraphs. This finding is consistent with completion test results in confirming that these questions facilitated delayed retention of concepts from questioned paragraphs relative to a reading-only group. Free recall data also showed a significant advantage of Concept Organizer questions over the other question treatments. Although cued-recall data demonstrated the same general trend, the advantage of Concept Organizer questions did not result in significant differences between question treatments.

Further comparison between free recall and cued recall results confirms the superior performance of all treatments on the latter measure. This means that all subjects had more concepts available than they spontaneously reported in free recall. Since only subjects given Concept Organizer questions recalled a high proportion of available concepts, it is assumed

that, for these subjects, representation of text included conceptual as well as factual content. In addition, these subjects produced more concepts in free recall from questioned than from unquestioned paragraphs. Since this result is not consistent with results for factual recall or concept availability, it is attributed to the direct effect of Concept Organizer questions on how conceptual content was represented in memory.

Concept Organizer questions resulted in proportionately high recall of the topics explicitly provided by questions. The first half of the text sequence included four times as many facts as concepts. But group means for Concept Organizer questions were approximately the same for concepts ($\underline{M}$ = 2.17) and for facts ($\underline{M}$ = 2.67) from questioned paragraphs. This finding confirms that content provided in the prequestions was more likely to be recalled than content provided in paragraph text.

Only Concept Organizer questions outperformed the reading-only group in total recall from questioned paragraphs. These questions also tended to produce greater total recall than other question treatments.

Total recall from unquestioned paragraphs was equivalent for all treatments. Concept Organizer questions produced similar levels of total recall from questioned and unquestioned paragraphs; for other treatments, recall was higher from unquestioned paragraphs.

Clustering analyses did not reveal any significant differences between treatments in effects of organizational variables on delayed recall of factual content. Additional results support the conclusion that recall of facts was not associated with recall of concepts for any treatment in this study.

Specific questions produced the highest learning of facts, but showed no advantage in free or prompted recall of concepts. Concept Organizer questions facilitated recall and availability of concepts, but did not increase learning of factual content.

Concept Organizer questions were the only treatment to produce free recall of a substantial number of concepts from questioned paragraphs. Yet these questions did not increase clustering of the facts explicitly linked by conceptual content. Apparently, Concept Organizer questions influenced the processing of particular text features, but did not result in greater organization of text in memory.

Results of the current research have been summarized and discussed for each of the question properties under study. Theoretical implications of these results are considered next in the context of attentional and processing models of question effects.

Theoretical Implications

Explanatory models of question effects provide a theoretical context for interpreting the results observed in this study. A recent, prototypical model was proposed by Andre (1979). In Andre's Directed Attention Model, attention refers to a set of activities at one stage in a multistaged reading process. The product of directed attention is the encoding of particular aspects of attended-to text. Adjunct questions function to guide the reader's encoding activities. Questions which direct attention to particular information lead subjects to construct a memory representation of that information. Conversely, questions which fail to influence encoding activities, fail to facilitate subsequent recall of questioned information.

This attentional model of question effects predicts the results observed for Specific questions in the present study. Specific prequestions were available to guide encoding activities. By directly questioning factual content, these questions were highly efficient in identifying to-be-remembered text. Consequently, factual learning was facilitated, and learning effects were sustained over a retention interval.

Verbatim prequestions typically are associated with a direct effect on learning. Results of multiple specific prequestions confirm that the strength of this direct effect is a function of the amount of questioned text. Further, with amount of question-relevant text controlled, multiple specific

questions may produce a learning advantage over more general questions.

Consistent with effects of directed attention, different outcomes of Specific prequestions were observed for learning of relevant versus incidental text. These questions facilitated recall of relevant facts in questioned paragraphs, but did not facilitate recall (or availability) of concepts from the same paragraphs. Concepts were implicit in the text but were not needed to answer Specific questions.

Specific questions also inhibited recall of factual content from unquestioned paragraphs. Such mathemagenic negative effects of verbatim prequestions are widely reported in the literature (see Anderson & Biddle, 1975). In Rickards' (1976) study, verbatim prequestions yielded less incidental recall than a control on both immediate and delayed testing. In that study, a questioned and unquestioned paragraph were presented together to measure effects on relevant and incidental learning. In the present study, the relationship between paragraphs 8 and 9 provides a similar measure, with a questioned paragraph (8) immediately followed by an unquestioned paragraph (9).

The change in performance from paragraph 8 to paragraph 9 reflected a particularly sharp decrease for subjects given Specific questions. On paragraph 8, only these subjects demonstrated facilitation of learning relative to a control. But on paragraph 9, these same subjects demonstrated inhibition of learning. Effects of selective attention can account

for this change in performance. But it is likely that the first presentation of unquestioned text also was accompanied by a decrease in the level of general attention to text.

Attentional hypotheses fully account for effects of question specificity on factual text learning. The conception of directed attention also explains effects of question level on retention of factual content.

Research has confirmed that factual recall is specific to items targeted by questions regardless of question level (for example, Frase, 1969b, 1970; Watts, 1973). Accordingly, increased recall with general or higher-order questions may be attributed to increased attentional responses to text. In Rickards' (1976) study, delayed factual recall was greater for higher-order prequestions than for verbatim questions. But since that study did not control for amount of question-relevant text, higher-order questions directed attention to more text items than were targeted by single verbatim questions.

In the present study, higher-order questions did not increase factual recall compared to multiple specific questions, or to a reading-only group. Although this latter finding is inconsistent with Rickards' (1976) results for Conceptual questions, there are similar findings in the literature. For example, recent replications (reported by Andre, 1979) failed to show any influence of Frase's (1969b) Inference questions on level of factual recall.

An attentional model assumes that questions provide a set

of criteria for selecting the information to be encoded. In this way, questions promote use of appropriate reading strategies. And different strategies result in different encodings of text. It has been shown that differences in encoding can influence subsequent performance in sentence learning (Andre & Sola, 1976) and learning of prose materials (Andre & Womack, 1978). There is a great deal of evidence in the present study that Concept Organizer questions influenced encoding strategies and subsequent recall performance.

Delayed recall performance supports the conclusion that Concept Organizer questions were highly efficient in directing attention to conceptual information. In particular, the finding that paragraph topics were far more likely to be recalled than facts confirms that topical content was perceived as relevant and important to reading objectives. The proportionately higher recall of concepts also implies that attentional responses were directed primarily to information in the questions themselves.

It is speculated that the "why" nature of Concept Organizer questions did not require that specific text items be attended to or rehearsed. Instead, answering each question required that the explicit topic provided by the question be held in working memory while the following paragraph was read. During reading, conceptual information could be rehearsed and text facts checked for congruency with the stated topic.

Specific prequestions selectively facilitated learning of facts at the expense of conceptual learning. In contrast,

Concept Organizer questions directed attention to conceptual content, but did not direct attention away from facts in the text. It is proposed that, in this way, Concept Organizer questions developed an effective strategy for encoding both conceptual and factual content.

The strategy developed by Concept Organizer questions apparently depended on explicit provision of topic information, so that factual recall decreased when that information was no longer provided. Similar to performance of Specific questions, Concept Organizer questions showed significant depression of factual recall only on the first unquestioned paragraph. Again, this finding is attributed to effects of selective attention on learning of incidental text.

In general, mathemagenic negative effects of questioning are associated with prequestions regardless of question level. For example, in Rickards' (1976) study, Conceptual prequestions were no more effective than verbatim prequestions in promoting incidental recall. In the present study, depression of recall on unquestioned paragraphs was an immediate effect of question treatment. On delayed testing, there were no differences between question treatments and the reading-only group in level of incidental recall.

Concept Construction questions did not influence attentional responses to text facts. And in contrast to Concept Organizer questions, they did not promote greater recall of concepts than reading with no questions or reading with specific questions. An attentional interpretation of these results is

that Concept Construction questions were not efficient in clarifying reading objectives. These questions asked for inferential content rather than for information stated in prequestions or in paragraph text. Since they did not direct attention to any particular text features, they did not lead subjects to develop a question-relevant strategy for encoding text content.

The similarity of Concept Construction questions to the reading-only group on all recall measures supports that these questions were not used effectively. Immediate recall on the first unquestioned paragraph was not depressed below the control as it was for other question treatments. And the completion test did not show a learning or transfer advantage for Concept Construction questions even though test items asked for the same information solicited by Concept Construction questions.

Results of higher-order questions in the present study have been discussed in the context of an attentional model of question effects. Directed attention accounts for observed effects of higher-order and Specific questions on the level of factual recall. And directed attention has been shown to influence learning in related areas of research. For example, prompts in programmed instruction materials were shown to influence subjects not to attend to particular text features (Anderson & Faust, 1967). And attentional effects accounted for the influence of such adjunct aids as learning objectives (Duell, 1974) and typographical cues (Glynn & DiVesta, 1979).

Processing models of question effects differ from attentional models in their concern with how question-related processes influence cognitive operations in memory. For example, Andre (1979) proposes a processing model which is concerned primarily with the characteristics of, and relationship between, episodic and semantic memory. The model attempts to account for the influence of question level on how text information is assimilated and stored in cognitive structure. Similarly, other models (for example, Neisser, 1967) rely on the construct of schemata to explain how questions activate pre-existing knowledge in cognitive structure, thereby influencing acquisition of new knowledge.

It was proposed that the higher-order questions examined in the present study would demonstrate effects on text processing. It was expected that the organizing property of Concept Organizer questions would promote text integration, thereby facilitating recall of passage information. However, these questions did not increase factual recall relative to a reading-only group. And clustering data did not show greater organization of factual content for these questions than for any other treatment. Accordingly, results do not support the conclusion that the organizational property of Concept Organizer questions influenced the level of text processing.

The task requirement associated with Concept Construction questions was expected to promote thorough text processing,

and, because of their organizing function, these questions also were expected to produce highly organized recall. However, Concept Construction questions failed to demonstrate any evidence of processing effects.

A critical issue for question level research is whether the construct of directed attention is able to fully account for all observed effects of higher-order questions, or whether higher-order question effects need to be understood in the context of a processing model. The literature provides few examples of question outcomes which cannot be attributed to the effects of directed attention. Watts and Anderson's results with Application questions represent one of the clearest examples of processing effects. It is improbable that the learning produced by these higher-order questions could be replicated by asking multiple verbatim questions. Evidence of facilitated learning with paraphrased questions provides a similar example of reading outcomes which cannot be attributed to a greater requirement for attentional responses. Facilitation with paraphrased questions has been observed on posttests which measured semantic encoding of text (Andre & Sola, 1976; Andre & Womack, 1978) and on a problem-solving criterion test (Felker & Dapra, 1975).

In each of these examples, higher level questions produced transferable knowledge. However, this finding does not warrant generalizable conclusions about processing effects because of the numerous exceptions in question level research. A

recent series of studies (Andre, 1979) provides a particularly relevant illustration of the unpredictability associated with processing effects of questions.

A series of three studies was conducted to replicate Watts and Anderson's (1971) results with Application questions. Factual or Application questions were presented either before or after reading to groups of high school and college students. Results on new application posttest items were different for all three replications. For college students, pre-factual questions were superior, or there were no treatment effects. For high-school students, factual questions in both positions were superior to Application questions. As Andre concludes, these results were not only inconsistent with Watts and Anderson's findings, they were inconsistent with each other.

Andre reports that performance means in his studies were lower than performance means in Watts and Anderson's (1971) study, and he suggests that the generally poorer level of performance in his studies and this restricted score range may have reduced the size of the effect due to Application questions. Similarly, recall means were considerably lower in the present study than in Rickards' (1976) study. The difference in results for Concept Construction questions in the present study and Conceptual questions in Rickards' study raises the possibility that treatment effects may not generalize to all populations.

It is also possible that differences in the design of the present study and Rickards' study contributed to the

differences in performance of Concept Construction questions. Paragraph analysis clearly demonstrated substantial effects of recency and, in particular, of paragraph-specific content. Since learning conditions on unquestioned paragraphs were identical for question groups and the reading-only group, and since these paragraphs all were massed after questioned paragraphs, recency and/or content effects may have weakened effects of questions on earlier paragraphs.

A final consideration pertains to the implications of observed results for processing interpretations of higher-order question effects. It is possible that higher-order questions in the present study did result in processing effects, but that retention is not an appropriate or adequate measure of such effects. A rationale for this approach is provided by applying Mayer's (1979) account of Assimilation Encoding Theory to the function of Concept Organizer questions.

According to Mayer's model, Concept Organizer questions provide superordinate information before learning, thereby facilitating activation of related existing knowledge in long-term memory. Facilitation continues as this anchoring knowledge is transferred to working memory and integrated with incoming knowledge. Since new information is assimilated to a broader context, the model predicts loss of specific facts and original organizational features from the text. It predicts facilitation on "far transfer" tasks which are dissimilar from text content.

Mayer's model accounts for the different effects of paraphrased questions observed by Felker and Dapra (1975) on their two measures of text learning. These questions showed no advantage over verbatim questions on a measure of text retention. But on a "far transfer" problem-solving test, paraphrased questions were superior, demonstrating evidence of deeper processing of text content. It is not clear whether higher-order questions in the present study are fully explained by attentional hypotheses, or whether the learning and transfer measures employed do not permit full examination of processing effects. This conclusion implies the need for continued research on learning from text. Implications of the current research for educational practice and for future research are considered next.

Educational and Research Implications

Research on goal-directed reading has important educational applications. What is learned from reading depends to a large extent on the purposefulness of the reading experience. Adjunct questions promote goal-directed reading in two ways. They provide a methodology for modifying instructional material according to the particular goals of the instructional situation. Whether the instruction situation involves teacher-based classroom learning, printed text, visual aids or other material, it typically is more practical to apply a question treatment than to alter the material itself.

Questions also provide the instructor with an aid to help the student. Goal-relevant questions make the reader's task easier, and increase the likelihood that important reading content will be remembered.

If questions are used to promote goal-directed reading, it follows that the type of questions used should match the objective of the particular reading situation. Matching question type to objective requires that the effects of question level and position be fully understood. The current body of knowledge about question level effects provides tentative evidence of differential learning outcomes for different types of questions. This evidence suggests that higher-order questions should be used if the instructional goal is to promote general new learning from the text; specific questions are more effectively used to promote retrieval of precise factual information. Clearly, effective use of questions in practical applications demands more precise information about how and when different types of questions influence reading.

Similarly, more information about position effects is needed to provide a methodology which best meets actual classroom use requirements. Prequestions have a practical advantage. Postquestions may be superior in some experimental settings, but most reading situations do not permit laboratory control over the student's inspection behavior. Students may in fact look at postquestions before reading assigned text.

One important goal of future research should be to clarify position and level effects in more naturalistic settings. Previous investigations (see Dunkin & Biddle, 1974, for a review) of questions used orally in classroom lecture and discussion have had limited usefulness, mainly due to the unreliability of observational methods and measurements. More positive outcomes were reported (Anderson et al., 1975) for use of adjunct questions as part of a CAI economics program. In that research, questions at cognitively high levels significantly enhanced performance.

Future research on text questioning needs to recognize some methodological problems in current research. In order to study position effects, text and questions are presented separately. For example, in the present study and in previous research using the same materials, text was artificially divided so that paragraphs could be presented on separate pages. Procedures which allow subjects to study adjunct questions along with text would result in more naturalistic reading conditions.

Another methodological issue relates to the advantage observed for question groups over reading-only controls. It has been suggested (Faw & Waller, 1976) that increased recall may be due to the increased study time for question treatments. Friedman (1977) tested study time effects by using a typical, unpaced control and a second control which read each paragraph twice within the same time limit imposed on reading both questions and paragraphs. Total retention showed no difference

between the two controls. Similar results were obtained (see Rickards & Denner, 1978) for two controls in research on note-taking and underlining. And studies using task-irrelevant question groups (Rickards, 1976; Rickards & DiVesta, 1974) directly controlled for equal reading time for treatment and control groups.

Despite these results, it is not clear how retention effects may be mediated by effects of content presented in questions. For example, Specific prequestions in the present study repeated paragraph facts. This additional opportunity for study and rehearsal of factual content may have contributed to the advantage of Specific prequestions over higher-order questions in recall of factual content.

Future research also needs to reflect the importance of subject-related variables. There are several theoretical models (for example, Ausubel, 1968; Wittrock, 1974) which emphasize the idiosyncratic nature of reading activities. Based on these models, Frase and Schwartz (1975) studied effects of questions generated by the subjects themselves. In general, their experiments found that intentional learning was increased for subjects who independently constructed their own questions.

In interpreting learning outcomes, researchers need to consider how question effects may be mediated by subject-generated activities. Effects of questions may be weakened if a question-induced strategy interferes with an idiosyncratic strategy, or if multiple strategies are used in reading.

Previous research has demonstrated that individual differences in reading can significantly mediate question effects. In one study (Shavelson et al., 1974), treatment effects varied depending on the verbal ability of subjects. Performance of high-verbal subjects was equivalent under all treatment conditions, but low-verbal subjects showed highest performance with higher-order postquestions.

In a more recent study (Rickards & Hatcher, 1978), performance of good and poor readers was compared on the 1974 version of the materials used in the present study. In that study, reading ability was classified according to grade level in vocabulary and reading comprehension. Consistent with Shavelson et al.'s findings, questions did not affect the performance of higher ability subjects. Poor readers produced more factual recall with Meaningful Learning postquestions than with verbatim questions or no questions. The organization of recall also varied for different ability subjects. Poor readers given Meaningful Learning questions tended to recall topically related facts together with related superordinate topics. For good readers, these higher-order questions apparently did not promote integration of subordinate facts under topic information.

These findings are important because they demonstrate that efficient use of a question-induced strategy may depend on reading ability. If all subjects in Rickards and Hatcher's (1978) study had been good readers, effects of question level

would not have been revealed. Clearly, future research must recognize that individual differences in reading is an important variable in understanding question effects.

Finally, future research needs to examine content-related variables. Content-specific and recency effects were found to exert a strong influence on performance in the present study. A replication using different paragraph sequences is needed to obtain a precise measure of these effects, and to identify salient content features. Continued research should be directed to clarify how content-related variables interact with question condition to influence reading outcomes.

In summary, question effect research offers a promising methodology for practical use in instructional settings. But in order for research findings to be effectively applied, a great many issues still need to be clarified.

Cognitive theory and memory research offer several useful models (Anderson, 1977; Andre, 1979; Collins & Quillian, 1972; Kintsch, 1974) to guide future study of the processes involved in question effects. The theoretical framework provided by such models should be used to direct research efforts--for example, to define question-and-text relationships, to design experiments which test specified effects, and to select meaningful measures of those effects.

In particular, future research should be directed to examine effects of questioning on forward text processing. Previous studies have focused on the forward influence of postquestions;

study of forward effects of prequestions requires a different experimental paradigm. Selective attention effects have resulted in positive transfer only for a narrow range of information. And transfer results have not been consistent even for such highly identifiable types of information as proper names and numerals. Processing effects have resulted in positive transfer of learning from text, but continued research is needed to clarify the conditions under which such transfer occurs.

Evidence of transfer of processing strategies is of particular importance to educational purposes. Such evidence demonstrates that use of adjunct questions can have an effect beyond the immediate instructional experience. It confirms that questioning facilitates learning in new situations, and implies that appropriate use of questions may result in shaping of long-range strategies for effective reading.

APPENDIX A

EXPERIMENTAL MATERIALS

Materials used in the study are provided in the following order:

Instructions

(1) For Specific questions (SF)
(2) For Concept Construction and Concept Organizer questions (CC/CO)
(3) For the reading-only group (ROC)

Questions for paragraphs 1-8

(1) Specific prequestions
(2) Concept Construction prequestions
(3) Concept Organizer prequestions

Paragraphs 1-16

Immediate (IR) and delayed (DR) free recall tests

Completion test

INSTRUCTIONS

This experiment examines the effect of questions on learning from written materials.

You'll read a series of paragraphs about Mala, a fictional African country. Each paragraph is printed on a separate page.

Each paragraph page is preceded by a page with several questions; the questions refer to the text material on the following page. Use the questions as a study aid by answering them as you read the text.

A taped Turn signal will tell you exactly when to begin reading each page. You'll have 10 seconds to read each question page, and 15 seconds to read each paragraph page. DO NOT WRITE ANYTHING IN YOUR BOOKLET. DO NOT TURN BACK TO ANY PAGE ONCE YOU'RE ON A NEW PAGE.

Later in the booklet, paragraph pages are NOT preceded by question pages. For these, you'll just read the text. There will be Turn signals as usual, and 15 seconds will be allowed for each page.

There will be a test after you complete the entire passage.

Please raise your hand now if you have any questions.

INSTRUCTIONS

This experiment examines the effect of questions on learning from written materials.

You'll read a series of paragraphs about Mala, a fictional African country. Each paragraph is printed on a separate page.

Each paragraph page is preceded by a question page; the question refers to the text material on the following page. Use each question as a study aid by answering it as you read the text.

A taped Turn signal will tell you exactly when to begin reading each page. You'll have 10 seconds to read each question page, and 15 seconds to read each paragraph page. DO NOT WRITE ANYTHING IN YOUR BOOKLET. DO NOT TURN BACK TO ANY PAGE ONCE YOU'RE ON A NEW PAGE.

Later in the booklet, paragraph pages are NOT preceded by question pages. For these, you'll just read the text. There will be Turn signals as usual, and 15 seconds will be allowed for each page.

There will be a test after you complete the entire passage.

Please raise your hand now if you have any questions.

INSTRUCTIONS

This experiment examines how learning occurs from written materials.

You'll read a series of paragraphs about Mala, a fictional African country. Each paragraph is printed on a separate page.

A taped Turn signal will tell you exactly when to begin reading each page. You'll have 15 seconds to read each paragraph. DO NOT WRITE ANYTHING IN YOUR BOOKLET. DO NOT TURN BACK TO ANY PAGE ONCE YOU'RE ON A NEW PAGE.

There will be a test after you complete the entire passage.

Please raise your hand now if you have any questions.

How large is Mala's army?

What is the legal requirement for military service?

How much military training occurs in elementary school?

What percent of factories produce military goods?

What is Mala's most popular tourist attraction?

What words describe the northern villages?

Where are the lakes found?

What grows abundantly in the northern meadows?

What does the land of western Mala consist of?

What does the Peace Corps teach there?

What does western Mala supply to the rest of the country?

What product is western Mala a leading exporter of?

How many inches of rain fall per year?

What are the soils like?

How much land has vegetation?

How high are summer temperatures?

Who were the most respected citizens of the Nok civilization?

Nok art was as advanced as art of what country?

What is made today using many Nok techniques?

How long did Nok art festivals last?

What happened in Mala in 1610?

Who occupied land belonging to natives?

How well were Malans paid to work in foreign-controlled factories?

What did the Arab nomads do in Mala?

What percent of Daka's residents have European origins?

What city does Daka greatly resemble?

What is displayed in the galleries?

What European products are available in the market place?

With what foreign country is Mala most closely tied?

With what European nation does Mala trade the most?

What is Mala's position in the war in Southeast Asia?

How much in foreign aid did Mala receive from Russia in 1969?

What is the apparent orientation or leaning of the government of Mala?

What one word best describes the entire region of northern Mala?

On what is the economy of western Mala based?

What geographical term best describes
southern Mala?

What one word best describes the Nok civilization of Mala?

In a word or two, what have foreigners done to the Malans throughout history?

What is the character or flavor of Mala's capitol, Daka?

What political system does Mala favor with regard to its foreign policy?

Why can it be said that the Malan government has a militaristic orientation?

Why is northern Mala considered an area of great natural beauty?

Why can it be said that western Mala's economy is based on agriculture?

Why is southern Mala considered a desert?

Why can it be said that the Nok civilization of Mala was very creative?

Why can it be said that Mala has been exploited?

Why can it be said that Daka has a distinctly European character?

Why can it be said that the Malan government favors communistic countries with regard to its foreign policy?

Mala has the largest army in Africa. In Mala, there is a law which requires two years of military service for both men and women. Military training begins at the elementary school level in Mala where one hour per day is devoted to such training. 25 percent of the factories of Mala are engaged in the production of military goods.

The magnificent Kaba waterfall in northern Mala is Mala's most popular tourist attraction. The people of northern Mala take pride in their quaint and colorful villages. Several crystal-clear mountain lakes can be found in northern Mala. In the springtime, the abundance and variety of flowers in the meadows of northern Mala is unsurpassed in all of Africa.

The land of western Mala consists of rich volcanic soil. The Peace Corps has sent men and equipment to western Mala in order to teach people there the newest methods of farming. The wheat and rice grown in western Mala supplies completely the entire country of Mala. Western Mala is one of the leading exporters of peanuts in Africa.

Rainfall is less than 2 inches per year in southern Mala. The soils in southern Mala are either sandy or rocky. Vegetation covers only about 2 percent of the land area of southern Mala. In the summertime temperatures have been recorded as high as 135 degrees in southern Mala.

Findings indicate that artists were the most respected citizens of the early Nok civilization of Mala. In many ways, Nok art was as advanced as that of the Egyptians. Many of the techniques of the Nok artisans are followed today in the making of ceramics. During the time of the Nok civilization, art festivals were held annually for two full weeks in many parts of Mala.

The first slaves were forcefully taken from Mala to Europe in 1610. When Europeans came over to Mala to settle they never paid the native Malans for the land that they occupied. For the first 50 years of this century foreign-controlled factories employed the Malans at deplorably low wages. Prior to the coming of the Europeans, Arab nomads frequently plundered villages in Mala.

About 70 percent of the residents of Mala's capitol, Daka, are either of German, Italian, Spanish, or French origin. The city plan of Daka greatly resembles that of Paris. Many of the paintings of Europe's great artists are on display in the galleries and museums of Daka. In the market place of Daka, all types of Continental foods are available.

Mala's closest foreign ties are with the Chinese Mainland. Among European nations, Mala trades most with Albania. Malan leaders have publicly expressed their support of North Viet Nam in the war in Southeast Asia. In 1969, Soviet Russia gave $40,000,000 in foreign aid to Mala.

The life expectancy of the average Malan is a mere 40 years. Most Malans are undernourished because of a severe lack of protein in their diet. Disease spreads rapidly in Mala due to the prevalence of the tsetse fly and various kinds of mosquitoes. Because of a lack of proper sewage in Mala, there is a high incidence of dysentery and related infections.

70 percent of the Malans are literate. Mala is the only country in Africa that requires by law that both boys and girls complete 12 years of school. The University of Mala has become internationally famous for its research in African history and culture. A larger proportion of Malan high school graduates receive scholarships to American universities than any other African nation.

Only one-tenth of the roads in Mala are paved. There are no television stations in the entire country of Mala. In Mala, there is only one telephone for every 15,000 inhabitants, the lowest telephone-to-people ratio in Africa. There are 3 airports in all of Mala and only one of them can accommodate jet-propelled airplanes.

The representatives of Volta province to Mala's national legislature vote only on matters directly related to their province. The Bantu province has made repeated claims for independence from Mala. The Hamu province recently boycotted the national elections to express their disinterest in the national government. The Rinu province representatives consistently propose legislation that would create the construction of fences and roadblocks between the provinces.

An entire half of Mala's coastal region is obstructed by numerous offshore sandbars. The other half of Mala's coastal area has high rocky cliffs all along the shore. Sea inlets in Mala are almost all overgrown by the tropical mangrove plant. The few areas along the coast that are open to ships are subject to frequent tidal waves.

The average Malan pays a full 40 percent of his income to the government. There is a 10 percent sales tax in Mala on all sales transactions. The tax on luxury items in Mala is approximately equal to the price of the item itself. It is rare that Malans are able to buy foreign products because of the excessive import tax on such goods.

Mala's oil deposits are estimated at 10 percent of the world's total. The country of Mala ranks eighth in the world in its amount of iron ore. Some of the largest diamonds in the world have been found in Mala. Mala's aluminum deposits are large enough to supply the aluminum needs of the entire world for the next 35 years.

The lakes of eastern Mala contain over 1500 varieties of fish. Practically every known species of predatory animal has been seen in eastern Mala. The tiger and the rhinoceros, which are nearly extinct in other parts of the world, are still thriving in eastern Mala. Eastern Mala is one of Africa's most popular areas for safaris.

NAME: _____

Write the same name you used on your booklet.

Write down everything you can remember about Mala.

Use the attached pages.

When you're done, please raise your hand.

NAME: _____

Write the same name you used last week.

Write down everything you can remember about Mala.

Use the attached pages.

When you're done, please raise your hand.

NAME: _____

Complete each of the sentences below by writing in a word or short phrase on the blank line. When you're done, please raise your hand.

1. The entire region of northern Mala is best described by the word _____.
2. Education in Mala can be described as _____.
3. Mala's capitol, Daka, has a _____ character or flavor.
4. The economy of western Mala is based on _____.
5. The amount of mineral deposits in Mala can be described as _____.
6. The health of Malans can be described as _____.
7. Malan foreign policy favors countries which have a _____ political system.
8. The Nok civilization of Mala is best described by the word _____.
9. Throughout history, foreigners have _____ the Malans.
10. There is a lack of _____ between Mala's provinces.
11. Taxes in Mala can be described as _____.
12. Wildlife in eastern Mala can be described as _____.
13. Mala's communication system can be described as _____.
14. Southern Mala is best described by the geographical term _____.
15. The government of Mala has a _____ orientation or leaning.
16. Mala's coast can be described as _____.

APPENDIX B

SCORING PROCEDURES

General Guidelines: For scoring purposes, each sentence was reduced to a phrase of three or four words. Each complete sentence, sentence reduction or its semantic equivalent was counted and scored as one point. Incomplete statements, inferences, or invalid alterations were not counted as correct and were not included in the subject's score. Valid recall statements of text sentences did not alter the meaning of text content. Correct attribution was necessary, and general statements were valid only if they were logical statements of text content. For example, the statement "There is less than 2 inches of rainfall per year in Mala" would not be scored as correct because this statement is true only for a specified region of Mala.

Scoring Protocols: Scoring protocols identified acceptable sentence reductions and alterations for each paragraph. Sentence reductions are indicated by underlined words. Some

semantic equivalents are indicated immediately above text words; additional equivalents were acceptable. The first, lettered sentence in each paragraph represents the implicit (but not stated) topic for that paragraph.

Paragraph 1

A. military state
The Malan government is militaristic. Mala has the
1. very large 2.
largest army in Africa. In Mala, there is a law which re-
compulsory draft or service
quires two years of military service for both men and women.
3.
Military training begins at the elementary school level in
Mala where one hour per day is devoted to such training.
4. many produce
25 percent of the factories of Mala are engaged in the pro-
duction of military goods.

Paragraph 2

A. 1.
Northern Mala is beautiful. The magnificent Kaba water-
fall in northern Mala is Mala's most popular tourist attrac-
2.
tion. The people of northern Mala take pride in their quaint
3.
and colorful villages. Several crystal-clear mountain lakes
4. many
can be found in northern Mala. In the springtime, the abun-
dance and variety of flowers in the meadows of northern Mala
is unsurpassed in all of Africa.

Paragraph 3

A.
The economy of western Mala is devoted mainly to farm-
1.
ing. The land of western Mala consists of rich volcanic
2.
soil. The Peace Corps has sent men and equipment to western
Mala in order to teach people there the newest methods of
3.
farming. The wheat and rice grown in western Mala supplies
completely 4.
the entire country of Mala. Western Mala is one
of the leading exporters of peanuts in Africa.

Paragraph 4

A. dry or arid 1. little
Southern Mala is a desert. Rainfall is less than 2
2.
inches per year in southern Mala. The soils in southern Mala
3. very little
are either sandy or rocky. Vegetation covers only about 2
of
percent of the land area of southern Mala. In the summertime
4. very high
temperatures have been recorded as high as 135 degrees in
southern Mala.

Paragraph 5

A. early Malans artistic
The Nok civilization was very creative. Findings indi-

1.
cate that artists were the most respected citizens of the

2. early
early Nok civilization of Mala. In many ways, Nok art was

good 3.
as advanced as that of the Egyptians. Many of the techniques

early artists pot-
of the Nok artisans are followed today in the making of cera-

tery 4.
mics. During the time of the Nok civilization, art festivals

frequently
were held annually for two full weeks in many parts of Mala.

Paragraph 6

A. being taken advantage of
Mala has a history of foreign exploitation. The first

1. early
slaves were forcefully taken from Mala to Europe in 1610.

2.
When Europeans came over to Mala to settle they never paid

the native Malans for the land that they occupied. For the

3. for many years or early part of the century European
first 50 years of this century foreign-controlled factories

employed the Malans at deplorably low wages. Prior to the

4. early in Malan history
coming of the Europeans, Arab nomads frequently plundered

villages in Mala.

Paragraph 7

A. cosmopolitan flavor 1.
Daka has a distinctly European character. About 70 percent of the residents of Mala's capitol, Daka, are either European 2.
of German, Italian, Spanish or French origin. The city plan of Daka greatly resembles that of Paris. 3. Many of the paintings of Europe's great artists are on display in the galleries and museum of Daka. 4. In the market place of Daka, all types of continental foods are available.

Paragraph 8

A. the reds 1.
Mala's government favors communistic countries. Mala's closest foreign ties are with the Chinese Mainland. Among 2. 3.
European nations, Mala trades most with Albania. Malan leaders have publicly expressed their support of North Viet Nam in the war in Southeast Asia. 4. In 1969, Soviet Russia gave much money
$40,000,000 in foreign aid to Mala.

Paragraph 9

Note: This paragraph has a maximum score of 7 correct facts.

A. 1.
Malans have poor health. The life expectancy of the
short 2. many
average Malan is a mere 40 years. Most Malans are under-
3.
nourished because of a severe lack of protein in their diet.
4. 5. many
Disease spreads rapidly in Mala due to the prevalence of the
tsetse fly and various kinds of mosquitoes. Because of a
6. poor 7.
lack of proper sewage in Mala, there is a high incidence of
dysentery and related infections.

Paragraph 10

A. 1. many
Education in Mala is very good. 70 percent of the
2.
Malans are literate. Mala is the only country in Africa
that requires by law that both boys and girls complete 12
high school 3.
years of school. The University of Mala has become inter-
nationally famous for its research in African history and
4. many
culture. A larger proportion of Malan high school graduates
receive scholarships to American universities than any other
African nation.

Paragraph 11

Note: This paragraph has a maximum score of 6 correct facts.

A. Communication in Mala is very poor. 1. Only one-tenth of the roads in Mala are paved. 2. There are no television stations in the entire country of Mala. 3. In Mala, there is only one telephone for every 15,000 inhabitants, 4. the lowest telephone-to-people ratio in Africa. 5. There are 3 airports in all of Mala and only one of them 6. can accommodate jet-propelled airplanes.

Paragraph 12

Note: This paragraph has a maximum score of 5 correct facts.

A. Mala lacks national unity. The representatives of 1. Volta province is provincial or divided to Mala's national legislature vote only on matters directly related to their province. 2. The Bantu province has made repeated claims for independence from Mala. 3. The Hamu province recently boycotted the national elections to express 4. their disinterest in the national government.

5.
The Rinu province representatives consistently propose legislation that would create the construction of fences and roadblocks between the provinces.

Paragraph 13

A. almost very hard to get to
Mala's coastline is practically inaccessible. An en-
1.
tire half of Mala's coastal region is obstructed by numerous
2.
offshore sandbars. The other half of Mala's coastal area
3.
has high rocky cliffs all along the shore. Sea inlets in Mala are almost all overgrown by the tropical mangrove plant.
4.
The few areas along the coast that are open to ships are subject to frequent tidal waves.

Paragraph 14

A. 1.
Mala has high taxes. The average Malan pays a full
much of 2.
40 percent of his income to the government. There is a 10
very high 3.
percent sales tax in Mala on all sales transactions. The tax on luxury items in Mala is approximately equal to the price of

few Malans buy foreign products
the item itself. It is rare that Malans are able to buy

4.
foreign products because of the excessive import tax on such

goods.

Paragraph 15

A. large amount mineral deposits 1.
Mala has abundant natural resources. Mala's oil depos-

large
its are estimated at 10 percent of the world's total. The

2. much
country of Mala ranks eighth in the world in its amount of

3. very large
iron ore. Some of the largest diamonds in the world have

4.
been found in Mala. Mala's aluminum deposits are large

enough to supply the aluminum needs of the entire world for

the next 35 years.

Paragraph 16

Note: This paragraph has a maximum score of 5 correct facts

A. much game and fish 1.
Eastern Mala has abundant wildlife. The lakes of east-

many kinds
ern Mala contain over 1500 varieties of fish. Practically

2. many animals
every known species of predatory animal has been seen in east-

ern Mala. (3.) The tiger and the rhinoceros, which are nearly extinct in other parts of the world, are (4.) still thriving in eastern Mala. (5.) Eastern Mala is one of Africa's most popular areas for safaris.

APPENDIX C

ANALYSIS OF VARIANCE TABLES

Learning: Facts from questioned paragraphs

Source	Sum of Squares	df	Mean Square	F Ratio	Significance
Treat	79.557	3	26.519	2.391	.074
Unit	1020.397	92	11.091		
Phases	273.130	1	273.130	98.132	<.001
Treat X Phases	18.307	3	6.102	2.193	.095
Phases X Unit	256.063	92	2.783		
Total	1647.454	191	8.625		

Transfer: Facts from unquestioned paragraphs

Source	Sum of Squares	df	Mean Square	F Ratio	Significance
Treat	80.396	3	26.799	1.700	.173
Unit	1450.586	92	15.767		
Phases	875.520	1	875.520	189.636	<.001
Treat X Phases	60.729	3	20.243	4.385	.007
Phases X Unit	424.750	92			
Total	2891.981	191	15.141		

Immediate Forward Effect:
Facts from questioned and unquestioned paragraph sets

Source	Sum of Squares	df	Mean Square	F Ratio	Significance
Treat	56.432	3	18.811	1.530	.213
Unit	1131.315	92	12.297		
Sets	663.795	1	663.795	77.905	<.001
Treat X Sets	164.807	3	54.936	6.447	.001
Phases X Unit	783.896	92	8.521		
Total	2800.246	191	14.661		

Delayed Forward Effect:
Facts from questioned and unquestioned paragraph sets

Source	Sum of Squares	df	Mean Square	F Ratio	Significance
Treat	5.625	3	1.875	.207	> .500
Unit	832.045	92	9.044		
Sets	161.333	1	161.333	36.690	< .001
Treat X Sets	12.125	3	4.042	.919	.435
Sets X Unit	404.543	92	4.397		
Total	1415.667	191	7.412		

Delayed Recall Concepts

Source	Sum of Squares	df	Mean Square	F Ratio	Significance
Treat	41.625	3	13.875	10.906	< .001
Unit	117.042	92	1.272		
Sets	4.688	1	4.688	5.851	.018
Treat X Sets	19.604	3	6.535	8.156	< .001
Sets X Unit	73.708	92	.801		
Total	256.667	191	1.344		

Delayed Total Recall:
Facts and Concepts

Source	Sum of Squares	df	Mean Square	F Ratio	Significance
Treat	50.208	3	16.736	1.279	.287
Unit	1203.793	92	13.085		
Sets	111.020	1	111.020	18.430	< .001
Treat X Sets	43.771	3	14.590	2.422	.071
Sets X Unit	554.208	92	6.024		
Total	1963.001	191	10.277		

Delayed Completion Test

Source	Sum of Squares	df	Mean Square	F Ratio	Significance
Treat	18.932	3	6.311	1.597	.196
Unit	363.439	92	3.950		
Sets	202.130	1	202.130	144.974	< .001
Treat X Sets	15.099	3	5.033	3.610	.017
Sets X Unit	128.271	92	1.394		
Total	727.871	191	3.811		

Immediate Paragraph Analysis:
Facts per Paragraph

Source	Sum of Squares	df	Mean Square	F Ratio	Significance
Treat	7.263	3	2.421	1.572	.202
Unit	141.715	92	1.540		
Paragraphs	296.767	15	19.784	20.669	< .001
Treat X Para	55.653	45	1.237	1.292	.096
Para X Unit	1320.950	1380	.957		
Total	1822.348	1535	1.187		

Delayed Paragraph Analysis:
Facts Per Paragraph

Source	Sum of Squares	df	Mean Square	F Ratio	Significance
Treat	.637	3	.212	.188	> .500
Unit	104.019	92	1.131		
Paragraphs	95.958	15	6.397	13.510	< .001
Treat X Para	27.040	45	.601	1.269	.112
Para X Unit	653.440	1380	.474		
Total	881.093	1535	.574		

APPENDIX D

CLUSTERING DATA

Question Treatment	# Facts in Clusters	Total # Facts Recalled	Percent Clustered	Arcsin Transformation
Factual Recall from All Paragraphs (1-16)				
Concept Construction	90	172	52.3	1.62
Concept Organizer	71	165	43.0	1.43
Specific	69	174	39.6	1.35
Reading-only	61	153	39.9	1.37
Factual Recall from Questioned Paragraphs (1-8)				
Concept Construction	16	57	28.0	1.12
Concept Organizer	19	64	29.7	1.14
Specific	19	73	26.0	1.07
Reading-only	10	50	20.0	.92
Factual Recall from Unquestioned Paragraphs (9-16)				
Concept Construction	74	115	64.3	1.85
Concept Organizer	52	101	51.5	1.60
Specific	50	101	49.5	1.56
Reading-only	51	103	49.5	1.56

REFERENCES

Allen, D. I. Some effects of advance organizers and levels of questions on the learning and retention of written social studies material. Journal of Educational Psychology, 1970, 61, 333-339.

Anderson, J. R., & Bower, G. H. Human associative memory. New York: Wiley, 1973.

Anderson, J. R., & Bower, G. H. A propositional theory of recognition memory. Memory and Cognition, 1974, 2, 406-412.

Anderson, R. C. Control of student mediating processes during verbal learning and instruction. Review of Educational Research, 1970, 40, 349-369.

Anderson, R. C. How to construct achievement tests to assess comprehension. Review of Educational Research, 1972, 42, 145-170.

Anderson, R. C. The notion of schemata and the educational enterprise. In R. C. Anderson, R. J. Sprio, and W. E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N. J.: Lawrence Erlbaum Associates, 1977.

Anderson, R. C., & Biddle, W. B. On asking people questions about what they are reading. In G. Bower (Ed.), Psychology of learning and motivation. (Vol. 9) New York: Academic Press, 1975.

Anderson, R. C., & Fause, G. W. The effects of strong formal prompts in programmed instruction. American Educational Research Journal, 1967, 4, 345-352.

Anderson, T. H., Anderson, R. C., Dalgaard, B., Paden, D., Biddle, W., Surber, J., & Alessi, S. An experimental evaluation of a computer based study management system. Educational Psychologist, 1975, 11, 184-190.

Andre, T. Does answering higher level questions while reading facilitate productive learning? Review of Educational Research, 1979, 49, 280-318.

Andre, T., & Sola, J. Imagery, verbatim and paraphrased questions, and retention of meaningful sentences. Journal of Educational Psychology, 1976, 68, 661-669.

Andre, T., & Womack, S. Verbatim and paraphrased adjunct questions and learning from prose. Journal of Educational Psychology, 1978, 70, 796-802.

Arkes, H. R., Schumacher, G. M., & Gardner, E. T. Effects of orienting tasks on the retention of prose material. Journal of Educational Psychology, 1976, 68, 536-545.

Ausubel, D. P. The psychology of meaningful verbal learning. New York: Grune & Stratton, 1963.

Ausubel, D. P. Educational psychology: A cognitive view. New York: Holt, 1968.

Ausubel, D. P., & Blake, E. Proactive inhibition in the forgetting of meaningful school material. Journal of Educational Research, 1958, 52, 145-149.

Ausubel, D. P., Robbins, L. C., & Blake, E. Retroactive inhibition and facilitation in the learning of school materials. Journal of Educational Psychology, 1957, 48, 334-343.

Ausubel, D. P., Stager, M., & Gaite, A. J. H. Retroactive facilitation in meaningful verbal learning. Journal of Educational Psychology, 1968, 59, 250-255.

Ausubel, D. P., Stager, M., & Gaite, A. J. H. Proactive effects in meaningful verbal learning and retention. Journal of Educational Psychology, 1969, 60, 59-64.

Bartlett, F. C. Remembering. London: Cambridge University Press, 1932.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (Eds.). Taxonomy of Educational Objectives: Cognitive Domain. New York: David McKay, 1956.

Boker, J. R. Immediate and delayed retention effects of interspersing questions in written instructional passages. Journal of Educational Psychology, 1974, 66, 96-98.

Bruning, R. H. Effects of review and test-like events within the learning of prose material. Journal of Educational Psychology, 1968, 59, 16-19.

Carroll, J. B. On learning from being told. Educational Psychologist, 1968, 5 (2) 1, 5-10.

Chomsky, N. A review of B. F. Skinner's "Verbal Behavior." Language, 1959, 35, 26-58.

Collins, A. M. & Quillian, M. R. How to make a language user. In E. Tulving & W. Donaldson (Eds.), Organization of memory. New York: Academic Press, 1972.

Corrozi, J. F. The effects of reading time, type of question, and instructional format on short- and long-term retention of relevant and incidental prose material. (Doctoral dissertation, University of Delaware) Ann Arbor, Mich: University Microfilms, 1970. No. 71-6465.

Craik, F. I. M., & Lockhart, R. S. Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 671-684.

Deese, J. From the isolated verbal unit to connected discourse. In C. N. Cofer (Ed.), Verbal learning and verbal behavior. New York: McGraw-Hill, 1961.

Dell, J. A. Some observations on the learning of sensible material. Journal of Educational Psychology, 1912, 3, 401-406.

Distad, H. W. A Study of the reading performance of pupils under different conditions on different types of materials. Journal of Educational Psychology, 1927, 18, 247-258.

Di Vesta, F. J., & Gray, G. S. Listening and note taking: II. Immediate and delayed recall as functions of variations in thematic continuity, note taking, and length of listening-review intervals. Journal of Educational Psychology, 1973, 64, 278-287.

Di Vesta, F. J., Schultz, D. 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 the retention of prose. Journal of Experimental Psychology, 1971, 88, 216-222.

Dooling, D. J., & Mullet, R. L. Focus of thematic effects in retention of prose. Journal of Experimental Psychology, 1973, 97, 404-406.

Duell, O. K. Effect of type of objective, level of test question, and the judged importance of tested materials upon posttest performance. Journal of Educational Psychology, 1974, 66, 225-232.

Dunkin, M. J., & Biddle, B. J. The study of teaching. New York: Holt, Rhinehart, & Winston, 1974.

Faw, H. W., & Waller, T. G. Mathemagenic behavior and efficiency in learning from prose materials: Review critique, recommendations. Review of Educational Research, 1976, 46, 691-7201

Felker, D. B., & Dapra, R. A. Effects of question type and question placement on problem-solving ability from prose material. Journal of Educational Psychology, 1975, 67, 380-384.

Frase, L. T. Learning from prose material: Length of passage, knowledge of results, and position of questions. Journal of Educational Psychology, 1967, 58, 266-272.

Frase, L. T. Effect of question location, pacing, and mode upon retention of prose material. Journal of Educational Psychology, 1968, 59, 244-249. (a)

Frase, L. T. Some unpredicted effects of different questions upon learning from connected discourse. Journal of Educational Psychology, 1968, 59, 197-201. (b)

Frase, L. T. Structural analysis of the knowledge that results from thinking about text. Journal of Educational Psychology, 1969, 60 (Monogr. Part 2). (a)

Frase, L. T. Cybernetic control of memory while reading connected discourse. Journal of Educational Psychology, 1969, 60, 49-55. (b)

Frase, L. T. Influence of sentence order and amount of higher level text processing upon reproductive and productive memory. American Educational Research Journal, 1970, 7, 307-319.

Frase, L. T. Effect of incentive variables and type of adjunct question upon text learning. Journal of Educational Psychology, 1971, 62, 371-375.

Frase, L. T. Maintenance and control in the acquisition of knowledge from written materials. In J. B. Carroll & R. O. Freedle (Eds.), Language comprehension and the acquisition of knowledge. Washington, D.C.: V. H. Winston & Sons, 1972.

Frase, L. T. Prose processing. In G. Bower (Ed.), Psychology of learning and motivation. (Vol. 9) New York: Academic Press, 1975.

Frase, L. T., Patrick, E., & Schumer, H. Effect of question position and frequency upon learning from text under different levels of incentives. Journal of Educational Psychology, 1970, 61, 52-56.

Frase, L. T., & Schwartz, B. J. Question production and answering as an aid to prose learning. Journal of Educational Psychology, 1975, 67, 628-634.

Friedman, F. The effects of inferential processing induced by inserted questions on prose recall. Unpublished doctoral dissertation, Purdue University, 1977.

Gagne, R. M. Context, isolation, and interference effects on the retention of fact. Journal of Educational Psychology, 1969, 60, 408-414.

Gagne, R. M. Learning and instructional sequence. In F. Kerlinger (Ed.), Review of research in education. Itasca, Ill: Peacock Publishers and American Educational Research Association, 1973.

Gagne, R. M., & Wiegand, V. K. Effects of a superordinate context on learning and retention of fact. Journal of Educational Psychology, 1970, 61, 406-409.

Gardner, E. T., & Schumacher, G. M. Effects of contextual organization on prose retention. Journal of Educational Psychology, 1977, 69, 146-151.

Germane, C. E. The value of the controlled mental summary as a method of studying. School and Society, 1920, 12, 591-593.

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

Glynn, S. M., & Di Vesta, F. J. Control of prose processing via instructional and typographical cues. Journal of Educational Psychology, 1979, 71, 595-603.

Golden, M. L. Reading guided by questions versus careful reading followed by questions. Journal of Educational Psychology, 1942, 33, 463-468.

Goss, A. E. Paired associates and connected discourse in the acquisition of knowledge. In E. Z. Rothkopf & P. E. Johnson (Eds.) Verbal learning research and the technology of written instruction. New York: Teachers College Press, 1971.

Hall, J. F. Retroactive inhibition in meaningful material. Journal of Educational Research, 1955, 46, 47-52.

Hiller, J. H., Learning from prose text; Effects of readability level, inserted question difficulty, and individual differences. Journal of Educational Psychology, 1974, 66, 189-201.

Holmes, E. Reading guided by questions versus careful reading and re-reading without questions. School Review, 1931, 39, 361-371.

Jersild, A. Primacy, recency, frequency and vividness. Journal of Experimental Psychology, 1929, 12, 58-70.

Johnson, N. F. Verbal units in the learning of connected discourse. In E. Z. Rothkopf & P. E. Johnson (Eds.), Verbal learning research and the technology of written instruction. New York: Teachers College Press, 1971.

Johnson, R. E. Recall of prose as a function of the structural importance of the linguistic units. Journal of Verbal Learning and Verbal Behavior, 1970, 9, 12-20.

Johnson, R. E. Abstractive processes in the remembering of prose. Journal of Educational Psychology, 1974, 66, 772-779.

Kintsch, W. The representation of meaning in memory. Hillsdale, N.J.: Lawrence Erlbaum, 1974.

Kirk, R. E. Experimental design: Procedures for the behavioral sciences. Belmont, California: Brooks/Cole, 1968.

LaPorte, R. E., & Nath, R. Role of performance goals in prose learning. Journal of Educational Psychology, 1976, 68, 260-264.

Mayer, R. E. Forward transfer of different reading strategies evoked by testlike events in mathematics text. Journal of Educational Psychology, 1975, 67, 165-169.

Mayer, R. E. Can advance organizers influence meaningful learning? Review of Educational Research, 1979, 49, 371-383.

McConkie, G. W., Rayner, K., & Wilson, S. J. Experimental manipulation of reading strategies. Journal of Educational Psychology, 1973, 65, 1-8.

McGeogh, J. A., & McKinney, F. The susceptibility of prose to retroactive inhibition. American Journal of Psychology, 1933, 46, 429-436.

Meacham, J. A. The development of memory abilities in the individual and society. Human Development, 1972, 15, 205-228.

Miller, G. A., Galanter, E., & Pribram, K. H. Plans and the structure of behavior. New York: Holt, 1960.

Morasky, R. Eye movements as a function of adjunct question placement. American Educational Research Journal, 1972, 9, 251-261.

Musgrave, B. S., & Cohen, J. C. Relationships between prose and list learning. In E. Z. Rothkopf & P. E. Johnson (Eds), Verbal learning research and the technology of written instruction. New York: Teachers College Press, 1971.

Myers, J. L., Pezdek, K., & Coulson, D. Effects of prose organization upon recall. Journal of Educational Psychology, 1973, 65, 313-320.

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

Newman, E. B. Forgetting of meaningful material during sleep and waking. American Journal of Psychology, 1939, 52, 65-71.

Newman, S. E., & Saltz, E. Effects of contextual cues on learning from connected discourse. American Journal of Psychology, 1960, 73, 587-592.

Paivio, A., & Olver, M. Denotative-generality, imagery, and meaningfulness in paired-associate learning of nouns. Psychonomic Science, 1964, 1, 183-184.

Peeck, J. Effect of prequestions on delayed retention of prose material. Journal of Educational Psychology, 1970, 61, 241-246.

Perlmutter, J., & Royer, J. M. Organization of prose materials: Stimulus, storage, and retrieval. Canadian Journal of Psychology, 1973, 27, 200-209.

Pichert, J. W., & Anderson, R. C. Taking different perspectives on a story. Journal of Educational Psychology, 1977, 69, 309-315.

Postman, L., & Senders, V. L. Incidental learning and generality of set. Journal of Experimental Psychology, 1946, 36, 153-165.

Quellmalz, E. Effects of three characteristics of text-embedded response requirements on the development of a dominant focus in prose learning. (Doctoral dissertation, University of California at Los Angeles) Ann Arbor, Michigan: University Microfilms, 1972. No. 72-13672.

Rickards, J. P. Interaction of position and conceptual level of adjunct question on immediate and delayed retention of text. Journal of Educational Psychology, 1976, 68, 210-217.

Rickards, J. P. Adjunct postquestions in text: A critical review of methods and processes. Review of Educational Research, 1979, 49, 181-196.

Rickards, J. P., & Denner, P. R. Inserted questions as aids to reading text. Instructional Science, 1978, 7, 313-346.

Rickards, J. P., & Hatcher, C. W. Interspersed meaningful learning questions as semantic cues for poor comprehenders. Reading Research Quarterly, 1978, 13, 538-553.

Rickards, J. P., Anderson, M. C., & McCormick, C. B. Processing characteristics of common-word and number questions in text. Paper presented at the annual meeting of the American Psychological Association, Washington, D.C., September, 1976.

Rickards, J. P., & Di Vesta, F. J. Type and frequency of questions in processing textual material. Journal of Educational Psychology, 1974, 66, 354-362.

Rothkopf, E. Z. Some conjectures about inspection behavior in learning from written sentences and the response mode problem in programmed self-instruction. Journal of Programmed Instruction, 1963, 2, 31-45.

Rothkopf, E. Z. Some theoretical and experimental approaches to problems in written instruction (Ch. 8). In J. D. Krumboltz (Ed.), Learning and the educational process. Chicago: Rand McNally, 1965.

Rothkopf, E. Z. Learning from written instructive materials: An explanation of the control of inspection behavior by test-like events. American Educational Research Journal, 1966, 3, 241-249.

Rothkopf, E. Z. The concept of mathemagenic activities. Review of Educational Research, 1970, 40, 325-336.

Rothkopf, E. Z. Experiments on mathemagenic behavior and the technology of written instruction. In E. Z. Rothkopf & P. E. Johnson (Eds.), Verbal learning research and the technology of written instruction. New York: Teachers College Press, 1971.

Rothkopf, E. Z., & Bisbicos, E. Selective facilitative effects of interspersed questions on learning from written behavior. Journal of Educational Psychology, 1967, 58, 56-61.

Royer, P. N. Effects of specificity and position of written instructional objectives on learning from lecture. Journal of Educational Psychology, 1977, 69, 40-45.

Sanders, J. R. Retention effects of adjunct questions in written and oral discourse. Journal of Educational Psychology, 1973, 65, 181-186.

Schumacher, G. M., Liebert, D., & Fass, W. Textual organization, advance organizers, and the retention of prose material. Journal of Reading Behavior, 1975, 7, 173-180.

Shavelson, R. J., Berliner, D. C., Ravitch, M. M., & Loeding, D. Effects of position and type of question on learning from prose material: Interaction of treatments with individual differences. Journal of Educational Psychology, 1974, 66, 40-48.

Shimmerlik. S. M., & Nolan, J. D. Reorganization and the recall of prose. Journal of Educational Psychology, 1976, 68, 779-786.

Slameck, N. J. Retroactive inhibition of connected discourse as a function of similarity of topic. Journal of Experimental Psychology, 1960, 60, 245-249.

Tobias, S. Achievement treatment interactions. Review of Educational Research, 1976, 46, 61-74.

Tulving, E., & Donaldson, W. (Eds.), Organization of memory. New York: Academic Press, 1972.

Tulving, E., & Thomson, D. M. Encoding specificity and retrieval processes in episodic memory. Psychological Review, 1973, 80, 352-373.

Voss, J. F. Acquisition and nonspecific transfer effects in prose learning as a function of question form. Journal of Educational Psychology, 1974, 66, 736-740.

Washburne, J. N. The use of questions in social science material. Journal of Educational Psychology, 1929, 20, 321-359.

Watts, G. H. The "arousal" effect of adjunct questions on recall from prose materials. Australian Journal of Psychology, 1973, 25, 81-87.

Watts, G. H., & Anderson, R. C. Effects of three types of inserted questions on learning from prose. Journal of Educational Psychology, 1971, 62, 387-394.

Welborn, E. L., & English, H. Logical learning and retention: A general review of experiments with meaningful verbal materials. Psychological Bulletin, 1937, 34, 1-20.

White, R. T., & Gagne, R. M. Retention of related and unrelated sentences. Journal of Educational Psychology, 1976, 68, 843-852.

Winer, B. J. Statistical principles in experimental design. (Second edition) New York: McGraw-Hill, 1972.

Wittrock, M. C., Learning as a generative process. Educational Psychologist, 1974, 11, 87-95.