To the Graduate Council:

I am submitting herewith a dissertation written by Mary Anna Lundy entitled "Effects of Three Text Variables on the Comprehension of a Norm-Referenced Test." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, with a major in Curriculum and Instruction.

J. Estill Alexander
Major Professor

We have read this dissertation
and recommend its acceptance:

Accepted for the Council:

Associate Vice Chancellor and
Dean of The Graduate School

EFFECTS OF THREE TEXT VARIABLES ON THE COMPREHENSION OF A NORM-REFERENCED TEST

A Dissertation

Presented for the

Doctor of Education

Degree

The University of Tennessee, Knoxville

Mary Anna Lundy

August 1991

ACKNOWLEDGMENTS

In the course of my work on this dissertation, a number of scholars have generously given of their time and assistance. In particular, I am indebted to Professors J. Estill Alexander, Lester N. Knight, John R. Ray, and George W. Harris, Jr., who served as my major professor and committee respectively. Without their expertise and encouragement, this dissertation would never have been written. Whatever errors remain in my work, however, are solely my responsibility.

In addition, I must acknowledge Dr. Linda Irwin-DeVitis who helped me to validate the procedure for propositional analysis and performed the propositional match between questions and texts. I would also like to acknowledge Dr. Brenda Kolker, Dr. Sabiha Aydelott, Catana Turner, Mary Kay Bordner, Jeanne Cobb, Teresa Willett and Mary Jane Hays whose assistance was invaluable.

ABSTRACT

It is felt that the assessment of reading comprehension on norm-referenced tests does not reflect new knowledge about the processes of comprehension. Comprehension, viewed from a process perspective, is an interaction between the text, the reader, and the writer of the text. This study was an attempt to investigate the effects of three text variables--number of propositions, hierarchical position of propositions, and imagery level--on the literal and interpretive comprehension on a norm-referenced test. The theoretical model of comprehension of van Dijk and Kintsch gave guidance. The model utilizes the proposition as a means of cognitive representation and acknowledges both a microstructure (literal), and a macrostructure (gist) of text. A role for imagery is accounted for by elaborative inferences.

Passages from a standardized test were propositionally analyzed to derive number of propositions, and propositionally analyzed questions were matched to propositionally analyzed test passages to derive a hierarchical ordering of questions and texts. An a priori computer analysis program was used to identify imagery level of passages.

Data collection was carried out in August and September 1989 and January 1990, at The University of Tennessee,

Knoxville. College students were administered a multiple choice, standardized test and, based on test results, two groups were formed--one good readers and one poor readers. The literal and interpretive responses of the good and poor readers were determined. Then, the literal responses of good and poor readers were determined for passages ranked high and low in number of propositions, for the questions at the top and at the bottom of the question/text hierarchies, and for passages ranked high and low in imagery level. Further, the interpretive responses of good and poor readers were determined for text variables under investigation. Data were subjected to chi-square analysis to determine significant differences.

The results of the study indicated that the literal and interpretive responses of good and poor readers was significantly different. However, effects for number of propositions, hierarchical position of propositions, and imagery level were nonsignificant. Thus, it appears that when the measurement task is multiple choice questions, effects for text variables is diminished.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

THE PROBLEM

Introduction

Assessment is a pervasive practice in American society. In fact, "it is estimated that 95 percent of the people in the United States have taken a standardized test at some time or other" (Farr and Carey, 1986, p. 8). Although in wide use, standardized tests are not without their critics. Some of the criticism centers on the information provided by standardized tests. The worth of a standardized test is judged by its validity, its reliability, and its practicality.

Major criticism lodged against standardized reading tests, designed to measure comprehension, is inherent in the issue of validity. In this regard, it has been stated that such tests are atheoretical (Schwartz, 1984), i.e. they are not based on a theory of reading. Indeed, several theories of reading are extant in the literature. A second criticism is that a consensus is lacking in terms of a definition of comprehension. A third criticism of standardized tests of reading comprehension asserts that the tests have changed little since their inception and do not reflect new knowledge about the processes of comprehension.

Although reading is variously defined, most reading professionals in the last decade have agreed that "the purpose of reading is comprehension" (Farr and Carey, 1986, p. 28). Moreover, research in comprehension has increased with particular emphasis being given to the processes involved in reading. Germane to this research is the notion that reading involves an interaction between the reader and the text or an interaction between reader, text, and writer. A result of this research is the enumeration of dimensions now regarded as important facets in the assessment of reading comprehension: the text itself, the prior knowledge of the reader, the nature of the task, and the context in which testing occurs (Cagney, 1988; Readence and Martin, 1988; Valencia and Pearson, 1987; Thornton, 1986; Kolker, 1986; Johnston, 1983). A greater understanding of these dimensions, a major consideration of researchers today, will contribute not only to the field of education but also to psychology, linguistics, and semiotics.

Statement of the Problem

Advancements in the development of reading models have abetted the investigation of dimensions considered integral to reading comprehension and, thereby, important to the assessment of comprehension. The van Dijk and Kintsch model (1983), classified as an inferential model (Singer and

Ruddell, 1985), is recognized for its ability to simulate comprehension (Kamil and Samuels, 1984; Irwin, 1988). Rayner and Pollatsek (1989) summarize four features of the model: (1) a reader's memory entails conjoined (propositions), (2) coherence is achieved by connecting propositions with common concepts, (3) a concept of levels is supported, and (4) a distinction between micro- and macrostructure, or literal and gist memory, is established (p. 298).

de Beaugrande (1981), utilizing his schema for evaluating models of reading, noted potential in the Kintsch and van Dijk model (1978) to explain learning, different text types, problem-solving, and differences in individual readers. Even greater explanatory power is envisaged with the 1983 model as a result of the inclusion and demonstration (Kintsch and Greeno, 1985; Mannes and Kintsch, 1987; Kintsch, 1988; Kintsch et al., 1990) of the situation model, a model of text based on inferences. The van Dijk and Kintsch model (1983) utilizes the concept of strategies to explain comprehension, although the operations of strategy-use are ill-defined (Drum, 1984). Thus, although the van Dijk and Kintsch model (1983) is not comprehensive, i.e., a reader's ability to decode text is assumed, and not without criticism (Rayner and Pollatsek, 1989; Drum, 1984), it appears an appropriate model to use to investigate dimensions important to the assessment of comprehension.

One dimension considered important in the assessment of reading comprehension is the text itself. The discourse processing models of Kintsch (Kintsch,1974; Kintsch and van Dijk, 1978; van Dijk and Kintsch, 1983) have been used to investigate effects for text variables on comprehension. Among text variables investigated are propositional density (Kintsch and Keenan, 1973), hierarchical position of propositions (levels effect) (Kintsch and Keenan, 1973; Kintsch and van Dijk, 1978), number of arguments (Kintsch et al., 1975), rhetorical form (Kintsch and Yarbrough, 1982), and imagery level (Irwin, 1988). These studies differed in terms of subjects, materials, conditions, and tasks; and, texts were manipulated to insure control. Results of these studies indicated effects for the text variables being investigated.

A second dimension considered important in the assessment of reading comprehension is the reader of the text. As such, text variables have been studied with regard to certain reader characteristics. Among reader variables that have been studied and related to text variables are grade level (Meyer et al., 1980), age (Meyer, 1975a), and ability level of reader, i.e. good and poor readers (Meyer, 1984). While inconsistencies do exist within individual experiments, a general conclusion from the research is that "part of the knowledge that separates the more skilled readers from the less skilled at any age has to do with

their ability to recognize and use text structures" (Ruddell and Speaker, 1985, p. 769).

Since the Kintsch system of propositional analysis was developed originally to aid in determining what information in a passage was available to the learner, so that recall could be more easily scored (Meyer, 1984), many of the studies conducted with the Kintsch models used production protocols to determine what subjects remembered after reading a passage. However, research into textual variables has not been restricted to this mode of task measurement, for Kintsch and associates checked comprehension by recognition, cloze, and question tasks (Kintsch, 1974; Kintsch and van Dijk, 1978; van Dijk and Kintsch, 1983).

Since questions are the major means of assessing comprehension (Readence and Martin, 1988; Beck and McKeown, 1981), research for text effects has been extended to a consideration of measurement tasks, a third dimension considered important in the assessment of reading comprehension. Although a theory for questions does not exist (Johnston, 1983), researchers, recognizing the need to explicate the role(s) which questions play in human learning (Hamaker, 1986; Graesser and Black, 1985; Pressley and Pressley, 1985; Dyer and Lehnert, 1982; Frase and Schwartz, 1975; Shavelson and Berliner, 1974; Watts and Anderson, 1971; Frase, 1968), have begun to build models. One such model, VAIL (an acronym addressing the model's attempt to

verify the assertions and implications of language), relies on propositions as a means of representing the information to be processed (Singer, M., 1985).

Prior to model building, researchers had attempted to identify the cognitive demands inherent in questions (Bloom, 1956; Sanders, 1966; Barrett, 1976) More recently, researchers have gone a step further and attempted to describe the relationship between passages read and questions asked (Pearson and Johnson, 1978; Lucas and McConkie, 1980). Taxonomies derived from this research make distinctions as to what information is available in the text for answering the question. With the Pearson and Johnson (1978) taxonomy, three kinds of questions are identified: (1) textually explicit, (2) textually implicit, and (3) script implicit. The relationship between each of these questions and the passage read is (1) answer right there on the page, (2) answer on the page, but not obvious, and (3) answer requires reader to use his or her script (knowledge structure), respectively.

A study (Askew, 1982) utilizing retellings, postquestions, and idea importance noted that "retellings were dominated by text-explicit responses, while question tasks appeared to produce responses more evenly distributed across the response categories" (text explicit, text implicit, script implicit, and implausible response) (p. 132). All four tasks (oral/written retellings and

oral/written postquestions) yielded more high-level (hierarchical position of) propositions.

Baumann (1980), investigating levels effect (hierarchical position of propositions) with third and sixth graders, considered both cued recall and multiple choice questions as measurement tasks. The study, a modified replication of Meyer's (1975b) research with young adults, did not find a levels effect. Baumann (1980) concluded that "either more powerful variables were operating than measurement mode or that psychological processes measured by free recall, cued recall, and recognition tasks are not comparable" (p. 153).

In reviewing the role of imagery on comprehension at the discourse level, Irwin (1988) noted that measurement task appeared to influence the findings on effects for imagery. When comprehension was measured by retelling, or by short answer comprehension questions, the imagery effect was found to be significant (Peters and Levin, 1986; Gambrell and Bales, 1986; Tirre, Manelis and Leicht, 1979). In studies employing multiple choice or cloze formats, quite often no significant imagery effect was found (Tirre, Manelis and Leicht, 1979; Anderson and Kulhavy, 1972).

Results of these studies indicate that, while effects have been found for textual variables, when different subjects are used (ability-wise, age-wise) and when the measurement tasks are varied (recall versus questions),

inconsistencies in findings appear. These findings and inconsistencies, found in accordance with manipulated texts and classroom-type materials, suggest the need for further research.

A source not yet investigated is the standardized test of reading comprehension. Because these tests are used to provide a global (product) measure of comprehension and typically employ a multiple choice format, a need exists to determine if textual variables are operating within this measure of comprehension and, if so, is the effect at the literal and/or interpretive level of comprehension and do the effects influence skilled and unskilled readers differently.

Statement of the Purpose

The present study has described the relationship between passages read and questions asked on a standardized test of reading comprehension to determine how textual variables as measured by postquestions influenced comprehension. More specifically, a primary purpose was to investigate the effects of three text variables--density of propositions, hierarchical position of propositions, and imagery level--operating in questions and/or passages on students' comprehension as measured by responses to literal and interpretive multiple choice questions. A secondary

purpose of the study was to determine if the textual effects under investigation in this study influenced the literal and interpretive responses of good and poor college readers differently.

The specific hypotheses tested were:

1. There will be no significant ($p \leq .05$) difference between the responses of good and poor college readers as measured by literal and interpretive multiple choice questions.

2. There will be no significant ($p \leq .05$) difference between the literal responses of good and poor college readers as a function of the number of propositions of passages read.

3. There will be no significant ($p \leq .05$) difference between the interpretive responses of good and poor college readers as a function of the number of propositions of passages read.

4. There will be no significant ($p \leq .05$) difference between the responses of good and poor college readers as a function of the match (hierarchical position) between question stems and passages read.

5. There will be no significant ($p \leq .05$) difference between the literal responses of good and poor college readers as a function of the imagery level of passages read.

6. There will be no significant ($p \leq .05$) difference between the interpretive responses of good and poor college readers as a function of the imagery level of passages read.

Justification

Since standardized tests are a viable source of assessment, then it seems logical to investigate this type of test, especially since the results of these instruments are used to evaluate individual students, groups of students, their teachers, and the progress of the nation as a whole. In fact, authors of standardized tests of reading comprehension often suggest that their test(s) can be used to identify superior students or students needing special help in reading, to predict college success, or to diagnose reading problems. Yet, a clear understanding of the textual factors influencing comprehension, the reader's contributions to the process, and the role(s) of questions in the cognitive interaction is essential to those persons (e.g., politicians and educators) relying on the results of standardized tests of reading comprehension to evaluate students and make decisions.

Therefore, it was felt that extending research to an investigation of an instrument used to assess reading comprehension for possible effects of number of propositions, hierarchical position of propositions, and

imagery level operating to influence the product (response to multiple choice question) would enlighten our knowledge about aspects of text that influence comprehension. With appropriate knowledge, text structures can be manipulated. With such manipulations, the examiner could have greater access to which structure is causing problems (Johnston, 1983, p. 28).

By investigating the effects of number of propositions, hierarchical position of propositions, and imagery level of text as measured by multiple choice questions, a typical format on standardized tests of reading comprehension, it was felt that any effects found would provide insights into features of standardized tests that distinguish readers. If textual effects were found to differentiate between good and poor readers, such findings would lend support for developing instructional methodology to overcome differences in readers as a result of text features.

Research has revealed that differences in good and poor readers are attributed to difficulties with text factors (Marshall and Glock, 1978-79; Reder, 1980), Johnston, 1983; Meyer, 1984; Ruddell and Speaker, 1985), to differences in readers (Golinkoff, 1975-76; Marshall and Glock, 1978-79; Daneman and Carpenter, 1980; August et al., 1984; Athey, 1985; Perfetti, 1985; Harris and Sipay, 1990; Daneman, 1991), and in measurement task (Tirre, Manelis, and Leicht, 1979; Johnston, 1981; Askew, 1982; Baumann, 1980; Meyer,

1984; Olson, 1985; Kolker and Terwilliger, unpublished; Davey, 1987; 1989). Since this study is investigating text effects on the comprehension of good and poor readers, it was anticipated that this study would provide additional insights into differences in literal and interpretive levels of comprehension resulting from number of propositions, hierarchical position of propositions, and imagery.

While questions written about information in a passage are the most commonly used approach for evaluating the comprehension of a passage, research has revealed problems with regards to questions. For example, Anderson (1972) found that two-thirds of the researchers of articles analyzed did not attempt to give any description of the information tapped by their questions. Johnston (1981; 1983) raised questions about the role of prior knowledge in answering questions. Samuels and Eisenberg (1981) questioned the distinction between literal and inferential questions. Trabasso (1981) indicated that how inferences are processed is unknown. Meyer (1975a) indicated that a "difficult problem exists in designing questions to evaluate reading comprehension and in specifying the kinds of information that a reader must understand to answer a particular question" (p. 6). These concerns have "resulted from a lack of a theory on which to base the writing of questions for tests to evaluate a reader's understanding of a passage" (Meyer, 1975a, p.7).

Since this study was designed to look at the interaction between types of questions asked and passages read, additional insight into the cognitive level of processing required to answer a question in relation to the three text variables investigated in this study was anticipated. Further, it was felt that if questions were found to function in preferential ways in regard to the textual variables being investigated in this study, then such information could be used to design more effective, valid and reliable assessment instruments. Such knowledge would give guidance to the development of a theory for questions.

Thus, this study was expected to enlighten our knowledge of three text effects (number of prepositions, hierarchical position of propositions, and imagery) on comprehension, was expected to indicate whether effects were at the literal and/or interpretive level of cognitive processing, and was expected to show whether text factors impacted good and poor college readers differently. It is felt that any effects derived from this study would have the potential to ameliorate the construction and utility of standardized tests of reading comprehension. Such insights would certainly be beneficial in responding to the overriding purpose of assessment--"What do I want to measure?" (Johnston, 1983) and would help assuage the criticism lodged against the validity of standardized tests

of reading. Additional theoretical contributions were anticipated for the area of question development and processing, and for further refinement of the van Dijk and Kintsch (1983) model of reading.

Definition of Terms

Comprehension: the understanding of a passage as measured by the number of correct responses to multiple choice questions.

Elaboration: an indication of depth of cognitive processing resulting from integrating information (inferencing), or from imaging.

Hierarchical Position of Propositions (or levels effect): with recall data, the tendency for propositions related to the top level (main ideas) to be recalled better than low level propositions (detail information, i.e., information peripheral to the central message); with this study, a match between question stem and test passage based on a literal and interpretive question classification, on the Pearson and Johnson (1978) taxonomy, and on the micro and macro-propositional text levels of van Dijk and Kintsch (1983).

Imagery: a mental representation grounded in visual experience and elicited while reading.

Imagery Level: the ratio of high imagery words to low imagery words in a passage.

Interpretive Question: a question for which the information required to answer the question must be inferred or deduced, i.e., the information must be integrated across sentences or paragraphs in the text, and/or integrated with world knowledge.

Literal Question: a question for which the information required to answer the question is stated explicitly in a single sentence of the text.

Macroproposition: a proposition derived from the sententially expressed propositions of a discourse.

Macrorules: semantic mapping rules that relate proposition sequences with proposition sequences at a higher level (van Dijk and Kintsch, 1983).

Macrostructure: a formal concept of the gist of a passage and derived by macrorules. Macrostructures are schema-like and enable comprehension or production of text.

Macrotext: a summary of a text derived by macrorules.

Microstructure: the level which corresponds to the template textbase (van Dijk and Kintsch, 1983).

Production Strategies: strategies that enable the generation of text, or the reproduction of processed text.

Proposition: an intensional (conceptual) unit corresponding to the meaning of a sentence in linguistic theory and to the conceptual representation of a sentence in a cognitive model of language comprehension (van Dijk and Kintsch, 1983, p. 112).

Propositional Analysis: the systematic analysis of any text into propositions by the procedures of Kintsch (1974) and which have been described by Turner and Greene (1977).

Redintegration: the retrieval of a whole memory trace in response to a partial cue.

Situation Model: a model of text derived by integrating propositions of text with background knowledge (van Dijk and Kintsch, 1983).

Spreading Activation: a plausible psychological model for matching text information with background knowledge. The model assumes that plausible matches occur first before other matches in the semantic network are tried (van Dijk and Kintsch, 1983, p. 316).

Textbase (or template textbase): a cohesive, interrelated group of propositions which represent the meaning of a text (Kintsch and van Dijk, 1978).

Assumptions of the Study

1. Literal and interpretive are distinguishable categories for questions and represent different levels of cognitive processing.

2. Correct responses to questions are indications of comprehension (that is guessing, although possible, is not assumed).

3. The ratio of high imagery words to low imagery words is a valid and reliable measure of imagery level.

4. Failure to include all words in a passage in an imagery rating does not alter significantly the imagery ratios of a passage.

Limitations of the Study

1. No attempt was made to establish or control for additional variables that could influence comprehension. Those variables include, but are not limited to, students' purpose for taking the test, complexity of sentence syntax, and metacognitive sophistication of the students.

2. Findings and conclusions cannot be generalized to populations which differ from the sample used in this study.

3. Findings cannot be generalized to different types of prose passages or to different tests of reading comprehension.

Delimitations of the Study

This study was delimited to The University of Tennessee, Knoxville, college students 18 years of age so that parental approval would not be necessary.

Overview of the Study

To test the hypotheses proposed in this study, the following procedures were planned. Students in Curriculum and Instruction, Efficient Reading and Study Skills, 141 (Fall Semester 1989, Spring Semester 1990) and Psychology of Statistics 385 (Fall Semester, 1989) at the University of

Tennessee, Knoxville, Fall Semester 1989, were given Form E of The Nelson-Denny Reading Test (NDRT). Based on results of testing, two groups were formed: one good readers (students who scored a 7, 8, or 9 stanine), the other poor readers (students who scored a 1, 2, or 3 stanine). Testing was conducted in accordance with directions provided in the NDRT manual. Students' correct responses to multiple choice questions were analyzed in terms of a literal and interpretive classification in accordance with the test manual (Brown et al., 1981), Rankin (1962), the taxonomy of Pearson and Johnson (1978) and the work of Raphael et al. (1980).

Preparation of materials used in this study involved the propositional analysis of the passages of the NDRT in accordance with the Kintsch models (Kintsch, 1974; Kintsch and van Dijk,1978; van Dijk and Kintsch, 1983) and the operations explained in Construction and Uses of a Propositional Textbase by Turner and Greene (1977). This analysis yielded the microstructure for each of the passages. From this analysis, number of propositions for each passage were determined. The passage with the greatest number of propositions and the passage with the lowest number of propositions were selected to investigate for effect of number of propositions.

The investigation of the effect for hierarchical position of propositions required the determination of the

macrostructure for the passages used in the study. The macrostructures were determined by following the macrorules of the van Dijk and Kintsch (1983) model and the suggestions proffered by Brown and Day (1983). The establishment of a textbase and macrostructure for each passage permitted a description based on the Pearson and Johnson (1978) taxonomy of the match between the propositions of questions and the propositions of passages. The ratios derived from the propositional matching were converted to percentages and ranked from high (no match) to low (some match). The hierarchical position of propositions was established by using the five questions matched at the high level (no match) and the five questions matched at the low level (some match) for both textbase and macrostructure levels.

To investigate the effect for imagery level on comprehension, the passages of the NDRT used in this study were analyzed for imagery level. Imagery level was established by using an a priori system devised by Terwilliger and Kolker (1985). Using data provided by the computer program, ratios for high to low imagery passages were determined. The passage with the highest ranking ratio and the passage with the lowest ranking ratio imagery were used in the study.

Analysis of data included:

1. Determining the total number of correct responses for students designated as good readers and for students

designated as poor readers for two question types: literal and interpretive.

2. Determining the number of correct responses for literal questions for good readers and then for poor readers for the passage with the greatest number of propositions and the passage with the least number of propositions; determining the number of correct responses for interpretive questions for good readers and then for poor readers for the passage with the greatest number of propositions and the passage with the least number of propositions.

3. Determining the number of correct responses for the five interpretive questions propositionally matched high to both the textbase and macrostructure for good readers and then poor readers; determining the number of correct responses for the five literal questions propositionally matched low to both the textbase and macrostructure for good readers and then poor readers.

4. Determining the number of correct responses for literal questions for good readers and then for poor readers for the passage with the highest imagery ranking and for the passage with the lowest imagery ranking; determining the number of correct responses for interpretive questions for good readers and then for poor readers for the passage with the highest imagery ranking and for the passage with the lowest imagery ranking.

Factors giving direction to the statistical analysis of data are:

1. The dependent variable in this study was the comprehension of good and poor readers as measured by correct responses to multiple choice literal and interpretive questions.

2. The independent variables in this study were: number of propositions, hierarchical position of propositions, and imagery level of passages.

3. For each proposed research question, a chi-square test of two independent samples was used to analyze the data. Data were nominal and/or ordinal in this study. Chi-square is appropriate for any level of measurement (Champion, 1970).

4. Results at the .05 level (two-tailed test) with one degree of freedom were regarded as significant.

Organization of the Study

Chapter I is an introduction to the study and includes the following: (1) a presentation of the problem, (2) a statement of the study's purpose, (3) a brief review of previous research related to the study, (4) an explanation of the need for such a study, (5) a list of definitions, assumptions, limitations, and delimitations related to the study, (6) a statement of research questions and statistical

hypotheses, and (7) a brief description of the methodology to be employed in the study.

Chapter II is a review of the literature and research related to the topic. The review includes an evaluation of the van Dijk and Kintsch (1983) model of reading based on five questions proposed by Singer and Ruddell (1985) and an evaluation of Paivio's (1986) dual coding model based on the same five questions, summaries of significant studies related to the independent variables of this study (number of propositions, hierarchical position of propositions, and imagery level) conducted since 1970, and a summary of literature and research concerned with measurement task effects on comprehension. Focus of research review was on studies conducted with expository prose that utilized multiple-choice questions as a means of measuring comprehension and identified subjects as good and poor readers.

Chapter III is a description of sampling, the measuring instrument, and procedures for determining imagery level of passages and propositional analysis of texts, for establishing macropropositions (gist) of text, and for propositional matching of test questions and test passages.

Chapter IV presents and analyzes data.

Chapter V includes a summary of the investigation, conclusions abstracted from the findings, and implications of the findings with recommendations for further study.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this chapter is to present a summary of: (1) the literature and research on the role of number of propositions in comprehension, (2) the literature and research on the hierarchical position of propositions in comprehension, (3) the literature and research on the role of imagery in comprehension, and (4) the literature and research on the role of measurement task in comprehension as it relates to the three variables under investigation in this study. Since this study investigated comprehension of expository passages, the review focused on findings with expository prose materials.

Since the van Dijk and Kintsch (1983) model and Paivio's (1986) dual coding theory gave particular direction to this study, the first section of this chapter begins with an evaluation of the van Dijk and Kintsch 1983 model, followed by an evaluation of Paivio's (1986) dual coding theory. The evaluation of theories section is followed by sections that review the research on number of propositions, on hierarchical position of propositions, on imagery level, and on measurement task effects.

The van Dijk and Kintsch Model

The van Dijk and Kintsch Model (1983) is an extension of the Kintsch (1974) and Kintsch and van Dijk (1978) models. The 1983 model has been elaborated further by Kintsch (1988) to include a more defined account of the role that knowledge plays in discourse comprehension. The 1983 model offers an explanation of how meaning is represented; the focus is on the semantic level of cognitive processing and strategies are employed to direct comprehension. Defining properties of the model include a complex-process orientation, the utility of strategies, different cognitive representations of text, and the strategic use of knowledge structures (pp 10-13).

Singer and Ruddell (1985) state that five questions give guidance to understanding a theory or model. Those questions are: (1) What does the theory assume? (2) What is the model's structure or components? (3) How does the model work? (4) What is its utility? (5) What are its limitations? (p. 623). These questions can be used to better understand the van Dijk and Kintsch (1983) model.

In response to the first question, What are the assumptions of the model, several basic assumptions are specified by van Dijk and Kintsch (1983). The first assumption asserts that understanding of a text involves constructing a mental representation of the text in memory.

This is the constructivist assumption. Another assumption, the interpretative assumption, reflects the semantic aspect of discourse comprehension--stories whether witnessed, listened to, or read are interpreted in the process of meaning acquisition. A third assumption, the on-line assumption, asserts that understanding occurs gradually as the events of a story are processed, and not post hoc. Understanding is also assumed to be influenced by internal, cognitive information, such as goals, interests, attitudes and general knowledge. This assumption is called the presuppositional assumption.

Some of the basic assumptions of the model give importance to the social context within which communication takes place. The functionality assumption, for example, asserts that a representation of the social context surrounding the text or events is constructed and interacts with the representation of the text or event itself. Further, with communication, nonverbal aspects of the discourse, dealing with intentions of speakers or writers, are also represented in memory. The need to represent these pragmatic aspects of communication is evidenced in the pragmatic assumption. Because each participant in a communication act has individual goals or motivation, the pragmatic assumption is generalized to the interactionist assumption, which gives recognition to the purposes, goals, motivations, etc., of each participant. Finally, the

situational assumption is provided to take into account the fact that meaning is tempered by the situation in which it occurs (van Dijk and Kintsch, 1983, pp. 4-8).

In summary, these assumptions implicate the model in both psychological and sociological contexts. The authors indicate that these assumptions have many corollaries and implications, thus not all assumptions are indicated. Assumptions are not specified for the syntactic, orthographic and phonemic properties of text. Likewise, assumptions are not specified for memorial processes such as how inference occurs and how representations are integrated.

The second question, What is the model's structure or components, addresses the structure or components of the model. The components of the model are the strategies, and different strategies are described to encompass the complexity of language itself. First, there is the strategic construction of propositions. Five characteristics describe the authors' propositional schema: (1) it is hierarchical, (2) it contains atomic propositions and concepts, (3) it includes a modifier category, (4) the predicate and the argument (or participant) category are organized at a higher level by a specific predication, and (5) the circumstance category enables organization of time, place, and possible worlds (e.g., to believe, to dream) (van Dijk and Kintsch, 1983, pp. 129-130).

The propositions of the textbase are linked as a result of the second strategy, local coherence. This strategy requires the reader to search for connections among the facts denoted by the propositions. The establishment of coherence is assumed to take place "on-line" in this model, rather than after processing a complete phrase or sentence. The central processor (to be explained later) plays a key role. Various strategies work to provide coherence; for example, argument overlap, i.e., where an argument of one proposition corefers to an argument of previous proposition; reinstatement, i.e, a previous proposition now in long term memory must be reinstated in short term memory; and bridging inferences, i.e., connections (bridges) made in text when reinstatement fails (Miller and Kintsch, 1980) (van Dijk and Kintsch, 1983, pp. 14-15). The authors note that inferences are not a part of the textbase but part of the situation model, a model constructed on the basis of the textbase and the reader's store of knowledge (van Dijk and Kintsch, 1983, p. 51). Therefore, the representation in memory is different for propositions stated explicitly in texts and propositions that required inferencing. "If the statement was presented explicitly in the text, the memory trace that was accessed was the proposition derived from it....If the statement had to be inferred, an inference generated proposition was accessed" (van Dijk and Kintsch, 1983, p. 50). Thus,

retrieval of information is impacted by the manner in which the information was encoded.

Strategies, as heuristics, are flexible and do not provide "the" representation of a text. As such, macrostrategies, a third strategy distinguished by van Dijk and Kintsch (1983), are a component of the model that enable, through inference, the establishment of macropropositions that result in the formation of the macrostructure, or gist, of the discourse (pp. 15-16). At this point, a distinction between the global and local levels of text can be made. The "macro" operators (macrostrategies, macropropositions, macrostructure, macroplan) reflect the global meaning of a text, i.e., its theme, gist, or main idea; whereas, the detail or local level is reflected in the textbase or microstructure of the text.

A fourth strategy, schematic strategies, enable the identification of the organization or structure of a text. To distinguish schematic strategies from the general term schema (Bartlett, 1932), van Dijk and Kintsch (1983) use the term superstructure. Superstructures are assumed to enable hypothesize generation from a top down perspective (global) in response to the textual and semantic information (a bottom-up perspective). These schematic strategies are important to the cognitive processes of the model. "The assumption is that information processing takes place in

multiple organized chunks, i.e., sentences and discourses are understood and stored on the basis of their units, categories, and levels" (van Dijk and Kintsch, 1983, p. 236). Language users learn these organizational patterns and use that knowledge to assign the appropriate superstructure designation. Thus, understanding, storage, and retrieval are implicated. The 1983 model does not specify the units, categories and levels that must be learned nor the constraints imposed on memory by these elements. The authors indicate that the role of schemata or superstructures in comprehension, storage, and retrieval of discourse must be investigated (van Dijk and Kintsch, 1983, pp. 236-237).

A fifth strategy discussed in detail is the production strategies. Production is viewed as the opposite side of comprehension. However, van Dijk and Kintsch (1983) note that the mapping from production to comprehension (or vice versa), with a strategic model, cannot be simply inverted. The reason given is that the strategies used by each participant in the communication act are different. Within the framework of production strategies, an account for the "reproduction" dimension of discourse processing is presented. This reproduction dimension is assumed to occur in response to a stimulus and thus represents retrieval of textual information, as in recall or cued recall tasks (pp. 16-17). The reproduction dimension has focused on idea

generation research, with the question of concern being: "How do the context node(s), or the topic node(s), manage to retrieve the nodes that are associated with them?" (p. 295). Van Dijk and Kintsch (1983) indicate that the Raaijmakers and Shiffrin (1981) model can be used to investigate the question. They indicate further that the model includes the following major features: importance of retrieval cue as Tulving and Thompson (1973) emphasize, an associative memory network as in the work of Anderson and Bower (1972), and a redintegrative process like Kintsch's (1974) pattern completion (van Dijk and Kintsch, 1983, p. 298). Thus, another component, the production strategies, of the van Dijk and Kintsch (1983) model are suggested as a potential area for research.

Finally, van Dijk and Kintsch (1983) indicate other strategies that have potential for impacting the comprehension and production of discourse. These include stylistic strategies, i.e., different ways of expressing the same idea; rhetorical strategies, e.g., figures of speech; nonverbal strategies; and conversational strategies (pp. 17-19). These strategies are mentioned with the admonition that they, too, are potential dimensions for development and research.

In summary, a consideration of the components of the 1983 model has focused on the strategy as a means of comprehension (or production) attainment. Although strategy

use is specified, the details of how and when strategies are used are not specified in the model. Drum (1984) has criticized the model (1983) for this vagueness. In essence, the strategy components are intended to provide flexibility so that the variety of processes involved in compression can be better simulated. Strategy use encompasses both external information (outside the head) and internal information (inside the head). As such, encoding, storage, and retrieval operations associated with memory are implicated and become potential areas of research in relation to comprehension.

The third question used to evaluate the model (1983) is: How does the model work? Since the strategy components have been discussed in detail, the answer to this question addresses the proposed framework of memory that enables the building of text representations by the integration of external and internal information.

With the van Dijk and Kintsch (1983) model, a circular framework is used to depict the memorial components. At the center of the circle is the central processor, the place where all cognitive operations take place. The central processor is also the cite of the working register, a short term memory component. With this model (1983), however, short term memory is described as not only capacity limited (the equivalent of three atomic propositions), but is also circumscribed by its accommodation of two functions--process

and storage (p. 352). Further, short term memory is noted as the locus of consciousness (p. 351).

Surrounding the central processor are three memory systems: the sensory register, the long term memory, and episodic memory including the situation model. The sensory register is the place where incoming perceptual information is held and made available to the central processor. The long term memory store, semantic memory, is the place where knowledge (knowledge structures and personal experiences) and the comprehender's goals, purposes, wishes, interests, and emotions, i.e., the control system, are located. The episodic text memory is the place where representations of the surface features of text, the textbase, and the macrostructure reside. Also included in the episodic text memory store is the situation model. The situation model is also a representation of text, but it is distinguished from the episodic text representations in that it represents an integration of external information with the comprehender's store of knowledge. As such, it is a model of the inferences required to integrate the two sources of information. With the van Dijk and Kintsch (1983) model, the situation model serves as a link between information (textual and nontextual) from different modalities (p. 341).

With this model (van Dijk and Kintsch, 1983), a major role is assumed for retrieval operations acting on memory. For example, retrieval is the only operation that can be

performed on memory outside the central processor. Differences are also assumed to exist for retrieving personal experiences and other knowledge structures residing in long term memory. For episodic text memory (propositional, macropropositional, or situational), recency cues are able to retrieve only the most recent items in memory. Retrieval, beyond recency, is possible because texts (e.g., the textbase) are interrelated, coherent networks (p. 348). The situation model is described as being most retrievable because it is the "most heavily interrelated and integrated structure" (p. 348). The authors note that the control system is outside the central processor to reflect that the control system is outside of consciousness. They appear to suggest that macropropositions, frames and goals (i.e., components of the control system) can be made active in an area bounding the central processor, but are not necessarily conscious. They further indicate that knowledge beyond this bounded area is not available for discourse processing unless retrieved (p. 351).

Retrieval operations in the van Dijk and Kintsch (1983) model are predicated on the principle of encoding specificity of Tulving and Thompson (1973) (p. 335), the networking of knowledge as proposed by Raaijmakers and Shiffrin (1981) and Walker (1982) (p. 315), and pattern matching (Kintsch, 1974) (p. 298). In essence the hypothesis is that the likelihood of retrieval will depend on the match

between the retrieval cue and the memory trace. As such, "memory is a by-product of processing" (p. 335). The more variable the processing, i.e., the more elaborate, meaningful, and enriched the encoding, the greater the memorability. An elaborated text is a situation model (p. 336). Since elaborations can occur via imagery, a role for imagery is implicated in comprehension. Strategies are assumed to reduce the amount of computation that must be performed in comprehension. Concepts adopted from researchers provide the theoretical assumptions: spreading activation (Quillian, 1968; Collins and Loftus, 1975; Anderson, 1976), rough approximate match (Atkinson and Juola, 1974), two system decision (Kintsch, 1977), argument overlap (Joshi, 1978) and match at the global level (schemata) (p. 316).

In summary, this description of the memory framework indicates very generally what knowledge is available for processing, where generally it might be stored, and how (retrieval-wise) it might be recovered. The central processor, the working register or short term memory component, is distinguished by its limited capacity, which is further constrained by its two functions--storage and process. The three memory systems surrounding the central processor are distinguished by retrievability constraints. Episodic memory is distinguished as the locus for text representations at four levels: surface, microstructure,

macrostructure, and situation model. Semantic memory is distinguished as the locus of long term memory and includes the control system, personal experiences, and knowledge structures. Thus, a consideration of the memorial framework of the model (1983) has addressed the loci of knowledge, text representations, and incoming perceptual information, although knowledge integration is unexplained in the model.

Some description, however, is provided for the knowledge structures. The knowledge system is defined as multi-leveled and comprised of nodes overlapping chunks at higher levels. Chunk size is limited (in accordance with Broadbent, 1975) to about four elements (van Dijk and Kintsch, 1983, pp. 311-312). Further, the van Dijk and Kintsch (1983) raise the question as to the nature of knowledge structures: "Are they abstract, propositional, or do they involve imagery?" (p. 311). They indicate that it is not their aim to provide the "right" theory, but to provide a theory that is capable of explaining the data in a "sensible, natural way" (p. 311). Thus, the possibility of other types of representation are not discounted.

Now that the model's assumptions, strategies and memory components have been provided, the next question addresses the model's utility. de Beaugrande (1981) evaluated the 1978 (Kintsch and van Dijk) model and found that it had potential to explain learning, different text types, problem-solving, and differences in individual readers. Irwin (1988)

evaluated the 1983 model and found that it had potential to explain reasoning in reading; encoding, storage, and retrieval; acquisition of new knowledge; changes in the model as a result of difficulty level of material and different content; and comprehension of sentences and discourse. Irwin (1988) found that the model (1983) was not able to explain word identification, decoding, knowledge of word meanings, or comprehension of words.

The Kintsch models (Kintsch, 1974; Kintsch and van Dijk, 1978; van Dijk and Kintsch, 1983) have been utilized to investigate text variables and reader variables which affect comprehension. A representative subset is: the number of propositions in a text (Kintsch and Keenan, 1973), the organization of propositions in memory (McKoon and Ratcliff, 1980; Perrig and Kintsch, 1985), the number of arguments, word concepts, in a text (Kintsch et al., 1975), rhetorical form (Kintsch and Yarbrough, 1982), imagery level of text (Irwin, 1988), readability and recall (Miller and Kintsch, 1980), differences in explicit and implicit text (Keenan and Kintsch, 1974), differences in comprehension as result of knowledge of readers (Spilich et al., 1979), cognitive processes in writing (Caccamise, 1981), differences in micro and macro processes (Vipond, 1980), retrieval of knowledge (Walker, 1982), children's memory for stories (Poulson et al., 1979), solving word arithmetic problems (Kintsch and Greeno, 1985), short term memory processes (Fletcher, 1981),

hierarchical position of propositions or levels effect (Caccamise and Kintsch, 1978; Kintsch et al., 1975), and age span (Spilich, 1983). In summary, these studies reflect the utility of the model to investigate variables associated with comprehension. The utility of the Kintsch models (Kintsch, 1974; Kintsch and van Dijk, 1978, van Dijk and Kintsch, 1983) to investigate a variety of text and reader variables affecting comprehension result from the generality and flexibility of the model as described in this review.

The last question for evaluating the 1983 model is: What are the limitations? The authors address three major limitations explicitly: (1) Linguistic parsing, the linguistic unit is not specified in the model, nor its analysis or synthesis; the focus is on semantic processing. (2) Knowledge representation and use, all knowledge (e.g., goals, beliefs, schemata) is not specified. The authors indicate that knowledge needed in comprehension may be intuitive or specified and then tested. (3) Contextual information, the situations in which language processing occurs, the participants of the interaction, and other pragmatic features are not specified. Again, these variables may be specified and then tested (van Dijk and Kintsch, 1983, pp. 8-9).

van Dijk and Kintsch (1983) note the theoretical incompleteness of the model and point out empirical limitations. The model assumes, for example, that principles

of discourse processing can be formulated that encompass the various discourse types, that language users are different, and that there are different modes, kinds or styles of comprehension (van Dijk and Kintsch, 1983, p. 9).

In summary, the semantic model of discourse processing proposed by van Dijk and Kintsch (1983) is deemed general and flexible enough to extend to a specific type of discourse, a standardized test of reading comprehension. Because the model acknowledges a role for memory in comprehension through processes of encoding, storage, and retrieval, the model is considered appropriate for an investigation of multiple choice questions as a stimulus for the retrieval of information. Since the model proposes strategies that allow for a representation of the text itself (textbase) and the text's gist (macrostructure), the model is further deemed appropriate for a study which considers the interaction between literal and interpretive questions and textual variables of number of propositions and height of propositions. The acknowledgement of a role for imagery via elaborative inferences permits a consideration of the van Dijk and Kintsch model for investigating the effects of imagery level.

Paivio's Dual Coding Theory

The purpose of this section is to evaluate Paivio's (1986) theory of representation as expressed in Mental Representation, A Dual Coding Approach with the same five questions used to evaluate the van Dijk and Kintsch (1983) model. Mental Representation, A Dual Coding Approach represents an encapsulation of Paivio's theory as it as evolved since Imagery and Verbal Processes (1971) (Paivio, 1986, p. vii). This evaluation addresses the major assumptions of the Paivio (1986) model, the structure and components, its operations, its utility, and its limitations. Similarities and/or differences between the Paivio (1986) model and the van Dijk and Kintsch (1983) model are noted.

The major distinction between the two theories is concerned with the representation of information in memory. Van Dijk and Kintsch (1983) assume that the representation is propositional; Paivio (1986) assumes that "cognition is served by two modality-specific symbolic systems that are experientially derived and differentially specialized for representing and processing information concerning nonverbal objects, events, and language" (p. 54). Paivio (1986) presents three additional assumptions related to the first that distinguish his model from van Dijk and Kintsch's. The second major assumption of Paivio is the independence/

additivity hypothesis which asserts that because information is dually coded it is remembered better. A third major assumption of Paivio's (1986) theory concerns the representation which can range from imagery to abstract propositions: the range is not analogous to a concrete/abstract continuum because both picture-like and language-like representations can vary in abstractness in a structural or a functional sense (p. 17). Finally, a fourth assumption of Paivio's dual coding theory is that the representation contains only information for which operations are defined to obtain it. Paivio (1986) suggests three different kinds of processing: representational, referential, and associative. These three processing operations will be explained later in terms of evaluating how the model works. Thus, Paivio recognizes the possibility of propositional representation; however, his concern is the representation of perceptual information, especially the imagible. The structure (representation) is an empirical question; imagery makes functional use of structure (Paivio, 1986, pp. 20-21).

In addition, several of the major assumptions of the van Dijk and Kintsch model are similar to the assumptions of Paivio's theory. These are the pragmatic, interactionist, constructive, interpretative and situation assumptions. The similarities derive from the acknowledgement of a role for nonverbal information by both theorist, with implications

inherent in the situation and the social context in which an interaction occurs, and from memorial processes implicated in information processing. Paivio's assumption that imagery can be used as a mnemonic is contingent with the presuppositional assumption of van Dijk and Kintsch (1983) which asserts that the goals of comprehenders play a role in the comprehension process.

Finally, although Paivio makes reference to functionality of imagery, the context is different from the functionality assumption of van Dijk and Kintsch (1983). With Paivio (1986), functionality refers to the use of imagery in understanding language. The on-line assumption of van Dijk and Kintsch (1983) is also distinguishable from the manner in which understanding accrues in the Paivio (1986) model. Again Paivio's emphasis is on the role of imagery in processing. As such, the focus is on the synchronous organization and processing of information, an underlying assumption of effects for induced, scanning, and mnemonic imagery tasks.

The second question in evaluating Paivio's (1986) theory addresses the structure/components of the model. Whereas van Dijk and Kintsch (1983) use the terminology, representation (propositions) and process (strategies, i.e., components with seemingly functional roles), Paivio (1986) distinguishes structure and function, and notes that his "emphasis is on understanding the function of imagery in

memory, thought, and language" (p. 20). As such, imagery is identified as serving a mnemonic function for individuals by helping them to achieve behavioral goals. Two additional functions for imagery are identified: evaluative and motivational and emotional (Paivio, 1986, p. 55). With evaluative function (i.e., image generation, scanning, counting, comparison), the processing is assumed to be under the conscious control of verbal mechanisms. With mnemonic and motivational and emotional, an explicit reference to conscious control is not made; however, a role for verbal mechanisms is made (Paivio, 1986, pp. 74-81). Structure (representation), on the other hand, is identified as an empirical concern and is, thus, not defined. Process, in Paivio's model (1986), consists of the activities involved in making functional use of structural information (pp. 66-67). Process is explained next, as part of the model's operations.

The third question addresses the operations of the model. The operations of Paivio's (1986) model entail the memorial consequences of information processing. Several assumptions are specified for these operations. First, three levels of processing are assumed. The first is the representational level, which reflects the modality specific representations, i.e., linguistic stimuli activate verbal representations and nonlinguistic stimuli activate nonverbal representations (Paivio, 1986, p. 69). At the

representational level, the verbal and nonverbal systems are assumed to be functionally independent but interconnected (p. 62), and modality-specific perceptual-motor analogues, hierarchically organized (p. 59). The second level is the referential, which assumes that the nonverbal system can be activated by the verbal stimuli or that the verbal system can be activated by nonverbal stimuli (p. 69). The third level of processing is the associative level, which assumes that processing involves activating representations in either system, or by representations within each system. Word associations are provided as examples of associative processing (p. 69).

Assumptions related to these levels of processing include: (1) the probabilistic nature of interunit relations between and within systems, (2) differential specialization for synchronous (nonverbal) and sequential (verbal) interunit processing within systems, and (3) automatic and conscious processing in both systems (Paivio, 1986, p. 62). Encoding of information is thus via the three levels of processing (p. 67).

Paivio's dual coding theory also distinguishes between episodic and semantic memory. The concepts of Tulving (1972) were adopted. As such, episodic memory is defined as "memory for specific events that occurred at a particular time and place" (Paivio, 1986, p. 140). The assumption is that episodic memory is a mixture of information derived from

both external and internal sources. The external and internal sources are used to distinguish between episodic and semantic memory. External information is information to be remembered. Internal information consists of long term memory representations and processes activated by presented material. With the internal source, a further distinction is specified: two types of representations are available, one being information that cannot be attributed to particular external episodic source and the other, information that can be attributed to such a source (Paivio, 1986, p. 140).

Retrieval operations and their assumptions are also specified by Paivio. Paivio (1986) notes that cued recall and recognition are based on similarity match between pattern of information evoked by the retrieval cue and information in the memory trace. Retrieval operations also assume that matching is based on "modality specific (verbal/nonverbal), holistic attributes of the test stimulus and any information it generates from semantic memory or long term memory which can be compared with information stored in the to-be-remembered episodic memory trace" (Paivio, 1986, p. 146).

Paivio (1986) notes effect differences in integrative task demands when instructed to image with cued recall and recognition versus noncued item recall or recognition tasks. When instructed to image with interactive pictures or interactive imagery, the "degree of trace integration is

crucial to redintegration of the entire compound trace by a retrieval cue" (Paivio, 1986, p. 148). With noncued items recall or recognition tasks, the "degree of integration is relatively ineffective" (Paivio, 1986, p. 148). He cites Begg's (1982) finding that integration of stimuli may hinder the discrimination between different items. Thus, retrieval in Paivio's model (1986) is a function of differences in storage of complex verbal and nonverbal information and tasks demands and organizational distinctions (p. 148). The retrieval cue plays a critical role in the activation. The model (1986) assumes that imagery is "more likely to be evoked" with objects or pictures or with concrete words as opposed to abstract words, even without instruction to image (Paivio, 1986, p. 68). Words or instructions to carry out a task verbally are more likely to arouse verbal representations (p. 68).

A summary of the operations of the Paivio (1986) model indicates that memory is distinguished by episodic and semantic memory. Episodic memory is a conglomerate of external (to-be-remembered) information and internal information (information from long term memory and processes activated by presented material.) Semantic information is the long term memory store which includes information derived from external episodic (i.e., memory of specific events that occurred at a particular time and place) source and information that is non episodic. Three process levels

are identified that code verbal and nonverbal information differently, with interaction and integration increasing from the representational to the associative level. The processing levels are seemingly the operations involved in the functional use of representation (structure). Although structure is recognized, it is not described. Stimuli, however, also play a crucial role, with the assumption being that nonverbal stimuli evoke the nonverbal and that verbal stimuli evoke the verbal.

The fourth question addresses the utility of Paivio's (1986) model. Pressley et al. (1989) noted that Paivio's (1971) theoretical perspective has given impetus to the development of strategic interventions (e.g., representational images and mnemonic images) in the teaching of reading comprehension. Paivio (1986) notes the utility of dual coding theory for mental imagery and mental rotation tasks. Much of Paivio's work documenting the effects of imagery (1968) for facilitating recall (1969, 1971) was carried out with word lists (Tirre, Manelis and Leicht, 1979). Induced mental imagery effects are documented for paired-associate learning (Levin and Pressley, 1981; Paivio and Yuille, 1969; Levin and Kaplan, 1972; Katz and Paivio, 1975) and for imagery organized tasks (Levin, 1973). Imagery rating of materials was found to be a predictor of comprehension (Kolker and Terwilliger, unpublished; Thorndyke, 1975; Jorgensen and Kintsch, 1973). More

recently, mental imagery was found to facilitate reading comprehension (Peters and Levin, 1986; Sadoski, 1985; Steingart and Glock, 1979), to be a factor in spatial and verbal problem solving in reading (Sadoski, 1983), and to play a role in learning from text (Gambrell and Bales, 1986; Sadoski, 1983; 1985).

Additional research has focused on individual differences in imagers and imagery value of texts (Denis, 1982), developmental differences (Pressley, 1977), reader skill and imagery/proposition interaction (Sindell, 1978), imagery and macro-/micropropositions recall (Irwin, 1988), and imagery and theme storage (Yuille and Paivio, 1969; de Villiers, 1974). All studies have not found a positive imagery effect (Anderson and Kulhavy, 1972; Katz and Paivio, 1975; Marschark and Paivio, 1977; Tirre, Manelis and Leicht, 1979). Results of these studies suggest that verbal strategies take precedence over imaginal strategies and/or that integration of abstractness and concreteness occurs so that effects for concreteness are diminished.

The fifth question addresses the limitations of Paivio's (1986) dual coding theory. The limitations are similar to those of van Dijk and Kintsch (1983) as discussed above: (1) Linguistic parsing, the linguistic unit is not specified in the model, nor its analysis or synthesis; the emphasis is on the processing of nonverbal information. Although nonverbal information is highlighted and

represented, a description of the nature of the information represented in memory is not provided, nor is the process for integration of information within modality specific codes or across modality specific codes defined. (2) Knowledge representation and use, all knowledge (e.g., goals, beliefs, schemata) is not specified. (3) Contextual information, all situations, participants, and other pragmatic features are not specified; the emphasis is on contexts that are picture-like, spatial, or vivid, i.e., the imaginal; imagery value of the materials; or specific task instructions to image. Paivio (1986) noted the inability of the model to explain integrative or holistic recall of both concrete and abstract sentences (p. 171).

In summary, the dual coding theory of Paivio (1986) offers a model for investigating the effects of imagery value (concrete/abstract) of text on comprehension, for investigating effects of imagery instruction, for investigating contextual (verbal/nonverbal stimuli) effects on comprehension, and for investigating individual differences in imagers. Thus, the model (1986) provides a theoretical base, from a dual coding perspective, to investigate comprehension when passages are identified as either high or low in imagery.

A Consideration of Differences in the Models of van Dijk and Kintsch and Paivio

A consideration of differences in the model of van Dijk and Kintsch (1983) and Paivio (1986) reveals: (1) differences in representational assumptions, i.e., propositional representation with van Dijk and Kintsch, dual coding system with emphasis on the nonverbal with Paivio. The inability of the Paivio (1986) model to explain integrative effects suggests the need for a common (abstract) level of representation in addition to the two modality-specific representational systems (Marschark and Paivio, 1977, p. 229); (2) differences in memory systems, with Paivio's distinguished as having automatic and conscious processes defined explicitly for the inclusion of the nonverbal. van Dijk and Kintsch, on the other hand, propose an important role for automatic but unconscious memory processes. While both models specify importance for encoding and retrieval operations, the Paivio model places greater emphasis on the stimuli (as variants of concreteness or abstractness) to retrieve information and the van Dijk and Kintsch model places greater emphasis on the representation stored in memory; (3) differences in utility, with van Dijk and Kintsch having greater utility for investigating text effects with discourse and Paivio having greater utility for investigating paired-associate (or word) tasks, contextual (verbal/nonverbal stimuli) effects on

comprehension, individual differences in imagers, and imagery instruction on comprehension.

Differences in the van Dijk and Kintsch (1983) and the Paivio (1986) models suggest a potential limitation of the Paivio model to the investigation of discourse comprehension. This possible limitation derives from the special function of imagery as a facilitator of comprehension in the Paivio model. Thus, with texts that are described as abstract, as many expository texts are, effect for imagery would not be anticipated.

Number of Propositions

The role of number of propositions in comprehension was investigated with college students by Kintsch and Keenan (1973). They found a strong positive relationship between the number of propositions occurring in sentences under two differing conditions--free reading time and restricted reading time. However, when restricted time was a condition in reading passages that varied in number of underlying propositions and number of words, effect for number of propositions was not significant.

Two sets of materials were designed for the study and presented by slides. Set A consisted of 10 sentences with 14-16 words each but varying with propositions from 4 to 9. Sentences were analyzed into propositions. Propositions were

numbered so as to show the hierarchical relations among them. Topics of sentences pertained to classical history--the topic was selected with the assumption that it was unfamiliar to the students. Set B materials consisted of 20 sentences and paragraphs in which the number of underlying propositions and the number of words were covaried. The topic of Set B was psychology and all sentences were definitions and descriptions of psychological terms. The topic here was also chosen on the pretext of unfamiliarity to students.

Results for Set A materials indicated a positive correlation for number of propositions presented and mean numbers recalled for free reading (r = .91) and for restricted reading time (r = .74). Recall was not as good when restricted reading was a condition as compared to free reading and the difference was greatest when sentences contained larger numbers of propositions. Results for Set B indicated free reading time yielded a strong positive relationship between numbers of propositions presented and recalled (r = .86). When reading was restricted, there was no noticeable relationship between the number of propositions in a sentence and the amount recalled (r = .23). The researchers concluded that to achieve an equivalent level of processing, longer texts require more reading time than short texts.

In summary, the Kintsch and Keenan (1973) study determined an effect for number of propositions on recall of information with sentences. With longer texts (20 sentences and paragraphs), they found a qualified result: with free reading time, a strong positive relationship between number of propositions presented and recalled; with restricted time, no noticeable relationship between number of propositions in sentences and amount recalled.

The role of number of proposition in comprehension has also been investigated when the material was pictures rather than words. Poulson et al. (1979) presented sixteen 4-year-olds and sixteen 6-year-olds with four stories in picture format. The condition of presentation varied so that some pictures were presented in story order (normal) and some were scrambled. In the first session, the children were asked to describe the pictures first, then to recall the story. In the second session, the children received a normal story first, followed by a scrambled story. The children's protocols were transcribed and then propositionally analyzed according to Kintsch (1974). The propositions derived from the protocol analysis were scored to determine if responses were core (gist) related, extra, or spurious (wrong). For both descriptions and recalls, results indicated that subjects gave as many responses in the normal condition as the scrambled condition ($F < 1$); however, a qualitative difference in responses was noted. More core propositions

relating to the gist of the story and fewer spurious (wrong responses) were given for the normal condition.

Poulson et al. (1979) interpreted their findings as support for a story schema which affected the way the children described and recalled stories. Thus, with this study, number of propositions in responses was less important than the quality of responses which the propositional analysis revealed.

Goetz et al. (1981) used Kintsch's (1974) system of propositional analysis to investigate the nature of sentence representation in memory. College students were presented booklets made up of three one-proposition sentences, three three-proposition sentences, and two filler sentences. Presentation of sentences was controlled by a beep of a tape recorder. Subjects saw either booklets with integrated or unintegrated sentences and were given a free recall test.

Results of this experiment indicated significance for number of propositions for subjects ($p < .01$) but not for sentences. As such there was better recall for one-proposition than three-proposition sentences both for content words and whole sentences This finding was interpreted as lending support to Kintsch's theory that the proposition is the unit of memory and that number of propositions has an effect on recall. Another finding of the study was that, although there was a trend for integrated sentences to be recalled holistically, recall of integrated

and nonintegrated sentences was not significant. An analysis of sentence differences noted that three types of the three-proposition sentences contained modifiers and that modifiers distinguished the recall of integrated and unintegrated sentences.

Summary of Studies--Number of Propositions

The role of number of propositions in comprehension was investigated by Kintsch and Keenan (1973). This study established the validity of the proposition as a unit for representing information in memory. When materials became more complex (i.e., paragraphs as opposed to sentences, scrambled as opposed to normal presentation, three-propositional as opposed to one-propositional) the effect for number of proposition was diminished by the influence of confounded text variables, a characteristic of more natural texts. Some of this influence was recognized perhaps in the effect for modifiers noted with the Kintsch and Keenan (1973) and the Goetz et al. (1981) studies. With the Poulson et al. (1979) study, qualitative differences in kinds of propositions in subjects' descriptions and recalls were interpreted as resulting from the influence of a story schema on comprehension. Story schema would be an example of a macrostructure in the van Dijk and Kintsch (1983) model. The influence of superordinate propositions or

macropropositions on comprehension is discussed in the next section.

Hierarchical Position of Propositions

The role of hierarchical position of propositions in comprehension was an unexpected finding in the Kintsch and Keenan (1973) study discussed in the last section. In that 1973 study, the researchers not only found an effect for number of propositions but also determined that propositions were not recalled randomly. Rather the recall of propositions was found to be in accordance with the hierarchical relationship among propositions. To determine this relationship, Kintsch and Keenan ranked each proposition according to superordinate and subordinate positions. The propositions of each sentence were then ranked high or low. In this study, 86 percent of the superordinate propositions were recalled and 74 percent of the subordinate propositions were recalled. Other factors found important determinants of recall besides rank were surface structure components. For example, adjectival and adverbial modifiers had high error rate (30 percent) when propositions appeared in this form, but propositions inherent in proper names used as modifiers had low error rate (8 percent). Kintsch and Keenan do not offer an explanation for this finding.

In summary, the Kintsch and Keenan (1973) study found an effect for the position of propositions in a text hierarchy, with propositions high (superordinate) in the hierarchy having greater recall. Also, an effect for errors with modifiers for propositions was noted: propositions appearing as adjectives and adverbs had high error rate, propositions appearing as proper names had low error rate.

The role of hierarchical position in comprehension was also investigated by Meyer (1984). Meyer considered dimensions of text relative to cognitive processing and found a significant effect for older adults (average age 69) described as expert readers, text dimensions, and levels. The levels effect was the primary measure used to assess changes in the way readers built cognitive representations of text. Levels, as used in this study, referred to the hierarchical position of propositions. The hypothesis is that high-level propositions are recalled better than low-level propositions and it is consistent with the Kintsch and van Dijk hypothesis (Kintsch and Keenan, 1973; Kintsch and van Dijk, 1978), although text analysis procedures differ between Meyer and Kintsch.

In this study, Meyer (1984) used results of the Quick Word Test of Borgatta and Corsini to divide 100 adults into two groups, one considered expert readers (extremely high vocabulary skills) and the other nonexpert readers (average or above average vocabulary skills). Additional information

gathered from interviews also served to distinguish the groups. Expert readers enjoyed reading, read more, were more familiar with the organizational properties of text, used these properties to organize their own recall of material read, and had more education (mean 16.18 years--70 percent professional as opposed to mean of 12.22 years--24 percent professional for nonexpert group) than the nonexpert group.

Materials used in this study consisted of five versions of two topics (supertanker and railroads). Two of the versions had normal emphasis plans: with signaling of logical structures and general details and with signaling logical structure and specific details. Two of the versions had differential emphasis plans: without signaling logical structure and specific details and without signaling logical structure and emphasized specific details. One version had without signaling logical structure and general details and no signaling of lower level information. "These manipulations were expected to influence the cognitive processes of selective encoding, frequency of encoding, and the subsequent organization of the reader's cognitive structure for use during retrieval of text propositions" (Meyer, 1984, p. 25). Expert and nonexpert readers were randomly assigned to the five conditions of text dimension variations. Subjects were presented with both recall and question tasks. One group read, then recalled and answered questions immediately; and another group read and recalled,

then returned one week later to recall and answer questions. A total of 28 questions were developed, fourteen testing logical relations and 14 testing details in the passages.

This study yielded significant main effects for reader expertise (p = .0000) and levels (p = .0000) on the immediate free recall data, significant text dimension variation x levels interaction (p = .0000), reader expertise x text dimension x levels interaction (p = .0112), and a passage topic (for supertanker) x levels interaction (p = .0000). These findings were in accordance with the predictions. It was predicted that text dimensions would influence the type of information recalled but not the amount and this was supported. It was predicted that when passages provided differential emphasis plans that both expert and nonexpert readers would use the detail strategy; however, the structure strategy was predicted for the other three versions with one exception: nonexperts were expected to use the detail strategy in the version with signaling logical structure and specific detail. These predictions were all supported when topics were considered together.

However, an exception to the predictions was found when topics were considered separately. Meyer (1984) predicted that with-signaling logical relations and specific details, nonexperts would "use the detail strategy or due to confusion use a default/list strategy" (p. 37). With the supertanker passage, however, both experts and nonexperts

followed the structure strategy with a large levels effect. Although the prediction was supported for the railroad passage, Meyer (1984) further noted that half of the nonexperts used the default strategy, simply listing ideas with no attempt to interrelate them, while the other half were described as being unable to perform the task, even though logical relations were explicitly stated in this version. The nonexperts remembered few of the logical relations and questions as cues provided no help with the railroad passage. Meyer (1984) indicated that the railroad passage appeared to have a more difficult logical structure and that the reduced levels effect resulted from the nonexperts being unable to perform the task, rather than their use of the default strategy (pp. 38-39).

A second prediction, involving free and cued recall, was also not supported. It was predicted that signaling would help nonexperts identify and remember logical relationships and passages without signaling would not. Yet, while signaling facilitated free recall for experts, no such effect was found for nonexperts. "Non-experts performed poorly on logical relations and explicit signaling did not assist, nor did explicit retrieval cues (questions)" (Meyer, 1984, p. 39). A comparison of cued recall data from the two different topics showed that the different passages resulted in differential selection of logical relations versus details (supertanker, 7.29 logical relations versus 3.07

details; railroads, 5.52 logical relations versus 4.78 details). Meyer (1984) concluded from this data that there are qualitative differences in cognitive representations between the two topics. These differences are based on the magnitude of propositions that can be encoded into long-term memory and differences in the relative proportions of logical relations versus details that were encoded (Meyer, 1984, p. 42).

In summary, Meyer's (1984) study determined a levels effect for type of information recalled but not amount of information recalled. Further, Meyer (1984) concluded from this finding and analysis of data that: a qualitative difference existed in the cognitive representations of expert and nonexpert readers. These different representations resulted, Meyer (1984) concluded, because of differences in magnitude (number) of propositions and proportions of logical relations and details encoded into long-term memory. Meyer (1984) also showed that emphasis plans could be varied and, thereby, impact on comprehension as measured by recall and questions. She concluded from the data that when emphasis plans focus on the top-level and superordinate structures, this plan increased the use of the text's top-level structure as an organizational schema. On the other hand, emphasis plans that used numbers, names, and pointer words (as emphasized details) appeared to interact with subordinate information that was emphasized. As a

result of the latter plan, use of the structure strategy was diminished and, thereby, the levels effect. (See Chang's (1983) adaptation of Aaronson's (1976) continuum for an alternative conceptualization for a reduced levels effect.)

Caccamise and Kintsch (1978) investigated whether effects for macropropositions, and thus hierarchical position of propositions, result from selective encoding or as a result of the retrieval process. Subjects were 32 undergraduate students. Materials consisted of four 2000-word stories and a recognition test. A recognition test was used with the assumption that if the same emphasis was found for macropropositions (superordinate propositions) as subordinate propositions, then differential storage would be indicated. Eighty true/false items were constructed for each story. For two of the stories, 40 verbatim statements (half topical/half detail) and 40 distractors were developed. For the other two stories, forty questions were used (20 student prepared statements representing story gists and 20 student prepared statements not included in summaries). Subjects read one story version corresponding to the type of recognition test (verbatim or paraphrase) and were tested immediately; then read the second story. One week later, the subjects were tested on both stories.

Results of the study indicated that on the immediate test condition, the topic (superordinate proposition) versus detail variable was significant ($p < .01$) and so was the

interaction between stories and type of statement (verbatim or paraphrase) ($p < .05$). Caccamise and Kintsch (1978) attributed the effects with the paraphrase condition to the requirement that statements be matched semantically on the recognition test. For the verbatim condition, no difference in topic/detail detectability was found. With delay testing, verbatim and paraphrase conditions did not differ from each other ($p < .05$). However, topic versus detail variable was significant ($p < .001$). Detectability (d values) was calculated for topic and detail. Results indicated that the topic effect was reliable for both immediate and delayed testing, but that the topic effect was reliable in the verbatim condition only for delayed testing. Caccamise and Kintsch (1978) interpreted these results as support for the differential effects of encoding, and thereby storage, rather than to retrieval effects.

Baumann (1980) investigated for effect of hierarchical position of propositions with 60 third and 60 sixth graders. Subjects were described as average or above average based on scores from the Metropolitan Achievement Test. The study was intended as a replication of the Meyer (1975b) study with adults in which a levels effect (i.e., more important, superordinate propositions located in the top of the text hierarchy are recalled better than lower level subordinate propositions). Baumann (1980), however, varied the study by using both a multiple choice test and short answer

questions. Materials were expository text. Baumann (1980) was concerned that the materials and question mode be typical of what children experience, in an attempt to establish ecological validity.

Results of the study indicated that the bias for better recall of superordinate ideas with adults was not significant with children, when tested with recognition (multiple choice) and cued recall (short answer) questions. Baumann (1980) concluded that "the kinds of questions that are written and the manner in which they are constructed can potentially color the quantity and quality of comprehension they purport to measure" (p. 152). Baumann (1980) further suggested that other perhaps more powerful variables were operating to influence comprehension, or that recall, cued recall, and recognition tasks measure different psychological processes (p. 153). Other variables noted as possibly contributing influence, and thereby diminishing the levels effect, were prior knowledge of reader, saliency of specific bits of information, and rhetorical structure.

Summary of Studies--Hierarchical Position of Propositions

A consideration of the role of the position of the proposition in a text hierarchy revealed that more propositions high in the hierarchy are recalled and/or recognized with both delayed and immediate testing (Kintsch and Keenan, 1973; Caccamise and Kintsch, 1978) and that

controlling text dimensions results in specified cognitive representations (Meyer, 1984). On the other hand, the review of research revealed that when measurement task differed, the levels effect was not supported (Baumann, 1980), that differences in rhetorical structure affected reader performance (Meyer, 1984), and that nonexpert readers performance on logical relations questions did not improve with cueing and/or signaling (Meyer, 1984). Two of the studies concluded that differences in recall variables (topic/detail) result in part from encoding preferences (Meyer, 1984; Caccamise and Kintsch, 1978).

Thus, these studies appear to establish a role for hierarchical position of propositions when the measurement task was recall and subjects were adults. When subjects were young children, when measurement task changed (cued recall or multiple choice), and when ability level of reader were taken into consideration, effects for hierarchical position of propositions were diminished or not significant. Paivio (1986) indicated that imaginal or nonverbal information (e.g., as reflected in the concreteness or abstractness of material) plays a role in comprehension. The role of imagery in comprehension is discussed in the next section.

Imagery

The role of imagery in comprehension was investigated by Irwin (1988). Subjects were 30 fifth graders reading at or above grade level on the California Test of Basic Skills (CTBS). Their CTBS scores ranged from 4.7 to 10.9. With this research, passages from a social studies text were analyzed for their imagery level using a computer program devised by Terwilliger and Kolker (1985). Passages were then ranked based on a ratio of high to low imagery words. Three passages ranked high in imagery and the three passages ranked low in imagery were selected for use in the study. With the imagery level for six passages determined, a propositional analysis of the passages was carried out. The researcher then determined a textbase (microstructure) and a macrostructure (gist) by which subjects' recall protocols could be judged to determine effects of imagery on recall of micro and macro levels of text.

This study found that imagery of passages did influence recall of passages read and that the influence was at the macro level of text. An additional finding was that significantly more macropropositions were recalled from high imagery passages, while significantly more micropropositions were recalled from low imagery passages.

Denis (1982) investigated the role of imagery in reading in four experiments. Subjects, students from an

introductory psychology course, read a long narrative (2,200 words) or abstract (1,600 words) text, responded to a 24-item two-alternative forced choice test, and completed the Vividness Imagery Questionnaire (VVIQ). Based on VVIQ scores, high imagery (HI) and low imagery (LI) groups were determined. Four experiments were carried out to investigate the following hypotheses: (1) HIs have longer reading times, (2) HIs are slower readers, (3) when subjects are told to read quickly, reading times of HIs will be reduced as a result of briefer image durations, and (4) under conditions of induced imagery, HIs performance will not be heightened.

Results of these experiments indicated that (1) HIs do have longer reading times, (2) HIs are not slower readers, but an effect for ability and text type (narrative/abstract) was found: effect for narrative, but not for abstract text, (3) with equivalent reading times, HIs obtain higher scores (narrative text) than LIs, and (4) imagery instructions effect for LIs; no difference for HIs. In discussing the findings, Denis (1982) noted that "part of the imagery activity developed during prose reading is not definitely directed toward memorization" (p 544) and, thus, imagery activity when reading narrative text is not necessarily goal directed (p. 545). Denis (1982) gave three interpretations to the findings that HIs have longer reading times for a descriptive/narrative text because of the imagery activity involved: (1) HIs maintain images longer, (2) HIs' images

are more complex, or richer in details (elaborated more and thus more time required), or (3) LIs simply do not construct images as often as HIs.

Tirre et al. (1979) used six natural language passages (three concrete and three abstract) to investigate the effects of a verbal strategy or imaginal strategy. Subjects were 80 undergraduate adults (57 females and 23 males). Passages were rated for imagery and abstractness and comprehensibility. Two tests were developed. One was a multiple choice test following the advice of Anderson (1972). With this test subjects had to determine the relationship between word sets. The other test was a production test. With this test, subjects had to explain in a few sentences how words were related to each other.

Results of the multiple choice test indicated a significant main effect for verbal over imaginal strategy ($\underline{P} < .05$). With the production test, a strong but not significant trend was found in favor of the verbal strategy ($\underline{P} < .07$) and concreteness was significant ($\underline{P} < .001$). The difference between verbal and imaginal strategies for concrete materials was larger than abstract materials but not significant.

With this 1979 study, the demonstrated superiority of concrete over abstract found with word lists was not obtained with the multiple choice test, but was found with the production test. Tirre et al. (1979) concluded that the

general superiority of the verbal strategy suggests that the subjects' representation of passages was closer to a verbal (perhaps abstract rather than word-based) form than imaginal form even for concrete passages (p. 105). Since concreteness effect is often attributed to facilitation of retrieval, the researchers further suggest that the concreteness effect found with the production test may be due to the facilitation of retrieval.

Kolker and Terwilliger (unpublished manuscript) investigated length of reading passage, type of comprehension question, and level of imagery on reading comprehension. Thirty fifth graders, reading between the 5.0 and 6.0 grade level based on results of the Gates MacGinitie Reading Test, participated in the study. Sixteen reading passages selected from a fourth grade social studies text were selected as the materials. The passages were divided evenly into long (385-440 words) and short (177-218 words) passages. Each of the long and short passage selections were further divided according to a high or low imagery ranking determined by a computer program developed by Kolker and Terwilliger (1985). Three fact and three inferential questions were prepared for each passage. Students read the passages silently, a clinician asked the questions orally and recorded answers verbatim. Students did not have passages available to answer questions.

Three of the results of the Kolker and Terwilliger study are important to this study. (1) The level of imagery, regardless of passage length, appeared to affect comprehension significantly. With high imagery passages, total comprehension was greater than low imagery passages ($\underline{P} < .0001$). (2) Comprehension of fact questions was greater for high imagery passages ($\underline{p} < .006$). (3) Comprehension measured by inferential questions was greater for low imagery passages than for high imagery passages ($\underline{p} < .0006$).

Kolker and Terwilliger (unpublished manuscript) in discussing the results concluded that the level of imagery seemed to affect total comprehension and thus appeared to be a factor in mediating recall. Further, the authors raised the question as to why responses to inferential questions were consistently lower than fact questions.

Summary of Studies--Imagery

With the imagery studies, effects were found for imagery value of passages (high or low) (Irwin, 1988; Tirre et al., 1979; Kolker and Terwilliger, unpublished), for imagery ability (Denis, 1982); for imagery instruction (Denis, 1982), for imagery value and question type (Kolker and Terwilliger, unpublished), for imagery level and propositional level (Irwin, 1988), for imagery level and test type (Tirre et al., 1979), for imagery ability and text type (Denis, 1982), and for imagery ability and test

performance (Denis, 1982). One study did not support an effect for imaginal strategy (Tirre et al., 1979).

The results of these studies suggest that imagery influences comprehension but further show that the range of influence is variable. Consistent with the levels effect, more macropropositions were recalled; however, more macropropositions were recalled from high imagery passages and more micropropositions were recalled from low imagery passages. Similarly, imagery level of passages was found to influence comprehension when fact and inferential questions were the dependent variable. High imagery passages resulted in more correct responses to fact questions and low imagery passages resulted in more correct responses to inferential questions. These studies suggest that aspects of the materials, the subjects, and the tasks contributed to the differential effects. The next section examines effects of measurement tasks.

Measurement Tasks

The Kintsch models (Kintsch, 1974; Kintsch and van Dijk, 1978; van Dijk and Kintsch, 1983) have used recall to measure comprehension. The review of studies presented thus far has noted differential effects for variables under investigation when measurement mode varied. The purpose of this section is to review recent literature and studies that

have addressed the role of measurement task in comprehension.

A study by Askew (1982) considered effects for different measurement tasks (retellings and structured postquestions) and response mode (oral and written) on able sixth graders' comprehension of expository text. Askew selected a social studies passage at the sixth grade level and analyzed it informally for propositions. Using the schema of Raphael et al. (1980), three questions representing each type (text explicit, text implicit, script implicit) were generated. Eighty subjects were randomly assigned to one of four task groups: oral retelling, written retelling, question/oral responses, and question/written responses. Five questions were used to guide the research; findings for four of the questions were nonsignificant.

Analysis of students responses revealed differences, however. For example, while significant differences in quality of student responses were not found, oral and written retellings of students contained more text explicit responses than text implicit, script implicit or implausible responses. A consideration of oral and written post questions revealed no significant differences; however, more textbase inferences were present than text explicit responses. Askew (1982) noted that questions focused readers to textbase inferences. Another research question concerned with the effect of oral and written post questions upon

quality and structural importance of textbase responses revealed no significance differences; yet, it was noted that more ideas designated as important were found. One significant finding was reported--a significant relationship between categories of invited responses and categories of actual responses. In other words, subjects responded to text explicit, text implicit, and script implicit questions with responses appropriate for each category. Askew (1982) concluded from this study that there are differences in types of information obtained with recall and post questions.

Johnston (1981) investigated the role of prior knowledge and reading comprehension test bias. One consideration in this study was the effects of prior knowledge as evident in the kind and numbers of questions answered. Three passages (650-750 words) were used to assess the comprehension of students (eighth graders selected from differing locals--one city, the other the country). These passages were also content specific so as to detect prior knowledge bias. Eighteen questions, based on the Pearson and Johnson (1978) taxonomy, were constructed for each passage. Results in this study found both question type contrasts were significant, indicating that textually explicit questions (mean = 45 percent) were easier than textually implicit (mean = 37 percent), which were easier than script implicit questions (mean = 29 percent).

Johnston (1981) summarized the findings relative to questions in this study. One summary statement has bearing on the present study:

> Readers find it easier to answer peripheral than central questions when the text is available, and this is also more pronounced for readers with greater relevant prior knowledge. (Johnston, 1981, p. 80)

With regard to this finding, Johnston (1981) indicated that with texts available (a typical condition in comprehension testing) that students do not answer more central (analogous to superordinate information in this study) questions, but rather more peripheral (analogous to subordinate information in this study) questions. This finding qualifies the findings of Meyer (1984) and Kintsch and Keenan (1973) discussed in this review. These researchers reported a levels effect as measured by recall and cued recall questions--without texts available. With the Johnston (1981) study, with text available and with students responding to multiple choice questions, a levels effect, in essence, was not found.

Another of Johnston's (1981) findings, however, is contingent with the levels effect reported by Meyer (1984) and Kintsch and Keenan (1973). This finding states:

> However, not having the text present actually improves their performance on questions testing central information, and this is particularly so for readers who have greater prior knowledge of the topic. (Johnston, 1981, p. 79)

Johnston (1981) explained this finding by stating that students come to depend on the text when answering peripheral questions, but when the text is not available, students must rely on their understanding of text (pp. 102-103). Johnston (1981) concluded from his data that the manner in which reading comprehension is measured, i.e. which question types and how much reliance on memory, can impact on comprehension scores.

Oakhill (1984) investigated the relation between ability to make inferences and memory for text under two conditions (passages available, or unavailable). Subjects were 24 children (7-8 years of age) divided into two groups (skilled and unskilled) based on scores from the Gates-MacGinitie Primary B vocabulary test and the Neale Analysis of Reading Ability (Form C). Materials were four short stories, eight to nine sentences long (100-120 words). Each child read each passage orally and was then asked eight questions (four literal and four inferential). After this procedure, each child received the story back and the same questions were asked, enabling the children to check their answers.

Overall analysis of variance (comprehension level x presentation condition x question type) found the main effect for each factor was significant. Skilled comprehenders made fewer errors than less skilled ($p < .001$); fewer errors were made when passage was

available ($p < .001$); and fewer errors were made on literal than inferential questions ($p < .005$). Oakhill (1984) also noted an improvement in answering literal questions over inferential questions when the passage was available ($p < .025$) and that the difference between skilled and less skilled comprehenders was larger for inferential than for literal questions ($.05 < p. 0.1$). Oakhill (1984) also found a difference in the three way interaction between comprehension level, question type, and presentation condition. When the passage was not available, skilled comprehenders were better than less skilled at answering both types of question, but when passage was available, skilled readers performed better only on the inferential questions.

Oakhill (1984) concluded from the study that unskilled readers have difficulty with inferential questions, even when the text is available. Thus, inferential ability distinguished the two groups. Oakhill (1984) provided two reasons for the inferential effect: (1) less skilled readers may "draw fewer implicit inferences because they do not execute the necessary constructive processes, or because they simply do not have the prerequisite knowledge on which the inferences are made" (p. 35). Oakhill (1984) also noted that the results of this study were consistent with the idea that good comprehenders use relevant background knowledge to

build a more complete and logical memory representation that later facilitates recall (p. 36).

Olson (1985) investigated good and poor readers' ability to answer text-based inference and paraphrase questions after reading two narrative and two expository passages to determine which category of inference causes the greatest difficulty. Subjects were third graders (27 good and 26 poor). Eight passages (334-353 words) were used with four altered to facilitate the match with paraphrase questions. Eighteen questions were constructed, six questions from each of three categories: paraphrase, information text-based inference, and logical text-based inference. Questions were based on the inference taxonomy of Warren, Nicholas, and Trabasso (1979).

Results of the study indicated a significant main effect for reader ability ($p < .0001$). Good readers answered more questions correctly than poor readers when averaged across text type and question types. Text type was also found significant ($p < .0001$). For all children, questions for expository passages were more difficult to answer than questions about narrative stories. Question type was found significant ($p < .02$). The order of difficulty was: informational inference, paraphrase, and logical inference with logical inference the most difficult. Finally, text type and question type interaction was significant ($p < .05$), indicating that responses to questions in the

different categories were affected by text type. Further analysis of data revealed that all levels of expository text questions differed significantly from all levels of narrative stories. Difference occurred with narrative passages and logical inference question type. Children answered fewer of the logical relations questions than either the paraphrase or informational inference questions. No significant difference among students' responses to question types was found after reading expository passages.

Olson (1985) interpreted the equal difficulty for answering paraphrase and informational inference questions as resulting from the deeper processing required because of the synonyms used to formulate paraphrase questions. The difference in logical relations questions for the two types of texts was explained as resulting from the underlying structural differences of narrative and expository texts. With narratives, story events must be linked together; with expository texts, different rhetorical structures exist. Slower reading, IQ, and metacognitive skill were also discussed as possible sources of problems for poor readers.

Summary of Studies--Measurement Task and Comprehension

A consideration of studies concerned with measurement task and comprehension revealed that different question types elicit different information (Askew, 1982; Johnston, 1981; Oakhill, 1984; Olson, 1985), that different types of

material affect responses to questions (Olson, 1985); Johnston, 1981), that the availability of material affects responses to questions (Oakhill, 1984; Johnston, 1981), that differences in ability affects responses to questions (Oakhill, 1984; Olson, 1985; Johnston, 1981), and that differences in background knowledge affects responses to questions (Johnston, 1981). These findings are consistent with the differential effects noted in the review of studies for number of propositions, hierarchical position of propositions, and imagery level. The next section summarizes the review of research presented in this study and evaluates the potential of van Dijk and Kintsch (1983) model to account for the variables of number of propositions, hierarchical position of propositions, and imagery level.

Summary of Research

This review of research and literature has revealed that the van Dijk and Kintsch (1983) model of comprehension is general and flexible enough to be expanded to a consideration of a test of reading comprehension. Components of the model particularly of interest in this study are addressed in the van Dijk and Kintsch model. Specifically, those aspects of text are height of propositions and number of propositions. Imagery in this model is accounted for by

elaborative inferences and recognized as critical to comprehension.

Studies related to the independent variables of this study were reviewed and findings support the following conclusions that may be summarized thusly: (1) Effects for number of propositions on comprehension; however, effect was diminished or not significant when confounded by other text variables, e.g., when materials increase in size, complexity, or in considerateness (scrambled). (2) Effects for hierarchical position of propositions when subjects were adults and measurement mode was recall; however, effect was diminished or not significant when texts were manipulated, when rhetorical structure was more difficult, when subjects were children, when measurement task was short answer or multiple choice questions, and when subjects differ in ability. (3) Effects for imagery when passages were ranked high in imagery, when subjects were described as high imagers, and when subjects were instructed to image; however, differential effects for imagery were found for question types when passages were ranked high and low, for propositional recall when passages were ranked high and low in imagery, for test type when passages were ranked high and low, and for test performance when subjects differed in imaging ability (high and low). One study found an effect for verbal strategy when comprehension was measured by a multiple choice test; and when comprehension was measured by

a production test, a strong but not significant trend in favor of the verbal strategy as opposed to the imaginal strategy was found, even though passages were ranked high in imagery.

Researchers offered a variety of reasons for the differential effects. Many of the reasons were reader variables: prior knowledge, IQ, metacognitive skill, encoding and/or retrieval operations, and reading speed. Some of the reasons were text related factors: saliency of specific bits of information, more difficult rhetorical structures, and text inconsiderateness (scrambled, unintegrated). One researcher suggested that different measurement modes measured different psychological processes and, therefore, effects on comprehension are different. A consideration of research related to measurement task, and thereby comprehension, revealed that measurement task effects were impacted by reader variables, by text variables, and by the situation in which testing occurred.

CHAPTER III

SUBJECTS, MEASURING INSTRUMENT, PROCEDURES

Design of the Study

This chapter explains the design of the study and includes: (1) a description of the subjects including a determination of the sample and initial passage restriction, (2) an explanation of the measuring instrument including a determination of passages and question types, (3) a detailed description of the procedures for determining the number of propositions, the hierarchical position of propositions, and the imagery level of passages, and (4) the statistical procedure for analyzing data.

Subjects

The population for the study was drawn from students, attending The University of Tennessee, Knoxville, who were enrolled in either Education Curriculum and Instruction, Efficient Reading and Study Skills, 141 (C & I 141), or in Liberal Arts, Psychology of Statistics 385 (Psy 385). The University of Tennessee at Knoxville is a coeducational, public university offering degrees at the bachelors, masters, and doctoral levels. Located in the eastern portion

of the state, The University of Tennessee, Knoxville assesses its entrance difficulty level as moderately difficult. In the fall of 1989, 79 percent of applicants were accepted (3,385 freshman). The total undergraduate enrollment was 19,067 and the graduate enrollment was 5, 949 in the fall of 1989. Of the fall 1989 undergraduates, 48 percent were women, 5 percent blacks, 1 percent native Americans, 1 percent Hispanics, and 2 percent Asian Americans.

Students enrolled in C & I 141 have frequently been recommended by advisors to take the course to improve their reading skills. However, the class is an elective and may be taken by both undergraduates and graduates. The Psy 385 class was a required course for students majoring in psychology.

The decision was made to use college students in this study in an attempt to minimize any confounding of effects that might occur with younger subjects because of decoding problems. Thus, it was felt that with this age group the construct of comprehension could be more readily investigated.

The sample consisted of two groups: good comprehenders and poor comprehenders at least eighteen years old. The study was delimited to eighteen year olds so that parental consent would not be necessary. The Nelson-Denny Reading Test, Form E, (NDRT) was administered to all students in

C & I 141 as part of the course requirement and to all students in Psy 385 by permission of the instructor. The criterion for selection into the good comprehenders' group was scores in the top third (7,8,9) of the stanine scale. The criterion used for selection into the poor comprehenders' group was scores in the bottom third (1,2,3) of the stanine scale. The decision to use the bottom and top scores of the stanine scale as criteria for the two groups was made because of the dichotomy offered (Marshall, 1981). With such a dichotomy, it was expected that any textual effects relative to level of cognitive processing (literal and interpretive) would be more fully realized.

On August 29, 1989, eighty-four (84) students enrolled in C & I 141 were tested. Of that number, eleven (11) were discounted because students were seventeen (17) years of age. Seventy-three tests remained for scoring and defining subjects relative to the two groups--good and poor comprehenders. Scoring of the tests revealed that twenty-four (24) students scored within the poor comprehenders range--1,2,3 stanines--and eight (8) students scored within the good comprehenders range--7,8,9 stanines. Thus, thirty-two (32) subjects became eligible for inclusion in the study from this administration. Of that number, one test was disqualified because responses had been recorded on the wrong section of the test answer sheet and one subject did not grant permission to the data. Thirty (30) subjects

were then eligible for the study--22 for the poor comprehenders group and 8 for the good comprehenders group.

On September 13, 1989, the NDRT was administered to thirty-one (31) students enrolled in Psy 385. Of the thirty-one (31) students taking the test, eight (8) students scored within the poor comprehenders range--1,2,3 stanines. One of the eight potential subjects one did not grant permission to participate in the study and two were eliminated because they were graduate students and norms were not provided for this school level group. Therefore, five (5) students were eligible for the poor comprehenders group. Three (3) students taking the test scored within the good comprehenders range--7,8,9 stanines. Thus, the total eligible for participation in the study from this test administration was eight (8) subjects. Combined administrations of the NDRT, therefore, yielded thirty-eight (38) subjects eligible to participate--twenty-seven (27) for the poor comprehenders group and eleven (11) for the good comprehenders group.

A closer examination of answer sheets of eligible subjects revealed that many of the poor comprehenders had not completed the test. Comparison of good and poor subjects' performance on the same passages from the test was essential to the study. Only seven (7) subjects from the poor comprehenders group had completed questions through passage six (6) of the eight passages. All eleven (11)

subjects comprising the good comprehenders group remained eligible. Thus, it was determined that eighteen (18) subjects had completed through passage six. Since sample size was a concern--a minimum of 20 subjects was desired--the researcher enhanced sample size by seeking participation of additional students enrolled in C & I 141 in the spring of 1990.

The NDRT was administered on January 25, 1990, to students enrolled in C & I 141. Thirty-six (36) students took the test. Evaluation of data sheets revealed that no students taking the test were eligible for the good comprehenders group. Seven (7) subjects were eligible for the poor comprehenders group, one of which did not give permission to use the data. Analysis of data sheets for the remaining six (6) potential subjects revealed that only one had completed through passage six. Thus, if passage six were used as the cut off for passage inclusion, only nineteen (19) subjects would be eligible for the study. Analysis of data sheets revealed that sample size could be increased by ten (10) subjects if use of test materials were restricted to consideration of passages one through five. Consideration of text variables under investigation (imagery and number of propositions) likewise revealed that eliminating passage six would not impact the study negatively. Thus, in order to have a greater sample size, the researcher determined to use the twenty-nine (29) tests of students who had completed

through passage five as subjects in the study. The two groups derived from this sample then became eighteen (18) subjects for the poor comprehenders group and eleven (11) subjects for the good comprehenders group.

Students' responses to questions were recorded on a Self-Scorable Answer Sheet provided by the testmaker. The researcher scored all tests. A form for recording data important to the study was prepared by the researcher and was used to record responses to questions. Confidentiality was maintained by recording all data in accordance with students' initials. An example of the form for collecting data is provided in Appendix A.

Measuring Instrument

The Nelson-Denny Reading Test (NDRT) is the predominant test employed by community colleges (van Meter and Herrmann, 1986-1987). In this capacity the NDRT is frequently used as a pre- and posttest measure of student gain in conjunction with a developmental course in reading and/or study skills. Since the NDRT is a major instrument for determining reading comprehension for some students, the decision was made to investigate the effects of three text variables--number of propositions, hierarchical position of propositions, and imagery level--possibly influencing comprehension on a standardized test of reading using this test.

The NDRT has been published since 1929 and comes in a variety of Forms. Form E, published in 1981, was used with this study. Selection of Form E was based on the fact that it is the most frequently administered form.

Administration of the NDRT followed procedures dictated by the test makers. The instructor of the C & I 141 classes administered the test to his students. The researcher administered the test to students in the Psy 385 class. Scoring, likewise, was in accordance with procedures specified in the testing manual. Raw scores were computed and converted to stanines. A copy of a letter to The Riverside Publishing Company requesting permission to use aspects of the NDRT (specifically, pages depicting the propositional analyses of passages and references to word(s) indicating their imagery rating) in this study is included in the Appendix A.

Although the NDRT is composed of two subtests--vocabulary and comprehension--only the comprehension subtest was considered with this study. Since the reading rate test is a part of the comprehension subtest, administration of the test included the reading rate measure. In accordance with the test manual, twenty minutes was allowed for the comprehension subtest.

The NDRT is comprised of eight passages. These passages are different in terms of both word length and subject matter. The first passage of the test is longer to allow for

the testing of reading rate. The researcher found the passage to contain 639 words. The authors indicate that the remaining seven are shorter "200-word passages" (Brown et al., 1981, p.12). However, a word count by this researcher found passage length of the seven shorter passages to vary on Form E from 189 to 251 words (hyphenated words were counted as one word). The subject matter of the passages consists of humanities, social sciences, and natural and physical science. Twelve (12) questions, in each form, are designated for each of the three subject areas (Brown et al., 1981, p. 12). The authors explain that the subject matter is varied because research suggests that reading scores within the same field are highly correlated (Brown et al., 1981, p. 10). All passages are expository, except the first, longer passage which is narrative.

As already noted, passage consideration was restricted to passages one through five because of the small number of students completing the entire test. To provide consistency in material type, passage number one was eliminated because of difference in both text length (639 words) and type (narrative). Thus, four passages (two through five) became the material subject to investigation of textual effects on comprehension. The subject matter of the four passages were evenly divided, two natural science and two social science.

The authors of the NDRT indicate that subdividing the 36 items of the comprehension subtest into subskills is not

practical. However, they do suggest examples of possible classification of items that may "provide instructional help" (Brown et al., 1981, p. 9). One such classification supports a two-factor definition of comprehension derived from a summary of research prepared by Rankin (1962). With this classification, items are "somewhat arbitrarily designated literal or interpretive" (Brown et al., 1981, p. 9). The authors designated eighteen questions for each type. They defined literal as "testing student ability to note explicit details" and interpretive as "requiring students to infer or deduce answers; such questions measure ability to grasp the central idea or purpose of a passage, or to make judgements about relationships" (Brown et al., 1981, p. 12). Thus, the literal and interpretive classification was deemed adequate for establishing two levels of cognitive functioning. Since questions play a role in establishing a level of cognitive functioning, it was necessary to establish a relationship between the passages of the test and the questions of the test. The work of Pearson and Johnson (1978) and Pearson and Raphael (1985) gave guidance. As a result, literal and interpretive indicated the relationship between passages and questions in this study. Literal was defined as having an answer explicit in a sentence of the text; and interpretive was defined as requiring an inference between lines of the passage or

between the question and information in a reader's background knowledge.

The researcher, thus, maintained the question classification suggested by the authors of the NDRT, but specified a specific relationship between the passages read and questions asked in terms of level of cognitive functioning. Sixteen questions (8 literal and 8 interpretive) accompanied the four passages used in the study. It was anticipated that the dichotomy proffered by the question classification (literal and interpretive) would provide a more succinct indication of textual factors influencing comprehension in relation to cognitive processing of information.

Procedures

Propositional Analysis

In order to investigate the effect for number of propositions and the effect for hierarchical position of propositions on the comprehension of good and poor readers, each passage used in the study was propositionally analyzed. First, the researcher propositionally analyzed each passage used in the study to determine the template textbases or microstructures. After summaries were prepared for the establishment of the macrostructures (the procedure will be explained in a later section), the researcher analyzed each

of the macrostructures into macropropositions. Finally, the researcher propositionally analyzed stems of all the questions under consideration in the study.

The Kintsch models (Kintsch, 1974; Kintsch and van Dijk, 1978; van Dijk and Kintsch, 1983) served as a theoretical basis. The procedures for propositional analysis according to the Kintsch (1974) model are delineated and explained operationally in The Construction and use of a Propositional Textbase by Turner and Greene (1977). This manual served as a guide for the propositional analysis. Turner and Greene (1977) define a proposition as "two or more word concepts, such that the first is a relation, the others arguments" (p.3) and indicate that arguments of a proposition are constrained by the relation. Turner and Greene (1977) identify three types of propositions (p.4) and several subtypes (p. 8):

(1) Predicate
    a. verbs
    b. nominals
    c. reference
(2) Modifier
    a. qualifier
    b. quantifier
    c. partitive
    d. negative

(3) Connective

a. conjunction

b. disjunction

c. causality

d. purpose

e. concession

f. condition

g. circumstance

1. time

2. location

3. manner

Turner and Greene (1977) explain that Fillmore's (1968; 1971) case system was used to classify the arguments of propositions according to their relationship to the predicate relation, when that relation is a verb (p. 10). Turner and Greene (1977) note that time, location, and manner are propositions of circumstances that are specifically identified (pp. 36-40) and point out that use of manner is severely restricted in the application of their procedures. Additional cases adopted from Fillmore (1971) are: agent, object, instrument, source, goal, experiencer.

Validation of the researcher's propositional analysis was carried out by sending a copy of the researcher's propositionally analyzed version of passage five, a passage which the researcher regarded as most difficult, to Dr. Irwin-DeVitis. An agreement of 84 percent was reached

between the researcher's list and Dr. Irwin-DeVitis's list. This researcher evaluated the differences between her propositional analysis and Dr. Irwin-DeVitis's analysis in terms of impact on the question and test passage interaction. Differences between the two analyses were determined to not impact on the question/text interaction. The differences in analyses do, however, reflect the interpretative, and thus subjective, nature of propositional analysis. For example, this researcher determined one relationship among clauses to be conditional; on the other hand, Dr. Irwin-DeVitis determined the relationship to be cause and effect. In accordance with Turner and Greene (1977) it is possible to analyze a text in terms of all plausible interpretations. A second difference between the two analyses was the appropriate indication of two implied propositions by Dr. Irwin-DeVitis. While appropriate, this researcher attempted to minimize the specification of implied propositions in the textbase.

A copy of Dr. Irwin-DeVitis's analysis and the researcher's appears in Appendix B, and a letter from Dr. Irwin-DeVitis discussing her evaluation appears in Appendix A. van Dijk and Kintsch (1983) advised that it is "neither necessary nor desirable" to represent texts propositionally at their full level of complexity and further indicated that a general framework will suffice unless goals require a more subtle analysis (p. 384).

The propositional analyses of the four passages yielded data important to the study. From the analysis, the researcher determined which passage had the greatest number of propositions and which passage had the least number of propositions. With this data, passages were ranked from high to low. The passage ranked highest in number of propositions and the passage ranked lowest in number of propositions were used in the study.

Hierarchical Position of Propositions

After passages were propositionally analyzed, additional preparation of materials was necessary to investigate the effect of hierarchical position of propositions on the comprehension of good and poor readers. In this study, hierarchical position of propositions was determined by matching question stems to the micro- and macrolevels of text. Several procedures had to be carried out to prepare the materials: (1) the determination of the macrostructures (or gists) of each passage, (2) the degree of propositional match between question stems and test passages, and (3) the degree of surface level match between question stems and test passages. All three procedures were important to the investigation of the effect of hierarchical position of propositions and are discussed next.

Macrostructures. In order to determine the hierarchical position of propositions, it was necessary to determine a macrostructure for each passage. The macrostructures (or gists) of the passages were generated by using the macrorules of the van Dijk and Kintsch (1983) model. The macrorules are defined as:

1. Deletion: Given a sequence of propositions, delete each proposition that is not an interpretation condition (e.g., a presupposition) for another proposition in the sequence.
2. Generalization: Given a sequence of propositions, substitute the sequence by a proposition that is entailed by each of the propositions of the sequence.
3. Construction: Given a sequence of propositions, replace it by a proposition that is entailed by the joint set of propositions of the sequence. (p. 190, van Dijk and Kintsch, 1983, p. 190)

van Dijk and Kintsch (1983) indicate that, since all propositions are not expressed but must be inferred, some macropropositions are abstractly derived from sequences of propositions in relation to a set of propositions that represent the world knowledge of the reader (p. 191). The macrostructure is, thus, a hypothesized level of text derived by connections (inferences) which the reader makes between the text and his/her store of knowledge.

The procedure for generating a specific macrotext level (summary) in accordance with the macrorules is explained by van Dijk and Kintsch (1983). Macropropositions must be linked coherently just as propositions of the textbase. When functional and conditional relations are established among

macropropositions, a specific macrotext level results. "This level may again be the input for the application of further macrorules, and produce a still higher level, and so on until the general topic of the text is derived" (p. 210). van Dijk and Kintsch (1983) indicated that more than one summary is possible from a textbase and that "any paraphrase would in principle be acceptable" (p. 219).

The researcher used the procedure described by van Dijk and Kintsch (1983) to establish two separate macrotext levels (summaries) for each passage used in the study. Two graduate students assisted in the development of the macrotexts for the study. The first step was the determination of a summary, a macrolevel I text. The graduate students met with the researcher for instructions on how to prepare the summaries. Passage six from the NDRT was used for practice. A copy of the macrorules were provided at the session. Using the macrorules, the graduate students were given instructions to reduce the original text by 1/3 to 1/2 and to follow the paragraph format, an indication of text markers (van Dijk and Kintsch, 1983, p. 218) of the original texts. After the practice session, the graduate students prepared independently a summary for each of the four passages used in the study.

One week later, the researcher met again with the graduate students to discuss the summaries. Some differences did exist but were worked out by discussion. Differences

typically involved a situation where greater generalization was appropriate. After this meeting, the researcher used the summaries prepared by the graduate students to establish a macrotext. This summary was designated macrolevel I by the researcher. The macrolevel I passages were then analyzed propositionally following the procedures outlined above. Propositional analyses for macrolevel I texts are provided in Appendix C.

The next step was to return the summaries (Macrolevel Is) to the graduate students with instructions to apply the macrorules and reduce the macrolevel I texts again by 1/3 to 1/2. In the meantime, the researcher prepared summaries for the macrolevel I texts. A week later, the graduate students returned their summaries of the macrolevel I texts to the researcher. The researcher's summaries were compared with those of the graduate students. A high degree of consistency existed between the three summaries. One summary differed in that more detail was included; an instance of greater generality was used in the study. In one instance, the researcher's summary included a detail which was thus eliminated. These last summaries were designated macrolevel II by the researcher and became the macrostructures for investigating the gist level of the four passages. These macrolevel II texts were then analyzed for macropropositions by the researcher. The procedure was again in accordance

with the Turner and Greene (1977) manual. Propositional analyses for macrolevel IIs are in Appendix C.

Question stem and test passage match. With microstructures and macrostructures determined, the next step was to determine the relationship between question stems and test passages in order to investigate the effect of hierarchical position of propositions on the comprehension of good and poor readers. As such, it was necessary to determine a match between the propositionally analyzed question stems and the propositions of the two levels of text (textbases and macrolevel IIs). In this study, literal was analogous to the Pearson and Johnson (1978) category of text explicit and interpretive was analogous to text implicit and script implicit. Thus, propositions explicitly stated in question stems and matched to propositions explicitly stated in text was a necessary condition for a literal level of cognitive processing. However, an interpretative level of cognitive processing was assumed if the propositions of a question stem did not match the propositions of the text. The assumption was that information must be inferred or deduced (e.g., integrated across sentences or deduced from world knowledge) to answer the question.

The work of van Dijk and Kintsch (1983) provided the theoretical base for determining the match between questions

and test passages. van Dijk and Kintsch (1983) indicate that what is remembered is a by-product of processing. They note that depth of processing and elaboration are important, because deeper more elaborate processes leave more traces that can be recovered. "Variable encoding leaves traces that can be matched by more retrieval cues" (p. 335). In order to retrieve an item from memory, the retrieval cue must match, at least partially, the encoded item (p. 335). Although passages were available during testing, the number of words in each passage indicated that comprehension may be dependent on episodic memory because of the limited capacity of short term memory (p. 335). Hence, in this study, test questions are considered as cues for the retrieval of information from episodic memory. With the van Dijk and Kintsch (1983) model, the microstructure and macrostructure are hypothesized as distinct models of text representation in memory. Thus, the researcher was concerned that questions be matched propositionally to both levels (textbase and macrolevel II) of text hypothesized to exist in memory.

In order to determine the match between question stems and test passages, the researcher developed a worksheet which used three categories of match: no match, partial match, complete match. The categories of match were derived from the literature (van Dijk and Kintsch, 1983; Tulving and Thompson, 1973). The rationale for propositional matching is further supported by the work of Singer, M. (1985) and is

utilized in his VAIL model. The VAIL (verification of the assertions and implications of language) model has been used with sentence verification tasks, and with yes/no, true/false, don't know, probably, and wh-question responses. Singer, M. (1985) discusses the need to extend the model to discourse. The current study applies propositional matching to expository texts.

Dr. Irwin-DeVitis was asked to examine the propositionally analyzed texts and mark by proposition numbers the propositions from the textbases and macrolevel IIs that were related to the relation and/or arguments of the propositionally analyzed question stems. The degree of match was based on three categories. A no match occurred when neither predicate nor arguments of the question stems were the same as the predicate and arguments of the textbase. A complete match occurred when the predicate and arguments of propositionally analyzed question stems were the same as the predicate or argument(s) of the textbase or macrolevel II texts. A partial match occurred when either the predicate or argument of propositionally analyzed question stems and texts were the same. Dr. Irwin-DeVitis marked the worksheet with the number of the microstructure or macrolevel II proposition(s), e.g., P1, P4, P16, that either partially or completely matched the relation and/or arguments of the propositionally analyzed question stems. Dr. Irwin-DeVitis noted that some propositions were not

matched exactly propositionally, but were matched synonymously. Dr. Irwin-DeVitis identified those propositions with brackets (< ...>). Examples of worksheets illustrating Dr. Irwin-DeVitis analysis are provided in Appendix D, and a copy of a letter from Dr. Irwin-DeVitis explaining her procedure is in Appendix A.

The results of Dr. Irwin-DeVitis's evaluation provided an identifiable number of propositions (e.g., 3) that were matched to the total number of propositions (e.g., 6) for each question stem. The ratio (e.g., 3/6) that resulted indicated the degree (e.g., 50 percent) of match between question stems and text passages. The ratios were converted to percentages to indicate the percentage of match between propositionally analyzed question stems and microstructures or macrolevel II texts. Table III-1 indicates the questions, question types, ratio of propositional match, and percentage of propositional match, ranked from no match to some match for the microstructure texts. Table III-2 indicates the questions, question types, ratio of propositional match, and percentage of propositional match, ranked from no match to some match for the macrolevel II texts.

Surface level match. Since the van Dijk and Kintsch (1983) model also assumes that a representation of the text itself is available in episodic memory, the researcher also sought evaluation of the degree of surface level match

TABLE III-1

QUESTIONS, QUESTION TYPE, RATIO OF PROPOSITIONAL MATCH, AND PERCENT OF PROPOSITIONAL MATCH, RANKED FROM NO MATCH TO SOME MATCH FOR THE MICROSTRUCTURES OF THE FOUR PASSAGES USED IN THE STUDY

	No Match to Some Match	
Question/Type	Ratio of Propositional Match	Percent of Propositional Match
11-Interpretive	3/3	100
12-Interpretive	3/3	100
15-Interpretive	3/3	100
16-Interpretive	3/3	100
23-Interpretive	3/3	100
20-Interpretive	5/6	83
19-Interpretive	3/4	75
13-Literal	2/3	66
10-Literal	4/7	57
17-Literal	2/4	50
24-Interpretive	3/6	50
22-Literal	1/3	33
18-Literal	1/4	25
14-Literal	2/8	25
21-Literal	1/5	20
9-Literal	1/5	20

TABLE III-2

QUESTIONS, QUESTION TYPE, RATIO OF PROPOSITIONAL MATCH, AND PERCENT OF PROPOSITIONAL MATCH, RANKED FROM NO MATCH TO SOME MATCH FOR THE MACROLEVEL IIS OF THE FOUR PASSAGES USED IN THE STUDY

	No Match to Some Match	
Question/Type	Ratio of Propositional Match	Percent of Propositional Match
11-Interpretive	3/3	100
12-Interpretive	3/3	100
15-Interpretive	3/3	100
16-Interpretive	3/3	100
20-Interpretive	6/6	100
23-Interpretive	3/3	100
24-Interpretive	5/6	83
19-Interpretive	3/4	75
17-Literal	3/4	75
10-Literal	5/7	71
13-Literal	2/3	66
21-Literal	3/5	60
9-Literal	3/5	60
22-Literal	1/3	33
14-Literal	2/8	25
18-Literal	1/4	25

between test questions and test passages. It was anticipated that the degree of surface level match would further substantiate an explicit text level and perhaps help distinguish any differences between surface level and propositionally analyzed text levels.

Dr. Aydelott, a reading educator, and two doctoral students in reading assisted with the task. Each participant was given a copy of question stems with answers indicated and the test passages, and a copy of a worksheet. The worksheet asked the participants to evaluate each question, e.g., question 9, in terms of the number of words in the question stem that matched words in the test passage. Participants were asked to restrict question/text matches to stems of questions to single sentences of test passages. Six categories, denoting a range of possible matches were provided the participants. The categories were 0, 1-5, 6-10, 11-15, 16-20 and 21-25. The ultimate range of 21-25 words had been determined a priori by the researcher as a potential number of matches. Each participant marked and returned the worksheet to the researcher. Examples of worksheets detailing participants' responses are in Appendix D.

When all worksheets were returned, the numbers indicated as the number of word matches for each question by the participants were averaged by the researcher. Table III-3 indicates the questions, the number of word

TABLE III-3

QUESTIONS, NUMBER OF MATCHES REPORTED, AND AVERAGE OF WORD MATCHES FOR THE FOUR PASSAGES USED IN THE STUDY

Questions	Number of Matches Reported	Average
9	5, 7, 7	6.33
10	2, 3, 4	3.00
11	0, 0, 0	0.00
12	0, 0, 0	0.00
13	2, 2, 2	2.00
14	11, 13, 30	18.00
15	0, 0, 0	0.00
16	0, 0, 0	0.00
17	2, 2, 2	2.00
18	2, 7, 11	6.66
19	0, 0, 0	0.00
20	0, 3, 2	1.66
21	0, 7, 7	4.66
22	4, 4, 3	3.66
23	0, 0, 0	0.00
24	2, 2, 3	2.33

matches noted by each participant and the resulting average of noted word matches. Table III-4 shows the data derived from the surface level match between question stems and text pages ranked from no match to some match.

The researcher now had data for three levels of text--the surface level, the microstructure, and the macrolevel II--that revealed the degree of match between the questions of test passages and the three text levels. All three levels of text were organized from degree of no match to some match. The hierarchies that resulted were divided roughly by thirds (five questions at the top, six questions from the middle, and five questions at the bottom). The five questions at the top of the hierarchies and the five questions at the bottom of the hierarchies were used to investigate the hierarchical position of propositions.

Imagery

To investigate the effect of imagery on the comprehension of good and poor readers, the imagery level of the four passages used in the study had to be determined. The Terwilliger and Kolker (1985) a priori rating scales, a program for assessing imagery level by feeding text into a computer, was used. The text fed into the computer is matched against dictionaries (19) of words classified according to three categories of imagery. Terwilliger and Kolker (1985) developed their rating scales by reviewing the

TABLE III-4

QUESTION, QUESTION TYPE, AND AVERAGE NUMBER OF WORDS MATCHED BETWEEN QUESTIONS AND THE FOUR PASSAGES USED IN THE STUDY RANKED FROM NO MATCH TO SOME MATCH

Question	Question Type	Average Number of Words Matched--From No Match To Some Match
11	Interpretive	0
12	Interpretive	0
15	Interpretive	0
16	Interpretive	0
23	Interpretive	0
19	Interpretive	0
20	Interpretive	1.66
13	Literal	2.00
17	Literal	2.00
24	Interpretive	2.33
10	Literal	3.00
22	Literal	3.66
21	Literal	4.66
14	Literal	6.33
18	Literal	6.66
9	Literal	18.00

lists of words established by Paivio et al. (1968) and Toglia and Battig (1978). They collapsed the Paivio et al. (1968) seven point scale and the Toglia and Battig (1978) eight point scale into a three category--low (1.0 to 3.9), middle (4.0 to 5.9), and high (6.0 to 7.0)--rating system for evaluating the imagery level of words in text. Terwilliger and Kolker (1985) counted words occurring on both lists only once. The rating scale matched, as well, words based on different parts of speech: nouns, verbs, adverbs, adjectives, pronouns, prepositions and conjunctions.

The analysis program developed by Terwilliger and Kolker (1985) was written in the C language and run on a VAX computer under the VMS operating system. Passages used in the study were given numerical designations for input into the computer program. Those numerical designations correspond to the passages in the text as: 500 (passage two), 501 (passage three), 503 (passage four), and 504 (passage five). The computer program ascertained the number of matches for each category of words (part of speech and imagery rating) in the dictionaries. The matched data were used to derive a ratio of high to low imagery words for each passage. The passages were then ranked by the ratios. The passage with the highest ranking imagery ratio and the passage with the lowest imagery ranking ratio were used in the study. Dr. Kolker acted as a consultant to this

researcher on the imagery data. She reviewed this researcher's data and procedure. Dr. Kolker indicated that the degree of difference between the high imagery and low imagery passages was acceptable.

Statistical Analysis of Data

This investigation was concerned with the effect of three textual variables--number of propositions, hierarchical position of propositions, and imagery--on good and poor readers' comprehension as measured by literal and interpretive multiple choice questions.

Scores on the NDRT were used to establish a good readers group (7, 8, 9 stanines) and a poor readers group (1, 2, 3 stanines). Eleven (11) subjects comprised the good readers group and eighteen (18) subjects comprised the poor readers group. Thus, twenty-nine (29) subjects participated in the study. Subjects correct responses to literal and interpretive questions was the independent variable.

Four passages from the NDRT were analyzed to establish the dependent variable data (number of propositions, and hierarchical position of propositions, and imagery level) for the study. The passage with the largest number of propositions and the passage with the smallest number of propositions were used to investigate the effect for number of proposition on the literal comprehension of good and poor

readers, and then the interpretive comprehension of good and poor readers.

To investigate for hierarchical position of propositions, propositions of question stems were matched with propositions of the textbase and the macrolevel II texts. The ratios of match were converted to percentages and then ranked from a high of no match to a low of some match. The responses of good and poor readers to the five questions (interpretive) from the top of the hierarchy and the responses of good and poor readers to the five questions (literal) from the bottom of the hierarchy were used in the study.

Effect for imagery level of passages read on the literal comprehension of good and poor readers and then on the interpretive comprehension of good and poor readers was investigated in this study by using the passage determined to have the highest imagery ratio and the passage determined to have the lowest imagery ratio.

Data were placed in 2 X 2 tables and a chi-square test of analysis was carried out to determine if observations differed significantly from what one would expect according to chance. Since the study is not predicting a change in any specific direction, the two-tailed test at the .05 level of significance with one degree of freedom is used; thus, a chi-square value equal to or larger than 3.841 ($p \leq .05$) is needed in order to have a significant difference between

literal and interpretive questions as a result of number of propositions, the hierarchical position of propositions, and imagery level of passage read. Data in this study are nominal and/or ordinal and chi-square is considered appropriate for any level of measurement (Champion, 1970).

CHAPTER IV

DATA PRESENTATION AND ANALYSIS

The purpose of the present study was to investigate the effects of three text variables--number of propositions, hierarchical position of propositions, and imagery level--on good and poor readers comprehension as measured by literal and interpretive multiple choice questions.

The null hypotheses to be tested were:

1. There will be no significant ($p \leq .05$) difference between the responses of good and poor college readers as measured by literal and interpretive multiple choice questions.

2. There will be no significant ($p \leq .05$) difference between the literal responses of good and poor college readers as a function of the number of propositions of passage read.

3. There will be no significant ($p \leq .05$) difference between the interpretive responses of good and poor college readers as a function of number of propositions of passage read.

4. There will be no significant ($p \leq .05$) difference between the responses of good and poor college readers as a function of the match (hierarchical position) between question stems and passages read.

5. There will be no significant ($p \leq .05$) difference between the literal responses of good and poor college readers as a function of the imagery level of passages read.

6. There will be no significant ($p \leq .05$) difference between the interpretive responses of good and poor college readers as a function of the imagery level of passages read.

Subject and Passage Determination

In August and September 1989 and in January 1990, The Nelson-Denny Reading Test, Form E, (NDRT) was administered to 151 University of Tennessee, Knoxville, students. Because the sample was restricted to students eighteen (18) years of age so that parental consent would not be necessary, eleven (11) potential subjects were eliminated from inclusion in the study. From the remaining 140 potential subjects, two groups were desired. One group was good comprehenders with scores on the NDRT in the high stanines--7, 8, or 9. The second group was poor comprehenders with scores on the NDRT in the low stanines--1, 2, or 3. Of the 140 subjects, forty-seven (47) were eligible for inclusion in the study, thirty-six (36) for the poor comprehenders' group and eleven (11) for the good comprehenders' group. Of the forty-seven subjects, seven were excluded: four did not grant permission, one responded to the wrong questions, and two were graduate students and graduate norms for scoring are

not provided with the NDRT. Of the twenty-nine (29) remaining subjects in the poor comprehenders group, many had not completed the test. In order to have a sample size greater than twenty (20), passage usage was restricted to passage five. This restriction resulted in eighteen (18) subjects being eligible for inclusion in the poor comprehenders group. Thus, twenty-nine (29) subjects, eleven (11) for the good comprehenders group and eighteen (18) for the poor comprehenders group, comprised the study population.

Further consideration of test materials revealed that passage number one differed in both passage length and passage type from passages two through five. In order to maintain consistency in materials, passage use was restricted to passages two through five. Each of these four passages was tested with four multiple choice questions, two literal and two interpretive. Responses to the sixteen (16) questions (eight literal and eight interpretive) were the dependent variable in this study.

Preparation of the Data

Preparation of the data consisted of: (1) determining correct responses to literal and interpretive questions for both good and poor readers, (2) determining the passage with the greatest number of propositions and the passage with the

least number of propositions; then, determining correct responses to literal and interpretive questions for good and poor readers for the passage with the largest number of propositions and the passage with the smallest number of propositions and then determining the correct responses to interpretive questions for good and poor readers for the passage with the largest number of propositions and the passage with the smallest number of propositions,
(3) determining questions at the top and the bottom of the textbase, macrolevel II, and surface level texts; then, determining correct responses to the five questions matched at the top level of the textbase and macrolevel II texts and correct responses to the five questions matched at the bottom level of the textbase and macrolevel II texts,
(4) determining the passage with the highest imagery ranking ratio and the passage with the lowest imagery ranking ratio; then, determining correct responses to the literal questions of good and poor readers for the passage with the highest rank and then determining the number of correct responses to interpretive questions for good and poor readers for the passage with the lowest rank.

Correct Responses

To investigate for differences in the literal and interpretive responses of good and poor readers, correct responses to literal and interpretive questions for good

readers and poor readers was determined. For good comprehenders, 176 correct responses were possible. Good comprehenders answered 86/88 (97.72 percent) literal questions correctly and answered 76/88 (86.63 percent) interpretive questions correctly. Poor comprehenders answered 131/144 (90.97 percent) literal questions correctly and answered 75/144 (52.08 percent) interpretive questions correctly. Table IV-1 indicates the number of correct responses for literal questions for good and poor readers, the number of correct responses for interpretive questions for good and poor readers, and the totals of correct responses for literal and interpretive questions for good and poor readers.

A consideration of the data revealed that poor students answered a smaller percentage of both literal and interpretive questions correctly than good comprehenders answered. Poor readers, however, answered a much smaller percentage (52.08 percent) of interpretive questions than the good comprehenders (86.63 percent).

Number of Propositions

The propositional analysis of the four test passages yielded data important to the study. From the analysis, the researcher determined which passage had the greatest number of propositions and which passage had the least number of propositions. With this data, passages were ranked from high

TABLE IV-1

NUMBER OF CORRECT RESPONSES FOR LITERAL AND INTERPRETIVE QUESTIONS FOR GOOD AND POOR COMPREHENDERS

	Literal			Interpretive	
	Good	Poor		Good	Poor
P/Q#			Q#		
2 9	11	18	11	11	12
10	11	16	12	10	15
3 13	11	17	15	9	7
14	9	15	16	11	8
4 17	11	18	19	10	6
18	11	17	20	9	7
5 21	11	15	23	9	11
22	11	15	24	7	9
Totals	86	131		76	75

P=Passage, Q=Question

to low. Passage number four was determined to have the greatest number of propositions and was, thus, ranked highest. Passage number two was determined to have the smallest number of propositions and was, thus, ranked lowest. Table IV-2 indicates the number of propositions and the resulting rank for each passage used in the study.

Additional preparation of the data involved determining the correct responses to the literal questions of good and poor readers for the passage with the largest number of propositions and the passage with the least number of propositions and, then, determining the correct responses to the interpretive questions of good and poor readers for the passage with the largest number of propositions and the passage with the smallest number of propositions.

Passage four was determined to have the largest number of propositions. Questions 17 and 18 were identified as the literal questions and questions 19 and 20 were identified as the interpretive questions. Good readers answered 22/22 (100 percent) literal questions correctly; poor readers answered 35/36 (97.22 percent) literal questions correctly. Good readers answered 19/22 (86.36 percent) interpretive questions correctly; poor readers answered 13/36 (36.11 percent) interpretive questions correctly. Passage two was determined to have the smallest number of propositions. Questions 9 and 10 were identified as the literal questions and questions 11 and 12 were identified as

TABLE IV-2

NUMBER OF PROPOSITIONS AND RANK
FOR EACH PASSAGE USED
IN THE STUDY

Passage	Number of Propositions	Rank High to Low
500 (two)	85	4
501 (three)	92	2
503 (four)	109	1
504 (five)	89	3

the interpretive questions. Good readers answered 22/22 (100 percent) literal questions correctly; poor readers answered 34/36 (94.44 percent) literal questions correctly. Good readers answered 21/22 (95.45 percent) interpretive questions correctly; poor readers answered 27/36 (75 percent) interpretive questions correctly. Table IV-3 indicates the number of correct literal and interpretive responses for the passage ranked high in number of propositions and the passage ranked low in number of propositions for good and poor comprehenders.

A consideration of the data revealed no difference (100 percent) on literal questions in the literal responses of good readers for passages ranked high and low in number of propositions. Poor readers, on the other hand, performed slightly better on literal questions on the passage with the large number of propositions (97.22 percent) than on the passage with the low number of propositions (94.44 percent). For interpretive questions, good readers performed slightly better on the passage with the low number of propositions (95.45 percent) than on the passage with the high number of propositions (86.36 percent). Poor readers, on the other hand, performed much better on the passage with the low number of propositions (75 percent) than on the passage with the high number of propositions (36.11 percent). Although both good and poor readers performed less well on interpretive questions, poor readers performed poorly on the

TABLE IV-3

NUMBER OF CORRECT LITERAL AND INTERPRETIVE RESPONSES FOR A PASSAGE RANKED HIGH AND A PASSAGE RANKED LOW IN NUMBER OF PROPOSITIONS FOR GOOD AND POOR COMPREHENDERS

	Literal			Interpretive	
	Good	Poor		Good	Poor
Question			Question		
Passage 4--high					
17	11	18	19	10	6
18	11	17	20	9	7
Totals	22	35		19	13
Passage 2--low					
9	11	18	11	11	12
10	11	16	12	10	15
Totals	22	34		21	27

interpretive questions for the passage ranked high in number of propositions.

In summary, number of propositions had differential effects on good and poor comprehenders' responses to literal and interpretive questions. Both good and poor comprehenders missed more interpretive questions, but poor comprehenders performed more poorly on interpretive questions than good comprehenders. With good comprehenders, performance was the same on the passages high and low in number of propositions with literal questions; with poor comprehenders, performance was slightly better on the passage high in number of propositions with literal questions. With good comprehenders, performance was slightly better for the passage ranked low in number of propositions for interpretive questions; with poor comprehenders, performance was better on the passage low in number of propositions for interpretive questions. Poor comprehenders had a great deal of difficulty (36.11 percent) with interpretive questions for the passage ranked high in number of propositions.

Hierarchical Position of Propositions

The propositional matching of questions and test passages and the surface level match of questions and test passages yielded data important to the study. The ratios derived from the matches were converted to percentages and ranked from degree of no match to some match for questions

and texts. Ranking the three levels of text (textbase, macrolevel II, and surface level) from no match to some match resulted in an hierarchical ordering of test questions.

A comparison of question hierarchies derived from the three levels of text--surface level, textbase, and macrolevel II--appears in Table IV-4. Table IV-4 shows the data organized from level of no match to some match for surface level text first. The columns for textbase and macrolevel II texts indicate their data in accordance with the hierarchy established by the surface level text.

The hierarchies were divided roughly by thirds (five questions at the top, six questions from the middle, and five questions at the bottom). The questions at the top and the bottom were basically the same hierarchically. A * is used to indicate the questions in the bottom of the macrolevel II column which are different hierarchically in degree of match between question stems and test passages. The five questions at the top and the five questions at the bottom across the three levels of text in the top third of the hierarchy possessed the same degree of match (no match--100 percent). The five questions at the top of the hierarchy were interpretive and the five questions at the bottom of the hierarchy were literal.

Additional preparation of the data involved determining responses to the five interpretive questions that comprised

TABLE IV-4

A COMPARISON OF QUESTION HIERARCHIES DERIVED FROM THREE LEVELS OF TEXT--SURFACE TEXTBASE, AND MACROLEVEL II FROM NO MATCH TO SOME MATCH

Question	Surface-ave.	Textbase-%	Macrolevel II-%
11	0	100	100
12	0	100	100
15	0	100	100
16	0	100	100
23	0	100	100
19	0	75	75
19	1.66	83	100
13	2.00	66	66
17	2.00	50	75
24	2.33	50	83
10	3.00	57	71
22	3.66	33	33
18	4.66	25	25
14	6.33	25	25
21	6.66	20	60*
9	18.00	20	60*

*Indicates difference in hierarchical position from surface and textbase levels of text.

the top of the hierarchy for good and poor readers and determining responses to the five literal questions that comprised the bottom of the hierarchy for good and poor readers. Questions 11, 12, 15, 16, and 23 were identified as the questions at the top of the hierarchy with no match to the textbase and macrolevel II texts. Questions from passage two, three, and five are represented in the top of the hierarchy. Good comprehenders answered 50/55 (90.90 percent) of the questions correctly. Poor readers answered 53/90 (58.88 percent) correctly. Questions 22, 18, 14, 21, and 9 were identified as the questions at the bottom of the hierarchy with some match to the textbase and macrolevel II texts. Questions from passage two, three, four and five are represented in the bottom of the hierarchy. Good comprehenders answered 51/55 (92.72 percent) of the questions correctly. Poor comprehenders answered 80/90 (88.88 percent) of the questions correctly. Table IV-5 indicates correct responses for questions with no match identified as the top of the hierarchy for good and poor readers and correct responses for questions with some match identified as the bottom of the hierarchy for good and poor readers.

A consideration of the data revealed that good and poor readers both answered a large number of questions from the bottom of the hierarchy. However, good comprehenders answered many more top level questions (92.72 percent vs

TABLE IV-5

RESPONSES OF GOOD AND POOR READERS TO FIVE QUESTIONS FROM THE TOP AND FIVE QUESTIONS FROM THE BOTTOM OF THE THREE TEXT HIERARCHIES

Questions	Good Readers	Poor Readers
Top		
11	11	10
12	10	15
15	9	7
16	11	8
23	9	11
Totals	50	53
Bottom		
22	11	15
18	11	17
14	9	15
21	11	15
9	11	18
Totals	51	80

58.88 percent) correctly than poor comprehenders.

Preparing the match between propositionally analyzed question stems and propositionally analyzed test passages revealed a hierarchical ordering of question/text matches from interpretive to literal for the macrolevel II text, and with the exception of question 24, for the textbase and surface level texts (see Table III-4). This question (an interpretive) received more incorrect responses from good readers than all the other questions; seven out eleven (7/11) good readers answered the question correctly. A possible explanation for the good comprehenders' performance was found in analyzing the question and text passage relationship. Although question 24 is classified as an interpretive question, the correct answer to the question was a verbatim phrase from the test passage. It is possible that good comprehenders were using an "inference superstructure" and, thereby, rejected the verbatim answer.

A ranking of good and poor readers' correct responses to the sixteen questions from most missed to least missed revealed a different pattern of error for good and poor readers (see Table IV-6). For poor readers, the hierarchical ordering of missed questions was identical to the hierarchical ordering derived for the match between questions and test passages. For good comprehenders, however, the rank ordering was different in terms of two questions, question 24 and question 14. An explanation for

TABLE IV-6

RANKING OF GOOD AND POOR READERS RESPONSES
FOR LITERAL AND INTERPRETIVE QUESTIONS
FROM NO ERRORS TO SOME ERRORS

Q/Type/#Errors--Good			Q/Type/#Errors--Poor		
9	L	0/11	9	L	0/18
10	L	0/11	17	L	0/18
13	L	0/11	18	L	1/18
17	L	0/11	13	L	1/18
18	L	0/11	10	L	2/18
21	L	0/11	14	L	3/18
22	L	0/11	21	L	3/18
11	I	0/11	22	L	3/18
16	I	0/11	12	I	3/18
19	I	1/11	11	I	6/18
12	I	1/11	23	I	7/18
14	L	2/11	24	I	9/18
20	I	2/11	16	I	10/18
23	I	2/11	15	I	11/18
15	I	2/11	20	I	11/18
24	I	4/11	19	I	12/18

Q=Questions, L=Literal, I=Interpretive

the errors for question 24 has already been offered. For question 14, an analysis of the data revealed that this question was the only literal question missed by good comprehenders. A consideration of the relationship between the question and the test passage revealed that the question stem had more words (22) and propositions (8) than any of the other question stems. Perhaps the two good readers that missed the question were unable to hold the propositions, or gist of the propositions, in working memory and search episodic memory for the appropriate propositional match.

In summary, a consideration of the data related to hierarchical order of propositions revealed little difference between the responses of good and poor readers answering literal multiple choice questions at the bottom of the hierarchy. On the other hand, good comprehenders performed much better on interpretive questions at the top of the hierarchy. A ranking of questions missed for good and poor comprehenders from questions most missed to questions least missed revealed that poor readers' errors formed the same hierarchical ordering as the match between questions and test passages for the textbase and macrolevel II texts. However, the hierarchical ranking of good readers' missed questions was different, with questions 24 and 14 having a different hierarchical position.

Imagery Level

Analysis of the imagery level of test passage using the computer program developed by Terwilliger and Kolker (1985) yielded data important to the study. The computer program determined matches between the words of the test passages and the words (categorized by part of speech and imagery rating) in the nineteen dictionaries of the computer program. Using the matched data, a ratio of high to low imagery words was determined for each passage. The passages were then ranked by the ratios. Passage number five, a social science passage, had the highest imagery ranking and passage number four, a science passage, had the lowest imagery ranking. Table IV-7 shows the imagery ratings, ratios and ranking for the four passages.

Additional preparation of the data involved determining the correct responses to literal questions for good and poor readers for passage five ranked highest in imagery level and for passage four ranked lowest in imagery level and, then, determining the correct responses to interpretive questions for good and poor readers for passage five ranked highest in imagery level and for passage four ranked lowest in imagery level. Questions 21 and 22 were identified as literal questions and questions 23 and 24 were identified as interpretive questions for passage five. Good readers answered 22/22 (100 percent) literal questions correctly; poor readers answered 30/36 (83.33 percent) literal

TABLE IV-7

IMAGERY RATINGS, RATIOS AND RESULTING
RANK OF THE FOUR PASSAGES
USED IN THE STUDY

Passage	High Imagery Rating	Medium Imagery Rating	Low Imagery Rating	Ratio	Resulting Rank
500 (two)	3	43	45	1:15.0	2
501 (three)	5	28	100	1:20.0	3
503 (four)	3	39	79	1:26.3	4
504 (five)	7	25	86	1:12.3	1

questions correctly. Good readers answered 16/22 (72.72 percent) interpretive questions correctly; poor readers answered 20/36 (55.55 percent) questions correctly.

Questions 17 and 18 were identified as literal questions and questions 19 and 20 were identified as interpretive questions for passage four. Good readers answered 22/22 (100 percent) literal questions correctly; poor readers answered 35/36 (97.22 percent) literal questions correctly. Good readers answered 19/22 (86.36 percent) interpretive questions correctly; poor readers answered 13/36 (36.11 percent) interpretive questions correctly. Table IV-8 indicates the correct literal and interpretive responses for passage five (high imagery) for good and poor comprehenders and the correct literal and interpretive responses for passage four (low imagery) for good and poor comprehenders.

A consideration of the imagery data revealed that good readers had no difficulty with literal questions of high and low imagery passages--100 percent for both. However, poor readers performed better on the low imagery literal questions (97.22 percent) as opposed to the high imagery literal questions (83.33 percent). Good readers performed similarly to poor readers for literal questions on interpretive questions. Good readers answered more interpretive questions (86.36 percent) correctly from the low imagery passage than from the high imagery passage

TABLE IV-8

NUMBER OF CORRECT LITERAL AND INTERPRETIVE RESPONSES FOR A PASSAGE RANKED HIGH AND A PASSAGE RANKED LOW IN IMAGERY FOR GOOD AND POOR COMPREHENDERS

	Literal			Interpretive	
	Good	Poor		Good	Poor
Question			Question		
Passage 5--high					
21	11	15	23	9	11
22	11	15	24	7	9
Totals	22	30		16	20
Passage 4--low					
17	11	18	19	10	6
18	11	17	20	9	7
Totals	22	35		19	13
	44	65		35	33

(72.72 percent). Poor readers, on the other hand, did not perform better on low imagery interpretive questions; instead, poor readers performed poorly (36.11 percent). Poor readers' performance on high imagery interpretive questions was better (55.55 percent) but still poor.

In summary, differential patterns were found between good and poor students answering literal and interpretive questions on passages ranked high and low in imagery. Poor readers performed better on literal questions for the low imagery passages; whereas their performance on interpretive questions was better for the high imagery passage. Good readers had no difficulty with literal questions, high or low; but they had more difficulty with high imagery interpretive questions than with low imagery interpretive questions.

Preparation of the data further revealed that passage four with the lowest imagery rating also was determined to be the passage with the largest number of propositions. This finding suggests that results of analysis and data testing will be confounded when passage four is a consideration.

Statistical Analysis of Data

The chi-square test for two independent samples was carried out for each null hypothesis. All data determined in the study was either nominal or ordinal and the chi-square

is an appropriate statistic for evaluating data at any level (Champion, 1970). Since direction of change was not specified, the two-tailed test at the .05 level of significance with one degree of freedom was used for determining the critical value of chi-square. Thus, a chi-square equal to or larger than 3.841 was necessary to have a significant difference between the observed values and what would be expected by chance.

Analysis of the Differences between Observed and Expected Literal and Interpretive Responses of Readers (Good and Poor) as a Result of Number of Propositions, Hierarchical Position of Propositions, and Imagery Level

This investigation was concerned with the effect of three textual variables--number of propositions, hierarchical position of propositions, and imagery level--on good and poor readers comprehension as measured by literal and interpretive multiple choice questions. One hypothesis under investigation was whether there are differences in the literal and interpretive responses of good and poor college readers for the four passages (16 questions) being investigated for textual effects in this study. Table IV-9 indicates the observed responses for literal and interpretive questions for good and poor readers. Chi-square analysis yielded a value of 4.136 ($p < .05$), which is greater than the critical value (3.841) regarded as the

TABLE IV-9

LITERAL AND INTERPRETIVE RESPONSES OF GOOD AND POOR COMPREHENDERS

	Responses Literal/Interpretive		
Good Comprehenders	86	76	162
Poor	131	75	206
	217	151	368

$\chi^2 = 3.841$ ($p < .05$)

level of significance used to test the hypothesis, and the null hypothesis was rejected.

To determine the effect of number of propositions on literal and interpretive comprehension of good and poor readers, correct responses for literal and interpretive questions for good and poor readers for the passage ranked high (number four) in number of propositions and then for the passage ranked low (number two) in number of propositions were determined (see Table IV-2).

To determine if number of propositions affected the literal comprehension of good and poor college readers differently, correct responses to literal questions for the passage ranked high and the passage ranked low in number of propositions for good and poor readers were placed in a 2 X 2 table (see Table IV-10). Chi-square analysis yielded a value of .188 ($p > .05$), which is less than the critical value (3.841) regarded as the level of significance used to test the hypothesis, and the null hypothesis was not rejected.

To determine if number of propositions affected the interpretive comprehension of good and poor college readers differently, correct responses to literal questions for the passage ranked high and the passage ranked low in number of propositions for good and poor readers were placed in a 2 X 2 table (see Table IV-11). Chi-square analysis yielded a value of 1.875 ($p > .05$), which is less than the critical

TABLE IV-10

NUMBER OF CORRECT LITERAL RESPONSES OF GOOD AND POOR COMPREHENDERS FOR PASSAGE RANKED HIGH AND PASSAGE RANKED LOW IN NUMBER OF PROPOSITIONS

	Number of Propostions		
	High	Low	
Good	22	20	42
Literal Comprehension			
Poor	30	32	62
	52	52	104

$\chi^2 = 3.841$ ($p < .05$)

TABLE IV-11

NUMBER OF CORRECT INTERPRETIVE RESPONSES OF GOOD AND POOR COMPREHENDERS FOR PASSAGE RANKED HIGH AND PASSAGE RANKED LOW IN NUMBER OF PROPOSITIONS

	Number of Propostions		
	High	Low	
Good	16	20	36
Interpretive Comprehension			
Poor	20	15	35
	36	35	71

$\chi_2 = 3.841$ ($p < .05$)

value (3.841) regarded as the level of significance used to test the hypothesis, and the null hypothesis was not rejected.

To determine if hierarchical position of propositions affected the comprehension of good and poor college readers differently, the correct responses for the five questions (interpretive) matched at the top level of the textbase and macrolevel II texts for good and poor readers were determined. Then, correct responses for the five questions (literal) matched at the bottom level of the textbase and macrolevel II texts for good and poor readers were determined (see Table IV-5). Table IV-12 indicates the number of correct responses for the questions from the top and the questions from the bottom for good and poor readers in a 2 X 2 table. Chi-square analysis yielded a value of 2.171 ($p > .05$), which is less than the critical value (3.841) regarded as the level of significance used to test the hypothesis, and the null hypothesis was not rejected.

To determine the effect of imagery level on literal and interpretive comprehension of good and poor readers, the correct literal and interpretive responses of good and poor readers for the passage ranked high in imagery and the passage ranked low in imagery were determined (see Table IV-8). The data were evaluated to establish the number of correct literal responses of good and poor readers for passages ranked high and low in imagery. Table IV-13

TABLE IV-12

NUMBER OF CORRECT RESPONSES FOR QUESTIONS (INTERPRETIVE) FROM THE TOP AND FOR QUESTIONS (LITERAL) FROM THE BOTTOM FOR GOOD AND POOR COMPREHENDERS

	Top (Interpretive)	Bottom (Literal)	
Good Readers	50	51	101
Poor Readers	53	80	133
	103	131	234

$\chi^2 = 3.841$ ($p < .05$)

TABLE IV-13

NUMBER OF CORRECT LITERAL RESPONSES OF GOOD AND POOR COMPREHENDERS FOR PASSAGE RANKED HIGH AND PASSAGE RANKED LOW IN IMAGERY

	Imagery Level		
	High	Low	
Good	22	22	44
Literal Comprehension			
Poor	30	35	65
	52	57	109

$\chi^2 = 3.841$ ($p < .05$)

indicates the literal responses of good and poor readers on passages ranked high and low in imagery in a 2 X 2 table. Chi-square analysis yielded a value of .154 ($p > .05$), which is less than the critical value (3.841) regarded as the level of significance used to test the hypothesis, and the null hypothesis was not rejected.

The data in Table IV-8 were further evaluated to establish the number of correct interpretive responses of good and poor readers for passages ranked high and low in imagery. Table IV-14 indicates the interpretive responses of good and poor readers on passages ranked high and low in imagery in a 2 X 2 table. Chi-square analysis yielded a value of 1.350 ($p > .05$), which is less than the critical value (3.841) regarded as the level of significance used to test the hypothesis, and the null hypothesis was not rejected.

Summary of the Findings

This researcher, using the chi-square test for two independent samples with each null hypothesis, found that there was a significant difference in the literal and interpretive responses of good and poor readers and that the difference was, thus, greater than what one would expect by chance. A difference in literal and interpretive responses of good and poor readers was not found, however, for the

TABLE IV-14

NUMBER OF CORRECT INTERPRETIVE RESPONSES OF GOOD AND POOR COMPREHENDERS FOR PASSAGE RANKED HIGH AND PASSAGE RANKED LOW IN IMAGERY

	Imagery Level		
	High	Low	
Interpretive Comprehension: Good	16	19	35
Interpretive Comprehension: Poor	20	13	33
	36	32	68

$\chi^2 = 3.841$ ($p < .05$)

three text effects under investigation in this study: number of propositions, hierarchical position of propositions, and imagery level of text.

CHAPTER V

SUMMARY, CONCLUSIONS AND IMPLICATIONS

This chapter contains a summary of the study, conclusions based upon the findings of the study, implications for theoretical models of comprehension, as well as implications for testing reading comprehension, for developing instructional models, and for reading research.

General Summary

Although assessment is a pervasive practice in American society, it is not without its criticism. It is felt, for example, that the standardized assessment of reading comprehension does not reflect new knowledge about the processes of comprehension. This new knowledge considers comprehension to involve an interaction between the text and the reader, or an interaction between the text, the reader, and the writer of the text. This interactive approach to reading has resulted in a need to investigate the effects of various dimensions of assessment: the text, the reader, the task, and the context in which testing occurs.

Recent advancements in models of reading have addressed the comprehension process. One such model is the Strategies of Discourse Comprehension by van Dijk and Kintsch (1983).

This model, known for its ability to simulate comprehension, represents text at both micro- and macrolevels with propositions. A third propositional level of text, the situation model, is a representation of text that includes the inferences which enable integration of the text and the reader's knowledge from semantic or long term memory. The various levels of text are assumed to reside in episodic memory. A recognition of an imagery component to comprehension is acknowledged via elaborative inferences and the situation model. A limited capacity working memory aids in the processing of information. Comprehension is achieved by the operation of strategies. Retrieval of information plays a crucial rôle in comprehension, for the assumption is that the retrieval cue must match at least partially the memory trace. The Kintsch models (Kintsch, 1974; Kintsch and van Dijk, 1978; van Dijk and Kintsch, 1983) are concerned with semantics and do not attempt to represent the various decoding components of language. The van Dijk and Kintsch (1983) model, with its ability to simulate comprehension, has been used to investigate various text effects, including number of propositions, hierarchical position of propositions, and imagery level.

Although a role for imagery is acknowledged with the van Dijk and Kintsch (1983) model, the model of Paivio (1986) is distinguished by its assumption that verbal and nonverbal information are coded by modality specific

subsystems. As such, the imagery value of text (i.e., its concreteness or abstractness) can differentiate encoding in memory. According to the theory, the stimulus cue (i.e., whether nonverbal or verbal) plays a crucial role in recall or comprehension. The assumption is that the stimulus cue must match one of the three memorial processes to activate recall or redintegration of the whole. However, Paivio's theory is not only distinguished from van Dijk and Kintsch's theory by the emphasis on the encoding and retrieval of nonverbal information, but also by the idea that nonverbal information is not coded propositionally. Thus, with Paivio's (1986) dual coding theory effects have been found with word tasks, with nonsignificant effects reported for some integrated texts.

With standardized tests of reading, multiple choice questions are most frequently used to evaluate a student's understanding of what has been read. Advancements in taxonomies for identifying levels of cognitive thinking tapped by questions have abetted an understanding of the comprehension process. Likewise, the taxonomy developed by Pearson and Johnson (1978) that describes the relationship between passages read and questions asked clarifies what information is needed to answer a question. These advancements in question/text relationships have abetted research into comprehension processes.

Research has further revealed that good and poor readers differ in terms of comprehension. Some of this difference has been attributed to differences in text factors, some in differences to reader characteristics, and some in differences to measurement tasks.

Statement of the Purpose

This study was designed to investigate the effect of three text variables--number of propositions, hierarchical position of propositions, and imagery--on the comprehension of good and poor readers as measured by literal and interpretive multiple choice questions.

The following null hypotheses were proposed:

1. There will be no significant ($p \leq .05$) difference between the responses of good and poor college readers as measured by literal and interpretive multiple choice questions.

2. There will be no significant ($p \leq .05$) difference between the literal responses of good and poor college readers as a function of the number of propositions of passage read.

3. There will be no significant ($p \leq .05$) difference between the interpretive responses of good and poor college readers as a function of number of propositions of passage read.

4. There will be no significant ($p \leq .05$) difference between the responses of good and poor college readers as a function of the match (hierarchical position) between question stems and passages read.

5. There will be no significant ($p \leq .05$) difference between the literal responses of good and poor college readers as a function of the imagery level of passages read.

6. There will be no significant ($p \leq .05$) difference between the interpretive responses of good and poor college readers as a function of the imagery level of passages read.

Subjects

The subjects were twenty-nine University of Tennessee, Knoxville college students enrolled in either Psychology of Statistics 385 (Psy 385) or Curriculum and Instruction, Efficient Reading and Study Skills, 141 (C&I 141). The University of Tennessee at Knoxville is a public, coeducational university located in the southeast which assesses its entrance difficulty as moderately difficult.

Based on the results of The Nelson-Denny Reading Test, Form E, (NDRT), which had been administered to students in C&I 141 as part of the course requirements and to students in Psy 385 by special permission of the instructor, two groups were established. One group was good readers and consisted of subjects whose scores were stanines 7, 8, or 9. The second group was poor readers and consisted of subjects

whose scores were stanines 1, 2, or 3. Eleven subjects comprised the good readers group and eighteen subjects comprised the poor readers group.

Preparation of Materials

Passages from the NDRT were used to investigate the three text variables. Because so few poor students had completed the test, passage use was restricted to passage five. This restriction enabled the researcher to have a sample size larger than twenty subjects. The elimination of passage six did not alter the imagery rankings and number of proposition rankings to be used in the study. Passage one of the test was also eliminated because it was different in word length (639 words) and type (narrative as opposed to expository). The remaining four passages were approximately 200 words in length and became the material for investigating text variables' effect on comprehension.

Each of the four passages was propositionally analyzed according to the procedures in Construction and Use of a Propositional Textbase (Turner and Greene, 1977). The microstructures or template textbases for the passages varied from 109-85 propositions. The passage with the largest number of propositions and the passage with the smallest number of propositions were used in the study.

After analysis of the passages for microstructures, the next step was preparation of the materials for investigating

the hierarchical position of propositions. First, the determination of macrostructures was carried out by asking two graduate students to summarize the four passages according to the guidelines of van Dijk and Kintsch (1983) and the suggestions of Brown and Day (1983). Differences were resolved by selecting instances of greater generality over detail. After macrostructures were determined, the researcher analyzed each of the macrotexts propositionally according to the Turner and Greene (1977) manual. The macrostructures varied in propositions from 25-16. After macrostructures were prepared, the next step was the matching of question stems to test passages.

Dr. Irwin-DeVitis matched propositionally analyzed question stems prepared by the researcher with the propositions of the microstructure and macrostructure texts. Ratios were determined by the researcher and converted to percentages. Questions were then ranked by the percentages. Five question stems were determined to have no match with the microstructure or macrostructure texts at the top of the hierarchy. Five questions at the bottom of the hierarchy were determined to have some match. Matches at the lower level varied from a match of 66 to 80 percent for the textbases and a match of 40 to 75 percent for the macrolevel II texts. The five questions at the top of the hierarchy were interpretive and the five questions at the bottom were literal according to the test developer's definition (Brown

et al., 1980). The match of question stems to test passages was consistent with the taxonomy of Pearson and Johnson (1978) which was used to describe the relationship between questions and passages.

Finally, to distinguish between a surface level match of question stems and test passages and the propositional match of question stems to propositionally analyzed test passages, two graduate students and Dr. Aydelott, a reading educator, provided data for the number of words matched between question stems and test passages. The indicated number of word matches were averaged by the researcher and ranked from degree of no match to degree of some match. The same five questions were determined to have no surface level match at the top of the hierarchy as the questions propositionally matched to texts, and the same five questions were determined to have some surface level match at the bottom of the hierarchy as the questions propositionally matched to texts.

The imagery level of the four passages was also determined to investigate for high and low imagery effect. The passages were fed into a computer program developed by Terwilliger and Kolker (1985). Words in the passages were matched to nineteen dictionaries of words classified according to three levels of imagery: high, medium and low. The matched data were used to derive a ratio of high to low imagery words for each passage. The passages were then

ranked by the ratios. The ratios varied from 1:12.3 to 1:26.3.

Validation

Validation of propositional analysis was carried out by sending Dr. Irwin-DeVitis, a researcher familiar with the Turner and Greene (1977) method of propositional analysis, a copy of passage five propositionally analyzed. Dr. Irwin-DeVitis indicated an agreement of 84 percent between her analysis and this researcher's. She also indicated that the degree of agreement was acceptable. Because of Dr. Irwin-DeVitis's experience with propositional analysis, she was also asked to evaluate the propositional match between questions and test passages. She indicated that there was little difficulty with no match and complete match categories. Because Dr. Irwin-DeVitis felt that some propositions were conceptually synonymous, she used a special designation (<...>) and placed such propositions under both the partial and complete categories. Consistent with the dichotomous approach to data used with this study, two categories were determined--no match and some match--by this researcher.

Procedures

Good and poor readers' responses to literal and interpretive questions were calculated first. Then, the

literal responses for good and poor readers were determined for: the passage high in number of propositions, the passage low in number of propositions, the passage high in imagery level, and the passage low in imagery level. This same procedure was carried out for the interpretive question responses of good and poor readers. For the hierarchical position of proposition variable, good and poor readers' responses to the five questions at the top of the hierarchy were determined, then good and poor readers' responses to the five questions at the bottom of the hierarchy were determined.

Findings

The data of this study were subjected to chi-square analysis. Results were considered significant if chi-square values were equal to or greater than 3.841 ($p \leq .05$) with a two-tailed test and one degree of freedom. The independent variables were number of propositions (high and low), hierarchical position of propositions (high and low), and imagery level (high and low). The dependent variable was the number of correct responses of good and poor readers to literal and interpretive questions. The chi-square value (4.136) for hypothesis one was significant at the .05 level and therefore the null hypothesis was rejected. Findings for hypotheses two through six were not significant ($p > .05$); therefore, the null hypotheses were not rejected.

Thus, this researcher found a significant difference in the literal and interpretive responses of good and poor readers which indicates that the difference was greater than what one would expect by chance. Other findings were that number of propositions (high and low) did not make a difference in the literal (.188, $p > .05$) and interpretive (1.875, $p > .05$) responses of good and poor readers; that hierarchical position of propositions (high and low) did not make a difference (2.171, $p > .05$) in responses of good and poor readers; and that imagery level (high and low) did not make a difference in the literal (.154, $p > .05$) and interpretive (1.350, $p > .05$) responses of good and poor readers.

Conclusions

The above findings support four conclusions. First, good and poor readers differ in their ability to answer literal and interpretive multiple choice questions on expository passages. The results of this investigation are consistent with previous research carried out with homogenous (ability-wise) readers (Kolker and Terwilliger, unpublished; Johnston, 1981) and with expert and nonexpert readers (Meyer, 1984), but are inconsistent with the idea that "good comprehenders are usually adept at both types of comprehension (literal and inferential) and poor

comprehenders are inept at both" (Harris and Sipay, 1990, p. 554). In this study, poor readers answered percentage-wise about the same literal questions as good readers; however, it was the interpretive questions that distinguished poor readers from good readers. Interpretive questions, by definition, require subjects to infer or deduce information across text or tie information in text with information in background knowledge. Trabasso (1981) has indicated that how inferences are processed is unknown. Reder (1980) has indicated that the speed with which inferences and elaborations are made distinguish good readers from poor readers.

Ability to understand text at a literal level is regarded as a prerequisite to understanding at an inferential level (Harris and Sipay, 1990). In this study, it appears that although both good and poor readers were able to answer literal questions, only good readers continued to perform well on interpretive questions. Given the limitations previously stated and the definition used for interpretive questions in this study, a clear distinction as to the source of the problem for poor readers cannot be ascertained from the data. That is, the data do not indicate whether poor readers had difficulty with inferences within the text, tying the information to background knowledge, or both; likewise, the data do not

indicate whether the source of the problem is encoding and storage or retrieval.

In summary, results of this investigation indicate that good and poor readers are distinguished by their ability to answer literal and interpretive multiple choice questions on expository passages and that specifically poor readers have more difficulty with interpretive questions. Further, it appears that literal and interpretive questions are tapping different cognitive information.

A second conclusion of this study is that number of propositions (high and low) for expository passages does not distinguish good readers from poor readers when answering literal and interpretive multiple choice questions. However, an analysis of data showed that both good and poor readers performed better on interpretive questions when the passage was ranked lowest in number of propositions. Since no studies were found that considered number of propositions in relation to cognitive level of functioning as measured by multiple choice literal and interpretive questions, a direct comparison to other findings was not possible. However, with recall data, complexity of text resulted in qualified findings in relation to number of propositions (Kintsch and Keenan, 1973; Goetz et al., 1981; Poulson et al., 1979). With this study, when complexity of text increased as indicated by the interpretive question classification and number of propositions, number of propositions appears to

have had an influence, with both good and poor readers having better performance on the passage ranked lowest in number of propositions. However, the data in this study are difficult to interpret since passage four, ranked highest in number of propositions, was also ranked lowest in imagery.

Results of the present study relative to number of propositions were consistent with Sindell's (1978) finding that comprehension of sentences decreased as propositional levels increased in difficulty for unskilled readers, but qualify her finding that number of propositions does not affect skilled readers. In the present study, good and poor readers performed better on the passage with the lowest number of propositions. When interpretive questions were used to assess comprehension, poor readers performed poorly on the passage ranked highest in number of propositions. However, good readers' performance was diminished on both the passage high in number of propositions and the passage low in number of propositions when questions were interpretive. Sindell's method of assessing comprehension (true/false statements) had reasoning level variously spread over imagery and propositional levels, thus her findings were confounded relative to cognitive level of functioning. With cognitive level of functioning controlled, the present study appears to indicate that the performance of good readers is reduced on passages ranked high and low in number of propositions.

In summary, results of the present study indicate that number of proposition does not distinguish good and poor readers when comprehension is assessed by literal and interpretive multiple choice questions and expository passages. A closer analysis of data indicated that both good and poor readers performed better on the passage ranked lowest in number of proposition and that with cognitive level of functioning controlled, good readers' performance declined when interpretive questions measured comprehension for both the passage ranked high and low in number of propositions. A clear indication of effect for number of propositions was impossible since passage four is confounded by both number of proposition and imagery.

The third conclusion of this investigation is that hierarchical position of propositions does not distinguish poor readers from good readers when reading expository passages and answering multiple choice literal and interpretive questions. The nonsignificant levels effect found in this study is consistent with research that used a multiple choice task (Baumann, 1980) to measure comprehension, although adults were the subjects in this study and children were the subjects in the Baumann study. However, the results of the present study are inconsistent with the levels effect found with recall or recognition data (Kintsch and Keenan, 1973; Caccamise and Kintsch, 1978; Meyer, 1975b). Several suggestions can be presented to

explain the nonsignificant hierarchical position of propositions (or levels) effect: (1) Information implicated in the interpretive question classification is not "top level" or superordinate information. (2) Multiple choice questions are tapping different psychological processes. (3) Correct responses show a bias for either encoding and storage or retrieval operations.

Chang's (1983) taxonomy for investigating mental processes in reading used the concept of a continuum (Aaronson, 1976) with memory instructions at one end and comprehension instructions at the other. The assumption is that with different instructions, different representations of text are encoded. As such, verbatim (serial) recall represents a high memory and low comprehension demand; a question answering task represents a high comprehension but a low memory demand. Tasks near the middle represent both recognition memory or free-form paraphrase (Chang, 1983, pp. 223-4). The task imposed by multiple choice questions appears to include instructions across the continuum, thereby implicating different psychological and/or encoding/storage and retrieval processes. Chang's taxonomy serves to explain perhaps the reduced levels effect, especially for those readers confused by the complexity of the task demands.

Walker (1982) investigated retrieval of knowledge and noted that verbal learning tasks (e.g., primacy and recency

effects, category size effects, and part-list cueing effects) are more subject to the automatic aspects of encoding, storage and retrieval than the strategic aspects (p. 133). The van Dijk and Kintsch (1983) model assumes comprehension to result from strategic processes.

When Walker's (1982) task involved description of a stereotyped situation, the Raaijmakers-Shiffrin (1981) Retrieval Model failed to account for the data. Walker (1982) attributed the failure to a "lack of detailed, flexible control processes that coordinate and define retrieval strategies" (p. 133). Walker's (1982) conclusion implicates different psychological and/or retrieval processes in the processing of information, via a control process that coordinates the construction and alteration of retrieval plan(s) (p. 134). As such, a default or dysfunction of the hypothesized control processes, generated by a multiple choice question task, could result in the reduced levels effect.

Meyer (1984) found that cueing (questions) or signaling of logical relations (an inferencing task) did not help nonexpert readers in her study. With the present study, questions from the top of the hierarchy did not match with test passages, therefore a cue for retrieval is not assumed. Since the present study did not find a distinction between good and poor readers, question matching (or lack thereof) appears to play a less important role in determining correct

responses. If this conclusion is accepted, then greater reliance on encoding and storage is implicated and less reliance on retrieval with the present study. Such a conclusion is consistent with Meyer (1984). Likewise, with Meyer (1984), it appears that the significant effect found between the literal and interpretive responses of good and poor readers in this study is a result of the different representations stored in memory and not finally the realization of the levels effect.

With recall and recognition studies (Meyer, 1975b; Kintsch and Keenan, 1973; Caccamise and Kintsch, 1978) subjects' recall protocols and/or responses indicated that more superordinate information was recalled or recognized than subordinate information. Even though the top five questions represented a no match with test passages and were designated as interpretive questions in this study, it is possible that the information tapped by the top level questions was not superordinate or top level information. Such a finding would serve to reduce a levels effect.

In summary, results of this study indicated that hierarchical position of propositions did not distinguish good and poor readers answering literal and interpretive multiple choice questions after reading expository passages. Several suggestions were offered as explanations for the nonsignificant effect: (1) interpretive questions were not tapping top level or superordinate information, (2) multiple

choice questions were tapping different psychological processes, and (3) correct responses were biased for either encoding and storage or retrieval operations.

The fourth conclusion drawn from this study is that the imagery level (high and low) of passages does not distinguish poor readers from good readers when reading expository passages and answering multiple choice literal or interpretive questions. Results of this investigation are consistent with research carried out with a multiple choice test or cloze format (Tirre, Manelis, and Leicht, 1979; Anderson and Kulhavy, 1972), but are inconsistent with research using retelling and short answer questions (Peters and Levin, 1986; Gambrell and Bales, 1986; Tirre, Manelis, and Leicht, 1979).

With the present study, a closer analysis of the data revealed that both good and poor readers performed better on literal questions than on interpretive questions. Further, the analysis revealed that good and poor readers performed better on literal questions for the passage ranked lowest in imagery. Likewise, good readers performed better on interpretive questions for the passage ranked lowest in imagery. However, poor readers had most difficulty with the interpretive questions on the low imagery passage (36.11 percent). Thus, the data analysis suggested that passages ranked high and low in imagery generate different response patterns.

This differential response pattern was consistent with the Kolker and Terwilliger (unpublished manuscript) results found with young children as subjects and multiple choice questions as the measure of comprehension. Kolker and Terwilliger found that more fact questions were answered correctly from high imagery passages and more inferential questions were answered correctly from low imagery passages. Kolker and Terwilliger did not distinguish ability level of readers, but noted that all students performed less well on inferential questions. The results of the present study were consistent with the finding of difficulty for inferential (interpretive) questions over literal questions in the Kolker and Terwilliger (unpublished) study. However, only the good students performed better on interpretive questions when the passage ranked low in imagery in the present study. Poor readers performed better on the interpretive questions for the passage ranked high in imagery and performed poorly on the passage ranked low in imagery. Thus, analysis of data for this study revealed differential patterns of responses for good and poor readers answering literal and interpretive questions.

In summary, results of this study indicated that imagery level of passages (high and low) did not distinguish good and poor readers when answering literal and interpretive multiple choice questions. A closer look at data suggested that both good and poor readers performed

better on literal questions for the passage ranked lowest in imagery; whereas, differential performance was found for good and poor readers answering interpretive questions for passages high and low in imagery. Again it was difficult to interpret data, because passage four ranked low in imagery was also ranked highest in number of propositions. Further, because of the differential patterns of responses found in this study, a bias for facilitation of encoding or retrieval of information is difficult to support.

Summary of Conclusions

Four conclusions were drawn from this study:

(1) Good and poor readers differ in their ability to answer literal and interpretive questions on expository passages.

(2) Number of propositions (high and low) for expository passages does not distinguish good readers from poor readers when answering literal and interpretive multiple choice questions.

(3) Hierarchical position of propositions does not distinguish poor readers from good readers when reading expository passages and answering multiple choice literal and interpretive questions.

(4) Imagery level (high and low) of expository passages does not distinguish poor readers from good readers when

answering multiple choice literal and interpretive questions.

Discussion, Implications and Suggestions

The conclusions of this study suggest several theoretical implications. In accordance with the van Dijk and Kintsch (1983) model, the conclusions of this study support the diminution of an effect for number of propositions when text complexity and/or task demands increase. On the other hand, the conclusions of this study do not support the levels effect (hierarchical position of propositions) nor the bias for concreteness of text found in accordance with the Kintsch models (Kintsch, 1974; Kintsch and van Dijk, 1978; van Dijk and Kintsch, 1983) when comprehension is measured by recall. Further, in accordance with the need to develop a theory for questions, the conclusions of this study support the validity of a literal and an interpretive (inference) classification for questions and add credence to the assumption that the questions are tapping different levels of cognitive functioning.

The above theoretical implications result in implications for the development and interpretation of assessment instruments for reading comprehension, implications that extend to instructional models of knowledge acquisition. These implications may be explained

in terms of text factors, reader factors, and measurement factors that interact and impact when reading is assessed. Because interaction of variables is a major assumption of the reading process, a clearly demarcated consideration of text factors, reader factors, and measurement factors is not presumed.

First, conclusions from this study have implications for measurement tasks when assessing reading comprehension. This study indicates that when the measurement task is multiple choice questions, effects are not consistent with recall tasks. Further, conclusions from this study suggest that measurement tasks can be specified in accordance with a memory to comprehension continuum (Chang, 1983; Aaronson, 1976). This continuum appears compatible with the Pearson and Johnson (1978) question taxonomy and with the different text representations (e.g., surface level, textbase, and situation model) proposed by van Dijk and Kintsch (1983) and investigated by Zimny (1987), Kintsch, (1988), and Kintsch et al. (1990).

Further research of measurement task effects in accordance with the assumption of the van Dijk and Kintsch (1983) model that retrieval is cued could combine the taxonomies suggested here so that learning and testing could be clarified in terms of memory operations. The present study, with a rather simplistic paradigm for matching questions both at the surface and propositional levels of

text, appears to indicate that different questions function to retrieve information differentially.

The constructive-integrative model (Kintsch et al., 1990) proposes that a representation of the test sentence is compared with the representation of the whole paragraph with a recognition task. This assumption appears to be a departure from the encoding specificity and redintegration principles assumed with the 1983 van Dijk and Kintsch model. Moreover, researcher matching in this study could be described as visual matching, even with the propositional match. Additional research is needed to define memorial representation and possible cognitive interactions and functions when questions and/or matching tasks are used to assess comprehension. Thus, continued research is essential to answering the question: What role does measurement task play in the assessment of reading comprehension?

Second, conclusions from this study have important implications for the role of text variables in the assessment of reading comprehension. In this study, effects for number of propositions, hierarchical position of propositions, and imagery level were nonsignificant. However, further analysis of data in this study suggested that text variables have differential influence on the encoding, storage, or retrieval of information.

When discourse is the medium of communication, the number of text variables acting as potential influences on

comprehension increases. How these variables are represented in research investigations will impact experimenter findings. This assumption suggests that the proposition as the unit of memory representation may be inappropriate for some tasks (cf. Perrig and Kintsch, 1985). The correspondence between propositional levels (microstructure and macrostructure) found in this study generate suspicions as does the system of propositional analysis. The possibility of an alternative, non linguistic representation should be considered, for the propositional system of analysis and representation appears too constrained to encompass the literal, the metaphorical, the phonological, and the emotive (cf. Rayner and Pollatsek, 1989). Perhaps an abstract symbol system of representation would permit the inclusion of greater numbers of text variables and, thereby, reflect more ecological validity in the experimental condition. Additional consideration of text representation suggests that the orthogonal relations between encoding, storage, and retrieval advocated by Paivio (1986) may be possible but are not mandatory. Causal chains and mental models offer alternative representational models. However, these models are used to represent narrative text. Therefore, continued research is needed to understand the representation and memory for expository text.

The present study investigated expository texts, yet rhetorical features of the texts were not investigated. It

is possible that these structures serve, at least for some readers, as superstructures that function automatically and on-line as an inference mechanism that facilitates comprehension. Rhetorical superstructures as a component of comprehension may have played a significant role in distinguishing good and poor readers in this study. van Dijk and Kintsch (1983) noted that narrative texts are constrained by temporal and causal relations. Expository texts, on the other hand, while less constrained are much more variable in rhetorical structure (Graesser and Goodman, 1984). Research has indicated that rhetorical structure influences comprehension (Kintsch and Yarbrough, 1982), but does not interact with the complexity of text (Kintsch and Yarbrough, 1982).

The constructive-integrative model of Kintsch (1988) offers a potential model for investigating the role of rhetorical structure as a knowledge structure incorporated in the situation model of text. However, the variability of rhetorical structure especially within ecologically valid materials is an empirical problem. Further, the constructive-integrative model's representation of knowledge theoretically affords the possibility of investigating imagery constraints in the context of an associative network. Perhaps imagery values could be specified for the individual concepts and/or propositions within the associative network. The imaginal strengths of nodes within

the network could be determined and, thereby, their relative contributions to the dynamics of processing and decision making. Thus, continued research into text features and their representation in memory is essential to answering the question: What are the contributions of text when reading comprehension is assessed?

Third, conclusions from this study have important implications for the role of reader variables in the assessment of reading comprehension. Results of this study suggest that there are individual differences in the representations that are either encoded, stored, or retrieved from memory. A significant finding with this study was the difference in the literal and interpretive responses of good and poor readers. Because good and poor readers were similar in their responses to literal questions but were different in their interpretive responses, then implications address the interpretive level of cognitive functioning. By definition, the interpretive level requires the reader to make inferences.

The situation model proposed by van Dijk and Kintsch (1983) is a representation of text which includes inferences from the reader's knowledge store. The present study did not particularize the situation model, and it may be that the situation models of the texts would explain the difference in the interpretive responses of good and poor readers. Recent research, including the present study, has focused on

textual representations in memory. Three such representations (surface level, textbase and situation model) have been investigated and supported (Kintsch, 1990; Kintsch, 1988; Zimny, 1987). Inferencing plays a key role in the construction and/or integration of these representations. However, "the specific strategies (or rules) for the constructing of text propositions or inferencing" are still not specified (Kintsch, 1988, p. 164). Thus, how inferences occur, as well as when they occur, is still an empirical question.

Trabasso (1981) noted that inferences are automatic and unconscious. This assumption, however, does not explain why inferencing would distinguish good and poor readers. Are phylogenetic determiners responsible for inferencing skill, or is the skill developed through experiences and instructions? While inferencing may occur automatically and unconsciously, are such inferences guided by executive control processes equivalent to metacognitive skill? Again, this researcher suggests that perhaps a more abstract representation (cf. Walker, 1982; Marschark and Paivio, 1977) available to conscious memory and encompassing perceptual (verbal and nonverbal) and nonperceptual (goals and motivations) variables that are currently not computationally defined is needed to account for enigmatic operations like inference.

Intuitively, cognitive processes appear to operate synergistically and cybernetically when readers are performing at optimum, or successful, levels. The apparent myriad of processes (or subprocesses) involved in these operations generate theoretical concerns for parsimony and efficiency when representing these processes in models of reading. Concepts already available in the literature such as cascading, chunking, and variable use of the same neural representation mechanisms are theoretically important to future model building and testing. Thus, continued research to explicate the role of inferencing in reading and to determine the parsimonious and efficient mechanism(s) that control the comprehension process is essential. Such research is a requisite to answering the question: What are the reader's contributions when reading comprehension is assessed?

Answers to questions related to measurement task variables, text variables, and reader variables are not only important to the assessment of reading but are also important to the development of instructional models. It seems that a prerequisite to the specification of thinking skills (e.g., problem solving, decision making, critical thinking, and creative thinking) in teaching models is a clearer understanding of the contributions of tasks (including measurement or retrieval cues), text variables, reader variables, and context (e.g., testing or learning)

within a developmental framework. An understanding of the contributions of each of these variables is also needed relevant to other language skills (e.g., speaking, listening, and writing) and across subject domains (e.g., science, math).

As van Dijk and Kintsch (1983) noted, progress in comprehension testing cannot be made until "testing procedures are based on a detailed understanding of the psychological processes involved in comprehension" (p. 259). The psychological processes to which van Dijk and Kintsch allude must include an understanding of the contributions of the measurement task, the text, the reader, and the context (both learning and testing) to the process of comprehension.

BIBLIOGRAPHY

BIBLIOGRAPHY

Aaronson, D. (1976). Performance theories for sentence encoding: Some qualitative observations. Journal of Experimental Psychology: Human Perception and Performance Journal, 2, 42-55.

Anderson, J. R. (1976). Language, memory, and thought. Hillsdale, NJ: Lawrence Erlbaum Associates.

Anderson, J. R. (1978). Arguments concerning representations for mental imagery. Psychological Review, 85(4), 249-275.

Anderson, J. R. and Bower, G. H. (1972). Recognition and retrieval processes in free recall. Psychological Review, 79, 97-123.

Anderson, R. C. (1972). How to construct achievement tests to assess comprehension. Review of Educational Research, 42(2), 145-170.

Anderson, R. C. and Kulhavy, R. W. (1972). Imagery and prose learning. Journal of Educational Psychology, 63(3), 242-243.

Askew, B. J. (1982). A study of the effect of measurement task and response mode on able sixth graders' comprehension of expository text. Unpublished Doctoral Dissertation, Texas Woman's University.

Athey, I. (1985). Reading research in the affective domain. In H. Singer and R. B. Ruddell (Eds.), Theoretical Models and Processes of Reading (pp. 527-557). Newark, DE: International Reading Association.

Atkinson, R. C. and Juola, J. F. (1974). Search and decision processes in recognition memory. In D. H. Krantz, R. C. Atkinson, and R. D. Luce (Eds.), Contemporary Developments in Mathematical Psychology, 1 (pp.243-293). San Francisco: Freeman.

Atkinson, R. H., Longman, D. G. and Parrish, T. (1984). Schema theory, reader/text interaction, text analysis and metacognition: An overview and educational implications. In G. H. McNinch (Ed.), Reading Research in 1984: Comprehension, Computers, and Communication. Fifth Yearbook of the American Reading Forum (pp. 120-123). Athens, GA: University of Georgia.

August, D. L., Flavell, J. H. and Clift, R. (1984). Comparison of comprehension monitoring of skilled and less skilled readers. Reading Research Quarterly, 20(1), 39-48.

Barrett, T. (1976). Taxonomy of reading comprehension. In R. Smith and T. C. Barrett, Teaching Reading in the Middle Grades. Reading, MA: Addison Wesley.

Bartlett, F. C. (1932). Remembering: An experimental and social study. Cambridge: Cambridge University Press.

Baten, L. (1981). Text Comprehension: The parameters of difficulty in narrative and expository prose texts: A redefinition of readability. Urbana: University of Illinois. (ERIC Document Reproduction Service No. ED 220 788)

Baumann, J. F. (1980). Effects of height of information in the content structure and measurement mode on third and sixth graders' comprehension of expository discourses. Unpublished Doctoral Dissertation, University of Wisconsin.

de Beaugrande, R. (1981). Criteria for models of reading. Reading Research Quarterly, 16(2), 261-309.

Beck, I. L. and McKeown, M. G. (1981). Developing questions that promote comprehension: The story map. Language Arts, 58(8), 913-918.

Begg, I. (1982). Imagery, organization, and discriminative processes. Canadian Journal of Psychology, 36, 273-290.

Bloom, B. (Ed.). (1956) Taxonomy of Educational Objectives. New York: McKay.

Britton, B. K., Meyer, B. J. F., Hodge, M. H. and Glynn, S. M. (1980). Effects of the organization of text on memory: Tests of retrieval and response criterion hypotheses. Journal of Experimental Psychology: Human Learning and Memory, 6(5), 620-629.

Broadbent, D. E. (1975). The Magical number seven after 15 years. In R. A. Kennedy and A. Wilkes (Eds.), Studies in Long-term Memory. New York: Wiley.

Brown, A. L. and Day, J. D. (1983). Macrorules for summarizing texts: The development of expertise. Journal of Verbal Learning and Verbal Behavior, 22(1), 1-14.

Brown, J. I., Bennett, J. M. and Hanna, G. (1981). Examiner's manual, Forms E and F. The Nelson-Denny Reading Test. Chicago, IL: Riverside Publishing Company.

Caccamise, D. J. and Kintsch, W. (1978). Recognition of important and unimportant statements from stories. American Journal of Psychology, 91(4), 651-657.

Cagney, M. A. (1988). Measuring comprehension: alternatives to standardized tests. In S. M. Glaser, L. W. Searfoss and L. M. Gentile (Eds.), Reexamining Reading Diagnosis New Trends and Procedures (pp. 81-93). Newark, DE: International Reading Association.

Catterson, J. (1979). Comprehension: The argument for a discourse analysis model. In C. Pennock (Ed.), Reading Comprehension at Four Linguistic Levels (pp. 2-7). Newark, DE: International Reading Association.

Champion, D. J. (1970). Basic statistics for social research. University of Tennessee: Chandler Publishing Company.

Chang, F. R. (1983). Mental processes in reading: A methodological review. Reading Research Quarterly, 18(3), 216-230.

Christiaansen, R. E. (1980). Prose memory: Forgetting rates for memory codes. Journal of Experimental Psychology: Human Learning and Memory, 6(5), 611-619.

Collins, A. M. and Loftus, E. F. (1975). A Spreading-activation theory of semantic processing. Psychological Review, 82(6), 407-428.

Cross, D. R. and Paris, S. G. (1987). Assessment of reading comprehension: Matching test purposes and test properties. Educational Psychologist, 22(3/4), 313-332.

Daneman, M. (1991). Individual differences in reading skills. In R. Barr, M. L. Kamil, P. Mosenthal, and P. D. Pearson (Eds.), Handbook of Reading Research, Vol. II (pp. 512-538). New York: Longman.

Daneman, M. and Carpenter, P. A. (1980). Individual differences in working memory and reading. Journal of Verbal Learning and Verbal Behavior, 19, 450-466.

Davey, B. (1989). Assessing comprehension: Selected interactions of task and reader. The Reading Teacher, 42(9), 694-697.

Davey, B. (1987). Postpassage questions: Task and reader effects on comprehension and metacomprehension processes. Journal of Reading Behavior, 19(3), pp. 261-283.

Denis, M. (1982a). Images and semantic representations. In J. F. Le Ny and W. Kintsch (Eds.), Language and Comprehension (pp. 17-27). Amsterdam: North-Holland.

Denis, M. (1982b). Imaging while reading text: A study of individual differences. Memory and Cognition, 10(6), 540-545.

van Dijk, T. A. and Kintsch, W. (1977). Cognitive psychology and discourse: Recalling and summarizing stories. In H. Singer and R. B. Ruddell (Eds.), Theoretical Models and Processes of Reading, Third Edition, (pp. 794-812). Newark, DE: International Reading Association.

van Dijk, T. A. and Kintsch, W. (1983). Strategies of discourse comprehension. New York: Academic Press.

Drum, P. A. (1984). Book Reviews. Journal of Reading Behavior, 16(3), 219-233.

Dyer, M. G. and Lehnert, W. G. (1982). Question answering for narrative memory. In J. F. Le Ny and W. Kintsch (Eds.), Language and Comprehension (pp. 339-358). Amsterdam: North-Holland.

Engel-Ortlieb, D. (1987). How linguistic is cognition? In H. W. Dechert and M. Raupach (Eds.), Psycholinguistic Models of Production (pp. 181-183).

Farah, M. J. (1988). Is visual imagery really visual? Overlooked evidence from neuropsychology. Psychological Review, 95(3), 307-317.

Farr, R. and Carey, R. F. (1986). Reading, what can be measured? Newark, DE: International Reading Association, Inc.

Fillmore, C. J. (1968). The case for case. In E. Bach and R. T. Harms (Eds.), Universals of Linguistic Theory (1-88). New York: Holt, Rinehart, & Winston.

Fillmore, C. J. (1971). Types of lexical information. In D. D. Steinberg and L. A. Jakobits (Eds.), Semantics (370-392). Cambridge: University Press.

Fletcher, C. R. (1981). Short-term memory processes in text comprehension. Journal of Verbal Learning and Verbal Behavior, 20, 546-574.

Frase, L. T. (1968). Effect of question location, pacing, and mode upon retention of prose material. Journal of Educational Psychology, 59(4), 244-249.

Frase, L. T. and Schwartz, B. J. (1975). Effect of question production and answering on prose recall. Journal of Educational Psychology, 67(5), 628-635.

Gambrell, L. B. and Bales, R. J. (1986). Mental imagery and the comprehension-monitoring performance of fourth- and fifth-grade poor readers. Reading Research Quarterly, XXI(4), 454-464.

Gillund, G., and Shiffrin, R. C. (1984). A retrieval model for both recognition and recall. Psychological Review, 9(1), 1-67.

Glaser, R. (1981). The future of testing, A research agenda for cognitive psychology and psychometrics. American Psychologist, 36(9), 923-936.

Goetz, E. T., Anderson, R. C. and Schallert, D. L. (1981). The representation of sentences in memory. Journal of Verbal Learning and Verbal Behavior, 20, 369-385.

Golinkoff, R. M. (1975-1976). A comparison of reading comprehension processes in good and poor comprehenders. Reading Research Quarterly, 11(4), 623-659.

Graesser, A. C. and Black, J. B. (Eds). (1985). The psychology of questions. Hillsdale, NJ: Lawrence Erlbaum Associates.

Graesser, A. C. and Goodman, S. M. (1985). Implicit knowledge, question answering, and the representation of expository text. In B. Britton and J. Black (Eds.), Understanding Expository Text (pp.109-171). Hillsdale, NJ: Lawrence Erlbaum Associates.

Hamaker, C. (1986). The effects of adjunct questions on prose learnings. Review of Educational Research, 56(2), 212-242.

Harris, A. J. and Sipay, E. R. (1990). How to increase reading ability, A guide to developmental and remedial methods, Ninth Edition. New York: Longman.

Holmes, V. M. and Langford, J. (1976). Comprehension and recall of abstract and concrete sentences. Journal of Verbal Learning and Verbal Behavior, 15, 559-566.

Irwin, L. H. (1988). Imagery effects on recall of propositions at the micro- and macro-levels of text. Unpublished Doctoral Dissertation, The University of Tennessee, Knoxville.

Johnson-Laird, P. N. (1983). Mental Models. Cambridge, MA: Harvard University Press.

Johnson, R. E. (1982). Retrieval cues and the remembering of prose: A review. In A. Flammer and W. Kintsch (Eds.), Discourse Processing (219-238). Amsterdam: North-Holland.

Johnston, P. H. (1981). Prior knowledge and reading comprehension test bias. Unpublished Doctoral Dissertation, University of Illinois at Urbana-Champaign.

Johnston, P. H. (1983). Reading comprehension assessment: A cognitive basis. Newark, DE: International Reading Association.

Jorgensen, C. C. and Kintsch, W. (1973). The role of imagery in the evaluation of sentences. Cognitive Psychology, 4, 110-116.

Joshi, A. K. (1978). Some extensions of a system for inference on partial information. In D. A. Waterman and F. Hayes-Roth (Eds.), Pattern directed inference systems (241-257). New York: Academic Press.

Kamil, M. L. and Samuels, S. J. (1984). Models of the reading process. In P. D. Pearson, R. Barr, M. L. Kamil, and P. Mosenthal (Eds.), Handbook of Reading Research (pp. 185-224). New York: Longman.

Katz, A. N. and Paivio, A. (1975). Imagery variables in concept identification. Journal of Verbal Learning and Verbal Behavior, 14, 285-293.

Keenan, J. M. and Kintsch, W. (1974). The identification of explicitly and implicitly presented information. In W. Kintsch (Ed.), The Representation of Meaning in Memory. Hillsdale, NJ: Lawrence Erlbaum.

Kintsch, W. (1968). Recognition and free recall of organized lists. Journal of Experimental Psychology, 78, 481-487.

Kintsch, W. (1970). Models for free recall and recognition. In D. A. Norman (Ed.), Models of Human Memory (331-373). New York: Academic Press.

Kintsch, W. (1974). The representation of meaning in memory. Hillsdale, NJ: Lawrence Erlbaum Associates.

Kintsch, W. (1977). Memory and Cognition. New York: Wiley.

Kintsch, W. (1982). Memory for text. In A. Flammer and W. Kintsch (Eds.), Discourse Processing (pp. 186-204). Amsterdam: North-Holland Publishing Co.

Kintsch, W. (1982). Text representations. In W. Otto and S. White (Eds.), Reading Expository Material (87-101). New York: Academic Press.

Kintsch, W. (1987). Contributions from cognitive psychology. In R. J. Tierney, P. L. Anders and J. N. Mitchell (Eds.), Understanding Readers' Understanding (5-14). Hillsdale, N.J.: Lawrence Erlbaum Associates.

Kintsch, W. (1987). Psychological processes in discourse production. In H. W. Dechert and M. Raupach (Eds.), Psycholinguistic Models of Production (pp. 163-180). Norwood, NJ: Ablex Publishing Corporation.

Kintsch, W. (1988). The role of knowledge in discourse comprehension: A construction-integration model. Psychological Review, 95(2), 163-182.

Kintsch, W. and van Dijk, T. A. (1978). Toward a model of text comprehension and production. Psychological Review, 85(5), 363-394.

Kintsch, W. and Greeno, J. G. (1985). Understanding and solving word arithmetic problems. Psychological Review, 92(1), 109-129.

Kintsch, W. and Keenan, J. (1973). Reading rate and retention as a function of the number of propositions in the base structure of sentences. Cognitive Psychology, 5, pp. 257-274.

Kintsch, W., Kozminsky, E., Streby, W. J., McKoon, G. & Keenan, J. (1975). Comprehension and recall of text as a function of content variables. Journal of Verbal Learning and Verbal Behavior, 14, 196-214.

Kintsch, W. and Vipond, D. (1979). Reading comprehension and readability in educational practice and psychological theory. In L. G. Nilsson (Ed.), Perspectives on Memory Research: Essays in Honor of Upsala University's 500th Anniversary (pp. 329-365). Hillsdale, NJ: Lawrence Erlbaum Associates.

Kintsch, W., Welsch, D., Schmalhofer, F. and Zimny, S. (1990). Sentence memory: A theoretical analysis. Journal of Memory and Language, 29, 133-159.

Kintsch, W. and Yarbrough, J. C. (1982). The role of rhetorical structure in text comprehension. Journal of Educational Psychology, 74, 828-834.

Kolker, B. (1986). Classroom evaluation procedures. In J. E. Alexander (Ed.), Teaching Reading (pp. 444-481). Glenview, IL: Scott, Foresman and Co.

Kolker, B. and Terwilliger, P. N. The effect of level of imagery and length of passage on reading comprehension. Unpublished manuscript, The University of Tennessee, Knoxville.

Lachman, J. and Lachman, R. (1979). Comprehension and cognition: A state of the art inquiry. In L. S. Cermak and F. I. M. Craik (Eds.), Levels of Processing in Human Memory (183-209). Hillsdale, NJ: Lawrence Erlbaum Associates.

Lehnert, W. (1978). The Process of Question Answering. Hillsdale, NJ: Lawrence Erlbaum Associates.

Levin, J. R. (1973). Inducing comprehension in poor readers: A test of a recent model. Journal of Educational Psychology, 65(1), 19-24.

Levin, J. R. and Kaplan, S. A. (1972). Imaginal facilitation of paired-associate learning: A limited generalization? Journal of Educational Psychology, 63(3), pp. 429-432.

Levin, J. R. and Pressley, M. (1981). Improving children's prose comprehension: Selected strategies that seem to succeed. In C. M. Santa and B. L. Hayes (Eds.), Children's prose comprehension: research and practice (pp. 44-71). Newark, DE: International Reading Association.

Lucas, P. A. and McConkie, G. W. (1980). The definition of test items: A descriptive approach. American Educational Research Journal, 17(2), 133-140.

Mannes, S. M. and Kintsch, W. (1987). Knowledge organization and text organization. Cognition and Instruction, 4(2), 91-115.

Marschark, M. and Paivio, A. (1977). Integrative processing of concrete and abstract sentences. Journal of Verbal Learning and Verbal Behavior, 16, 217-231.

Marshall, N. (1981). The application of basic research to reading instruction. In D. F. Fisher and C. W. Peters (Eds.), Comprehension and the Competent Reader, Interspeciality Perspectives (pp. 35-50). New York, NY: Praeger Publishers.

Marshall, N. and Glock, M. D. (1978-1979). Comprehension of connected discourse: A study into the relationships between the structure of text and information recalled. Reading Research Quarterly, 14(1), 10-56.

McClelland, J. L. (1979). On the time relations of mental processes: An examination of systems of processes in cascade. Psychological Review, 86(4), 287-324.

McKoon, G. and Ratcliff, R. (1980). Priming in item recognition: The organization of propositions in memory for text. Journal of Verbal Learning and Behavior, 19, 369-386.

McNamara, T. P., Miller, D. L. and Bransford, J. D. (1991). Mental models and reading comprehension. In R. Barr, M. L. Kamil, P. Mosenthal, and P. D. Pearson (Eds.), Handbook of Reading Research, Vol. II, (pp. 490-511). New York: Longman.

van Meter, J. and Herrmann, B. A. (Winter 1986-87). Use and misuse of The Nelson-Denny Reading Test. Community College Review, 14(3), 25-30.

Meyer, B. J. F. (1971). Idea units recalled from prose in relation to their position in the logical structure, importance, stability, and order in the passage. Unpublished Masters Thesis. Cornell University.

Meyer, B. J. F. (1975a). Identification of the structure of prose and its implication for the study of reading and memory. Journal of Reading Behavior, 7(1), 7-47.

Meyer, B. J. F. (1975b). The organization of prose and its effect on memory. Amsterdam: North-Holland.

Meyer, B. J. F. (1981). Basic research on prose comprehension: A critical review. In D. F. Fisher and C. W. Peters (Eds.), Comprehension and the Competent Reader, Inter-Specialty Perspectives (pp. 3-35). New York, NY: Praeger Publishers.

Meyer, B. J. F. (1984). Text dimensions and cognitive processing. In H. Mandl, N. L. Stein and T. Trabasso, Learning from Texts (3-51). Hillsdale, N.J.: Lawrence Erlbaum Associates.

Meyer, B. J. F. (1985). Prose analysis: Purposes, procedures, and problems. In B. Britton and J. Black (Eds.), Understanding Expository Text (pp. 11-64). Hillsdale, NJ: Lawrence Erlbaum Associates.

Meyer, B. J. F., Brandt, D, and Bluth, G. J. (1980). Use of top-level structure in text: Key for Reading Comprehension of Ninth-Grade Students. Reading Research Quarterly, 1, 72-103.

Meyer, B. J. F. and Rice, G. E. (1984). The structure of text. In P. D. Pearson, R. Barr, M. Kamil, and P. Mosenthal (Eds.), Handbook of Reading Research (pp. 319-351). New York, NY: Longman.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological Review, 63, 81-97.

Miller, J. R. (1984). Prose comprehension and the management of working memory. In D. E. Kieras and M. A. Just (Eds.), New Methods in Reading Comprehension Research (pp. 327-347). Hillsdale, NJ: Lawrence Erlbaum Associates.

Miller, James R. and Kintsch, W. (1980). Readability and recall of short prose passages: A theoretical analysis. Journal of Experimental Psychology: Human Learning and Memory, 6(4), 335-353.

Moes, M. A., Foertsch, D. J., Stewart, J., Dunning, D., Rogers, T., Seda-Santana, I., Benjamin, L., and Pearson, P. D. (June 1984). Effects of text structure on children's comprehension of expository material. Champaign: IL: University of Illinois at Urbana-Champaign. (Technical Report No. 316).

Oakhill, J. (1984). Inferential and memory skills in children's comprehension of stories. British Journal of Educational Psychology, 54, 31-39.

Olson, M. W. (1985). Text type and reader ability: The effects on paraphrase and text-based inference questions. Journal of Reading Behavior, 17(3), 199-214.

Paivio, A. (1968). A factor-analytic study of word attributes and verbal learning. Journal of Verbal Learning and Verbal Behavior, 7, 41-49.

Paivio, A. (1969). Mental imagery in associative learning and memory. Psychological Review, 76, 241-263.

Paivio, A. (1971). Imagery and Verbal Processes. New York: Holt, Rinehart and Winston.

Paivio, A. (1986). Mental Representations, A Dual Coding Approach. New York: Oxford University Press.

Paivio, A. and Yuille, J. C. (1969). Changes in associative strategies and paired-associate learning over trials as a function of word imagery and type of learning set. Journal of Experimental Psychology, 79, 458-463.

Paivio, A., Yuille, J. C. and Madigan, S. A. (1968). Concreteness, imagery and meaningfulness values for 925 nouns. Journal of Experimental Psychology, 76, 1-25.

Paris, S. G. (1987). Introduction to current issues in reading comprehension. Educational Psychologist, 22(3/4), 209-212.

Pearson, P. D. and Campbell, K. (1981). Comprehension of text structures. In H. Singer and R. B. Ruddell (Eds.), Theoretical Models and Processes of Reading, Third Edition (pp. 323-342), Newark, DE: International Reading Association.

Pearson, P. D. and Johnson, D. D. (1978). Teaching Reading Comprehension. New York: Holt, Rinehart and Winston.

Pearson, P. D. and Raphael, T. E. (1985). Increasing students' awareness of sources of information for answering questions. American Educational Research Journal, 22(2), 217-235.

Perfetti, C. A. (1985). Reading Ability. New York: Oxford University Press.

Perrig, W. and Kintsch, W. (1985). Propositional and situational representations of text. Journal of Memory and Language, 24, 503-518.

Peters, E. E. and Levin, J. R. (1986). Effects of a mnemonic imagery strategy on good and poor readers' prose recall. Reading Research Quarterly, 21(2), 179-192.

Pollitt, A. and Hutchinson, C. (1986). The validity of reading comprehension tests: What makes questions difficult. In D. Vincent, A. K. Pugh, and G. Brooks (Eds.), Assessing Reading, Proceedings of the UKRA Colloquium on the Testing and Assessment of Reading (pp. 41-61). London: Macmillan Education.

Poulson, D., Kintsch, E., Kintsch, W., and Premack, D. (1979). Children's comprehension and memory for stories. Journal of Experimental Child Psychology, 28, 379-403.

Pressley, M. (1977). Imagery and children's learning: putting the picture in developmental perspective. Review of Educational Research, 47(1), 585-622.

Pressley, M., Johnson, D., Symons, S., McGoldrick, J. and Kurita, J. (1989). Strategies that improve children's memory and comprehension of text. The Elementary School Journal, 90(1), 3-32.

Pressley, M. and Forrest-Pressley, D. (1985). Questions and children's cognitive processing. In A. C. Graesser and J. B. Black (Eds.), The Psychology of Questions (pp. 277-296). Hillsdale, NJ: Lawrence Erlbaum Associates.

Pylyshyn, Z. W. (1973). What the mind's eye tells the mind's brain: A critique of mental imagery. Psychological Bulletin, 80(1), 1-24.

Quillian, M. R. (1968). Semantic memory. In M. Minsky (Ed.), Semantic Information Processing. Cambridge, MA: MIT Press.

Raaijmakers, J.G.W. and Shiffrin, R. M. (1981). Search of Associative Memory. Psychological Review, 88(2), 93-134.

Raphael, T. E., Winograd, P., and Pearson, P. D. (1980). Strategies children use in answering questions. In M. L. Kamil (Ed.), Twenty-Ninth National Reading Conference Yearbook (pp. 56-63). Washington, DC: National Reading Conference.

Rankin, E. F., Jr. (1962). The Definition of Reading Comprehension. In A. L. Raygor (Ed.), College and Adult Reading (pp. 16-19). First Annual Yearbook, North Central Reading Association.

Rayner, K. and Pollatsek, A. (1989). Representation of discourse. In The Psychology of Reading (pp. 264-321). Englewood Cliffs, NJ: Prentice Hall.

Readence, J. E. and Martin, M. A. (1988). In S. M. Glazer, L. W. Searfoss, and L. M. Gentile (Eds.), Reexamining Reading Diagnosis New Trends and Procedures (pp. 67-80). Newark, DE: International Reading Association.

Reder, L. M. (1980). The role of elaboration in the comprehension and retention of prose: A critical review. Review of Educational Research, 50(1), 5-53.

Rubenstein, H., Kender, J. P. and Mace, F. C. (1988). Do tests penalize readers for poor short term memory?. Journal of Reading, 32(1), 4-10.

Ruddell, R. B. and Speaker, R. B. (1985). The interactive reading process: A model. In H. Singer and R. B. Ruddell (Eds.), Theoretical Models and Processes of Reading (pp. 751-793). Newark, DE: International Reading Association.

Sadoski, M. (1983). An exploratory study of the relationship between reported imagery and the comprehension and recall of a story. Reading Research Quarterly, 19, 205-209.

Sadoski, M. (1985). The natural use of imagery in story comprehension and recall: Replication and extension. Reading Research Quarterly. 20, 658-667.

Samuels, S. J. and Eisenberg, P. (1981). A framework for understanding the reading process. In F. J. Pirozzolo and M. C. Wittrock (Eds.), Neuropsychological and Cognitive Processes in Reading (pp. 31-67). New York: Academic Press.

Sanders, N. M. (1966). Classroom Questions: What Kinds? New York: Harper and Row.

Schwartz, Steven. (1984). Measuring Reading Competence, A Theoretical-Prescriptive Approach. New York: Plenum Press.

Shavelson, R. J. and Berliner, D. C. (1974). Effects of position and type of question on learning from prose material: Interaction of treatments with individual differences. Journal of Educational Psychology, 66(1), 40-48.

Sindell, Z. (1978). The Relationship of Imagery and Propositions to the Understanding of Sentences. Unpublished Doctoral Dissertation, Fordham University.

Singer, H. (1982). Discussion of Walter Kintsch's "Text Representations." In W. Otto and S. White (Eds.), Reading Expository Material (pp. 103-107). New York: Academic Press.

Singer, H. and Ruddell, R. B. (Eds). (1985). Introduction to models of reading. In Theoretical Models and Processes of Reading, Third Edition (pp. 620-629). New York: Longman.

Singer, M. (1982). Answering questions from text: A process model. In A. Flammer and W. Kintsch (Eds.), Discourse Processing (pp. 172-183). Amsterdam: North-Holland.

Singer, M. (1985). Mental processes of question answering. In A. G. Graesser and J. B. Black (Eds.), The Psychology of Questions (pp. 121-156). Hillsdale, NJ: Lawrence Erlbaum Associates.

Spilich, G. J. (1983). Life-span components of text processing: Structural and procedural differences. Journal of Verbal Learning and Verbal Behavior, 22, 231-244.

Spilich, G. J., Vesonder, G. T., Chiesi, H. L. and Voss, J. F. (1979). Text processing of domain-related information for individuals with high and low domain knowledge. Journal of Verbal Learning and Verbal Behavior, 18, 275-290.

Stanovich, K. E. (1981). Toward an Interactive-compensatory Model of Individual Differences in the Development of Reading Fluency. Reading Research Quarterly, 16(1), 32-71.

Steingart, S. and Glock, M. (1979). Imagery and the recall of connected discourse. Reading Research Quarterly, 15(1), 66-83.

Terwilliger, P. and Kolker, B. (1985). Imagery level of text: Tentative observations. In G. H. McNinch (Ed.), Reading Research in 1984: Comprehension, Computers, and Communications. Fifth Yearbook of the American Reading Forum (pp. 32-35). Athens, GA: University of Georgia.

Thorndyke, P. (1975). Conceptual complexity and imagery in comprehension and memory. Journal of Verbal Learning and Verbal Behavior, 14, 359-369.

Thornton, G. (1986). The APU and the assessment of reading. In D. Vincent, A. K. Pugh, and G. Brooks (Eds.), Assessing Reading, Proceedings of the UKRA Colloquium on the Testing and Assessment of Reading (pp. 29-40). London: MacMillan Education.

Tirre, W., Manelis, L., and Leicht, K. (1979). The effects of imaginal and verbal strategies on prose comprehension by adults. Journal of Reading Behavior, 11(2), 99-106.

Toglia, M. P. and Battig, W. F. (1978). Handbook of Semantic Word Norms. Hillsdale: Lawrence Erlbaum Associates.

Trabasso, T. (1981). On the making of inferences during reading and their assessment. In J. Guthrie (Ed.), Comprehension and Teaching: Research Reviews (pp. 56-75). Newark, DE: International Reading Association.

Trabasso, T. and Sperry L. L. (1985). Causal relatedness and importance of story events. Journal of Memory and Language, 24, 595-611.

Trabasso, T. and van den Broek, P. (1985). Causal thinking and the representation of narrative events. Journal of Memory and Language, 24, 612-630.

Tuinman, J. (1971). Asking reading-dependent questions. Journal of Reading, 14(5), pp. 289-292, 336.

Tuinman, J. (1984). Book review. Journal of Reading Behavior, 16(2), 159-164.

Tulving, E. (1972). Episodic and semantic memory. In E. Tulving and W. Donaldson (Eds.), Organization of Memory. New York: Academic Press.

Tulving, E. and Thompson, D.M. (1973). Encoding specificity and retrieval processes in episodic memory. Psychological Review, 80(5), 352-373.

Turner, A. and Greene, E. (1977). Construction and use of a propositional textbase. Technical Report No. 63, Institute for the Study of Intellectual Behavior. Boulder, CO: University of Colorado.

Valencia, S. and Pearson, P. D. (1987). Reading assessment: Time for a change. The Reading Teacher, 40(8), 726-732.

de Villiers, P. (1974). Imagery and theme in recall of connected discourse. Journal of Experimental Psychology, 103(2), 263-268.

Vipond, D. (1980). Micro- and macroprocesses in text comprehension. Journal of Verbal Learning and Verbal Behavior, 19, 276-296.

Walker, W. (1982). Retrieval of knowledge from memory: A generalization of the Raaijmakers-Shiffrin retrieval model. Unpublished Doctoral Dissertation, University of Colorado.

Walker, C. H. and Yekovich, F. R. (1984). Script-based inferences: Effects of text and knowledge variables on recognition memory. Journal of Verbal Learning and Verbal Behavior, 12, 357-370.

Warren, W. H., Nicholas, D. W. and Trabasso, T. (1979). Event Chains and Inferences in Understanding Narratives. In R. O. Freedle (Ed.), New Directions in Discourse Processing, Vol. 2 (pp. 23-51). Norwood, NJ: Ablex.

Watts, G. and Anderson, R. C. (1971). Effects of three types of inserted questions on learning from prose. Journal of Educational Psychology, 62(5), 387-394.

Weaver, C. and Kintsch, W. (1991). Expository text. In R. Barr, M. Kamil, P. Mosenthal, and P. Pearson (Eds.), Handbook of Reading Research, Vol. II, (pp. 230-245). New York: Longman.

Whitney, P. (1985). Reading achievement and isolable subprocesses. Reading Research Quarterly, 20(5), 654-657.

Wixson, K. and Peters, C. (1987). Comprehension assessment: Implementing an interactive view of reading. Educational Psychologist, 22(3), 333-356.

Wood, N. (1988). Standardized reading tests and the postsecondary reading curriculum. Journal of Reading, 32(3), 224-230.

Yuille, J. (1983). The crisis in theories of mental imagery. In J. C. Yuille (Ed.), Imagery, Memory, and Cognition (263-284). Hillsdale, NJ: Lawrence Erlbaum Associates.

Yuille, J. and Paivio, A. (1969). Abstractness and recall of connected discourse. Journal of Experimental Psychology, 82, 467-471.

Zabrucky, K. (1988). Evaluation of Comprehension in College Students: Effects of Reading Proficiency and Text Structure. Paper presented at the American Educational Research Association, New Orleans.

Zabrucky, K. and Ratner, H. (1989). Effects of reading ability on children's comprehension evaluation and regulation. Journal of Reading Behavior, 21(1), 69-83.

Zimny, S. (1987). Recognition memory for sentences from discourse. Unpublished Doctoral Dissertation. University of Colorado.

APPENDIXES

APPENDIX A

LETTERS AND FORMS

DATA SHEET

SUBJECT'S INITIALS_____

AGE_____ SEX_____

CLASS_____ RACE_____
(Fr/soph/jr/sr)

PASSAGE #1		PASSAGE #2	PASSAGE #3
L 1._____	I. 5._____	L 9._____	L 13._____
L 2._____	I 6._____	L 10._____	L 14._____
L 3._____	I 7._____	I 11._____	I 15._____
L 4._____	I 8._____	I 12._____	I 16._____

PASSAGE #4	PASSAGE #5	PASSAGE #6
L 17._____	L 21._____	L 25._____
L 18._____	L 22._____	L 26._____
I 19._____	I 23._____	I 27._____
I 20._____	I 24._____	I 28._____

PASSAGE #7	PASSAGE #8	
L 29._____	L 33._____	TOTAL # LITERAL:_____
L 30._____	L 34._____	TOTAL # INTERPRETATIVE:_____
I 31._____	I 35._____	
I 32._____	I 36._____	

STATE UNIVERSITY OF NEW YORK
COLLEGE AT ONEONTA
ONEONTA, NEW YORK 13820

June 18, 1990

Ms. Anna Lundy
Reading Center
University of Tennessee
142 Claxton Addition
Knoxville, TN 37996-3505

Dear Ms. Lundy:

Enclosed are the analysis of Passage Five with a comparison of your propositional list and mine. Our analyses on this passage agree on roughly 81% of the propositions. The areas of disagreement tend to be judgmental and frequently involve areas of reference or interpretation of sentence structure.

In the analysis I have indicated next to my list of propositions the proposition number from your analysis which corresponds. Some explanatory notes appear to indicate areas which were not exact matches, but which were conceptually identical in my opinion. There is another case in which two of my propositions correspond to one of yours (P75 and 76 - Irwin are the equivalent of Lundy P76). If this is considered a match, the interrater reliability would be 84%.

It is not necessary to agree completely on all propositions. Certainly, many legitimate claims can be made for several versions. Agreement of 80% or more should be acceptable.

The analysis of the match between questions and the text propositions are also enclosed. There were few problems with the categories Complete Match and No Match. However, in some instances, there were propositions which I felt were conceptually synonymous. In those cases, I indicated the situation with <...> under the Complete Match column and also included the proposition under the Partial Match designation. You will have to make a determination as to which category the propostion more appropriately belongs.

Predicate relations and arguments were the only categories matched, relations which were not predicates (i.e. possession, number of, etc.) were not included in the matching process. This seems consistent with the semantic emphasis of the model.

In addition, I interpreted arguments to mean a complete match. Therefore, when a proposition took the role of an argument, the entire proposition was required in order to make a match. This appeared to be necessary after examination of the data and seemed to be more in the spirit of a semantic match.

If I can be of further assistance, or if you have any questions about my analyses, please feel free to ask. I will be in the Knoxville area about June 30 - July 3. I will contact you then at the Reading Center.

I hope this is helpful to you. I based my decisions on the Turner and Greene manuel and my data from my own dissertation and correspondence with Dr. Turner. If you need any further documentation for your committee, please let me know. I hope the work on you dissertation goes well. Best wishes.

Sincerely,

Linda Irwin-DeVitis

Dr. Linda Irwin-DeVitis
Asst. Professor

THE UNIVERSITY OF TENNESSEE
KNOXVILLE

received
7-13-89

Rt. 4, Box 126, Lakeview Rd.
Louisville, TN 37777

July 5, 1989

The Riverside Publishing Company
8420 Bryn Mawr Avenue
Chicago, IL 60631

Attn: Office of Copyright Affairs

College of Education

Department of Curriculum and Instruction

The Reading Center

Re: Request for permission to use aspects of The Nelson-Denny Reading Test, Form E, in a dissertation study.

Dear Sirs:

The purpose of this letter is to request permission to use aspects of The Nelson-Denny Reading Test, Form E, in a dissertation study investigating textual effects on comprehension. The study involves the propositional analysis of passages in Form E to ascertain number of propositions and hierarchical level of propositions. Further passages will be analyzed for imagery level by a computer program designed to provide this data.

The specific purpose of the study is to determine if there are differences in how students described as good and poor readers respond to literal and interpretative questions and, further, to determine if there are differential effects for density of propositions, hierarchical position of propositions, and imagery level of passages on students' comprehension as measured by the multiple choice questions of Form E.

Given the above account of the purpose of the study and implications of The Nelson-Denny Reading Test, Form E, permission is, hereby, sought to include pages depicting the propositional analyses of passages from From E in the Appendix section of my dissertation. Additional aspects of inclusion of test material in the study is the referencing of word(s) that reflect either a high or low imagery rating. Please be assured that this request is not for the inclusion of intact passages as they appear in the test.

Your consideration of this request and acquiescence to include information from your test as cited above will be greatly appreciated.

Sincerely,

M. Anna Lundy

M. Anna Lundy
Doctoral Candidate

cc: Dr. J. Estill Alexander
Advisor

mal

Claxton Addition 142 / Knoxville, Tennessee 37996-3400 / (615) 974-5448

The Riverside Publishing Company
8420 Bryn Mawr Avenue • Chicago, Illinois 60631-3476 • 1-800/323-9540 • 312/693-0040

July 24, 1989

M. Anna Lundy
Doctoral Candidate
Rt. 4, Box 126
Lakeview Road
Louisville, TN 37777

Dear Ms. Lundy:

This letter authorizes you to conduct research by using the Nelson-Denny Reading test. Each page of the adapted materials should bear the following notice:

> Adapted from the Nelson-Denny Reading Test for research purposes only. Reproduced with permission of the publisher, The Riverside Publishing Company, 8420 W. Bryn Mawr Avenue, Chicago, IL 60631. Copyright 1981.

This is a one-time permission granted for this specific research study only and is granted subject to your use of standard procedures for maintaining test security.

Variations of the original materials used for your study remain the property of the Riverside Publishing Company and should not be used for any other purpose. Please send us a copy of your translation when it is completed.

We are pleased that you have determined that this test may be useful in your research. You may contact our Customer Service Department at 800-323-9540 if you need to purchase copies of test materials.

Sincerely,

Fredrick L. Finch, Vice President
Editor in Chief, Test Division

FLF:mkk
enclosure

cc: A. Brennan

APPENDIX B

VALIDATION OF PROPOSITIONAL ANALYSIS

LINDA'S LIST

ANNA'S LIST

```
1    GIVE (FUNGI, CHEESE, P5) ..........P1
2    CONJ: AND (FLAVOR, COLOR, CHARACTER) ..........P2
3    PRIZE (GOURMET, P2) ..........P3
4    MANNER: (P3, HIGHLY) ..........P4
5    EXTENT OF: (P4, SO) ..........P5

6    FIND (*, P11) ..........P6
7    <ISA (FUNGUS, MOLD) ..........P7
8    QUAL (P7, SUCH) ..........P8
9    QUAL (P8, ONE) ..........P9
10   LOC: IN (P9, CAVES) ..........P10
11   LOC: NEAR (P10, P13) ..........P11
12   QUAL: (VILLAGE, FRENCH) ..........P12
13   ISA (12, ROQUEFORT) ..........P13
14   TIME: WHEN (P6, FIRST) ..........P14

15   SAY (LEGEND, P30) ..........P15
16   LEAVE (P17,P18) ..........P16
17   QUAL: (BOY, PEASANT) ..........P17
18   POSSESS: (LUNCH, *P17) ..........P18
19   QUAL: (PIECE, FRESH) ..........P20
20   QUAL: (P19, MILD) ..........P21
21   QUAL: (CHEESE, GOAT) ..........P23
22   CONSIST OF: (P18, P21) ..........P19
23   <QUAL: (CAVES, P11)
24   QUAN: (P23, ONE) ..........P25
25   LOC: IN (P16, P24) ..........P24
26   FIND (P17, P22, P27) ..........P29
27   CONJ: AND (MARBLED, TART, REDOLENT) ..........P28
28   RETURN, (P17)
29   CONJ: AND, P28, P26)
30   CAUS: BECAUSE, P16, P29)

31   PERMIT (*, P36, P38) ..........P31
32   QUAL: (CAVES, PARTICULAR) ..........P34
33   <REF: P32, P11)
34   LOC: FROM (CHEESE, AREA)
35   LOC: AROUND (P33, P34)
36   COND: (P35, ONLY)
37   QUAL: (NAME, ROQUEFORT) ..........P36
38   BEAR: (P36, P37) ..........P38

39   USE (*, P41) ..........P38
40   POSSESS: (RYE, FUNGUS) ..........P40
41   ISA (P40, ERGOT) ..........P39
42   FACILITATE (P39, CHILDBIRTH) ..........P43
43   PURPOSE: TO, P39, P42) ..........P44
44   QUAL: (CENTURY, SEVENTEENTH) ..........P42
45   TIME: AS EARLY AS, P39, P44) ..........P41
```

(my P30 = P14 30?)

my P36 = P32 + my P38 = P33

I am assuming you meant P36 as your second argument in P35

Do you mean P38 instead of P41 in P44?

```
46   ISA (P48, P53)
47   POSSESS:  ([P41], EFFECTS).....P45
48   QUAN: (P47, ONE).....P46
49   QUAL: (MUSCLE, INVOLUNTARY).....P49
50   QUAL: (P49, UTERUS).....P50
51   QUAL: (P50, PARTICULARLY).....P51
52   QUAL: (CONTRACTION, P52).....P48
53   CAUSALITY: [BECAUSE],(P52, P39)

54   ATTRACT (ERGOT, INTEREST).....P52
55   QUAL (DRUG, HALLUCINOGENIC).....P61
56   QUAL  (P55, LSD).....P62
57   DERIVE (*, P56, P58).....P60
58   ISA, ERGOT, SOURCE, CHEMICAL).....P58
59   QUAL (CENTURY, TWENTIETH).....P53
60   TIME:  IN, (P54, P59).....P54
61   QUAL:  (MORE, ONCE).....P56
62   CONTRAST: (P60, P61)
63   CAUS: [BECAUSE], (P62, P58)

P64  PRODUCE (FUNGI, P66).....P64
P65  QUAL: (ANTIBIOTICS, MODERN).....P65
P66  EXTENT OF:  (P65, MOST).....P66

P67  DISCOVER (ALEXANDER FLEMING, P80, P68).....P67
P68  NOTE ([ALEXANDER FLEMING], P79).....P70
P69  ISA (GENUS, PENICILLIUM).....P72
P70  QUAL:  (MOLD, P69).....P73
P71  CONTAMINATE (P70, P72).....P74
P72  QUAL: (CULTURE, STAPHYLOCOCCUS).....P75
P73  QUAL: (NUTRIENT, AGAR).....P77
P74  QUAL: (PLATE, P73).....P78
P75  GROW, (P72)                    } = P76
P76  LOC: ON, (P75, P74)            }
P77  QUAL: (GROWTH, BACTERIA).....P79
P78  HALT (P70, P77).....P71
P79  EXTENT OF: (P78, COMPLETELY).....P80
P80  NUMBER OF: ([P64], FIRST).....P68

P81  ISA, (ANTIBIOTICS, P82)
P82  PRODUCE (P83, P84, P86)
P83  QUAL (ORGANISM, LIVING).....P88
P84  QUAL (ORGANISM, LIVING')).....P89
P85  QUAL (P84, ANOTHER).....P90
P86  INJURE, (*, P85).....P91
P87  QUAN: (ANTIBIOTICS, MANY HUNDREDS).....P83
P88  DISCOVER, (*, P88).....P82
P89  TIME: NOW (P88).....P84
```

APPENDIX C

PROPOSITIONAL ANALYSES FOR TEXTBASE, MACROLEVEL II, AND QUESTIONS

Propositional Analysis of Text500.txt.

P1 reference [marketing, P2]
P2 consist-of [performance, P3]
P3 qualify [activities, P4]
P4 qualify [business, those]
P5 direct [P2, P7]
P6 conj: and [goods, services]
P7 qualify [flow, P6]
P8 loc: from [producer]
P9 loc: to [P10]
P10 reference: or [consumer, user]
P11 manner: [P5, P8, P9]

P12 qualify [marketing, P13]
P13 connect, [link, P14]
P14 conj: and [producer, P15]
P15 reference: or [consumer, user]

P16 bring [P17, P18]
P17 qualify [system, marketing]
P18 conj: and [production, consumption]
P19 manner [P16, together]

P20 engage in [P24, P25]
P21 qualify [persons, P22]
P22 quality of [employed, gainfully]
P23 extent of [P21, one in every six]
P24 qualify [P23, approximately]
P25 qualify [activities, P23]
P26 disjunction: or [wholesaling, retailing]
P27 manner [P17, directly]

P28 reference [ratio, P23]
P29 take into account [P28, P27]
P30 qualify [persons, other]
P31 serve [P30, marketing]
P32 manner, through [P31, P33]
P33 conj: and [transportation, communication, P34]
P34 qualify [jobs, office]
P35 negate [P29]

P36 provide [marketing, opportunities]
P37 purpose: for [P36, P40]
P38 extent of [kinds, many]
P39 qualify [P38, jobs]
P40 require [P39, P42]
P41 qualify [range, wide]
P42 qualify [P41, P43]
P43 conj: and [skills, abilities]

P44 exist [opportunities
P45 location: in [P44, P46]
P46 conj: and [management, advertising, P47, buying]
P47 qualify [research, P48]
P48 conj: and [market, product]
P49 think of [$, P50]

P50 qualify [selling, P51]
P51 reference [occupation, primary]
P52 location: in [P49, marketing]
P53 manner [P52, naturally]
P54 concession: although [P53, P44]

P55 determine [P56, P57]
P56 conj: and [productivity, consumption, employment]
P57 qualify [well-being, economic]
P58 qualify [P57, P59]
P59 possess [$, country]
P60 manner [P51, largely]

P61 affect [P62, P64]
P62 qualify [efficiency, P63]
P63 qualify [process, marketing]
P64 extent of [three, all]

P65 consume [people, goods]
P66 manner: at [P65, P67]
P67 qualify [rate, high]
P68 stimulate [marketing, demand]
P69 condition: if [P68, P66]

P70 require [P71, P72]
P71 qualify [consumption, high]
P72 qualify [productivity, high]
P73 meet [P70, P74]
P74 qualify [wants, people]
P75 conj: and [P72, P78]
P76 combine [$, P75]
P77 location: in [P76, marketing]
P78 qualify [activity, high-level]
P79 result in [P77, P80]
P80 qualify [employment, high]

P81 reference [marketing, key to, P83]
P82 qualify [level, high]
P83 qualify [P82, P84]
P84 qualify [living, economic]
P85 manner [P81, indirectly]

Macrostructure--Level I for text500.txt

P1 comprise of [marketing, P3]
P2 qualify [activities, business]
P3 bring [$P2, P4]
P4 conj: and [production, consumption]
P5 manner [P3, together]

P6 work in [P7, P8]
P7 extent of [employees, one of every six]
P8 conj: or [wholesaling, retailing]
P9 qualify [P6, approximately]
P10 conj: and [P9, P15
P11 include, P11, P13]
P12 employ in [$, P14]
P13 conj: and [transportation, communication, P15]
P14 qualify [jobs, office]
P15 negate P12

P16 consider [$, P19]
P17 reference [selling, P18]
P18 qualify [job, primary]
P19 location: in [P18, marketing]
P20 concession: although [P19, P31]
P21 require [P22, P29]
P22 qualify [jobs, P23]
P23 qualify [marketing, other]
P24 contrast: such as [P22, P26]
P25 conj: and [management, advertising, P27, buying]
P26 qualify [research, P28]
P27 conj: and [market, product]
P28 extent of [range, wide]
P29 qualify [P28, P30]
P30 conj: and [skills, abilities]
P31 manner [P21, also]

P32 determine [P33, P36]
P33 conj: and [productivity, consumption, employment]
P34 qualify [well-being, economic]
P35 possess [$, country]
P36 qualify [P34, P35]
P37 manner [P32, largely]

P38 concession: since [P41, P46]
P39 qualify [efficiency, P40]
P40 qualify [process, marketing]
P41 affect [P39, P42]
P42 extent of [three, all]
P43 qualify [marketing, responsible for, P45]
P44 qualify [prosperity, economic]
P45 qualify [P44, people]
P46 manner [P43, indirectly]

Macrostructure--Level II for text500.txt

P1 bring [marketing, P2]
P2 conj: and [production, consumption]
P3 manner [P1, together]

P4 qualify [person, employed]
P5 work [P4]
P6 number of [P4, one in every six]
P7 work in [P6, marketing]
P8 contrast: more than [P5, P7]

P9 offer [marketing, P10]
P10 qualify [jobs, P11]
P11 require [$jobs, skill in , P12]
P12 conj: and [selling, management, advertising, research, buying]

P13 qualify [marketing, responsible for, P15]
P14 qualify [well-being, economic]
P15 qualify [P14, country]
P16 manner [P13, indirectly]

Propositional Analysis of Questions for Text500.txt.

Question 9

P1 determine [factors, P3]
P2 qualify [well-being, economic]
P3 possess [$, P2]
P4 manner [P1, largely]
P5 question: [P4, how many]

Question 10

P1 mention [$text, P4]
P2 qualify [factor, P3]
P3 number of [major, one]
P4 affect [P2, P6]
P5 qualify [well-being, economic]
P6 possess [$, P5]
P7 question: [P4, what]

Question 11

P1 reference [P2, ?]
P2 qualify [purpose, passage]
P3 question: [P1, what]

Question 12

P1 reference [P2, ?]
P2 qualify [emphasis, chief]
P3 question: [P1, what]

Propositional Analysis of Text501.9.txt.

P1 reference [P2, P3]
P2 qualify [energy, atomic]
P3 qualify [energy, P4]
P4 hold [$, P5]
P5 qualify [nucleus, atom]
P6 manner [P4, together]

P7 believe [$, P8]
P8 originate from [P9, P14]
P9 possess [sun, energy]
P10 qualify [reactions, atomic]
P11 build up from [P12, P13]
P12 qualify [nuclei, helium]
P13 qualify [nuclei, hydrogen]
P14 location: in [P11, P10]

P15 find [$, P16]
P16 contrast: less than [P17, P20]
P17 qualify [mass, P18]
P18 qualify [nucleus, atomic]
P20 qualify [mass, total]
P21 qualify [P20, P22]
P22 qualify [particles, separate]
P23 qualify [P22 P24]
P24 make up [$P22, $P17]

P25 reference [reason, $for P16, P35]
P26 change into [P27, energy]
P27 qualify [part, mass]
P28 qualify [P27, P29]
P29 consist of [P27, P30]
P30 qualify [particles, component]
P31 form [nucleus]
P32 time: when [P31, P26]
P33 radiate [$energy]
P34 manner [P33, away]
P35 time: then [P32, P33]

P36 qualify [quantity, energy]
P37 release, [P36]
P38 location, in [P37, P39]
P39 qualify [reaction, kind]
P40 qualify [greater than, P41]
P41 qualify [inconceivably, almost]
P42 contrast: P40 [P38, P44]
P43 qualify [quantity, P44]
P44 release by [P48]
P45 qualify [type, other]
P46 extent of [P45, any]
P47 qualify [P46, reaction]
P48 involve [$P47, P50]
P49 qualify [quantities, similar]
P50 qualify [P49, material]

P51 extent of [second, every]

P52 send into [sun, space, P61]
P53 contrast: as much...as [energy, P58]
P54 number of [times, million]
P55 store [$energy]
P56 conj: and [coal, petroleum, P57]
P57 qualify [gas, natural]
P58 location: in [P55, P60]
P59 possess [$, P56]
P60 extent of [P59, all]
P61 extent of [P53, P54]
P62 time [P52, P51]

P63 cond: if [P64, P69]
P64 possible [P65]
P65 duplicate [$, P66]
P66 qualify [method, P67]
P67 release [$, energy]
P68 possible [P69]
P69 revoluntize [$, world]

P70 conj: and [P71]
P71 qualify [possibility, P72]
P72 do [$, P73]
P73 qualify [$P63, just]
P74 qualify [P71, P78]
P75 extent of [fantastic, more]
P76 negate [P75]
P77 time [P76, today]
P78 contrast: than [P77, P79]
P79 qualify [concept, P80]
P80 qualify [bomb, atomic]
P81 time: in [P77, 1990]
P82 possible [P83]
P83 come [time]
P84 time: when [P82, P89]
P85 provide from [hydrogen, P86, P87]
P86 quantity of [sea water, cubic mile]
P87 extent of [energy, enough]
P88 purpose: to [P85, P88]
P89 satisfy [$, P90]
P90 possess [$, needs]
P91 manner: at [P89, P94]
P92 qualify [rate, 1960]
P93 number of [centuries, 300]
P94 extent of [P92, P93]

Macrostructure--Level I for text 501.9

P1 reference [P2, P3]
P2 qualify [energy, atomic]
P3 qualify [$energy, P4]
P4 hold [energy, P5]
P4 qualify [nucleus, atom]
P6 manner [P4, together]

P7 feel [$, P8]
P8 originate from [P8, P10]
P9 possess [sun, energy]
P10 qualify [reactions, atomic]
P11 qualify [P9, P12]
P12 conj: and [helium, hydrogen]

P13 qualify [mass, P14]
P14 qualify [nucleus, atomic]
P15 qualify [mass, P16]
P16 possess [mass, P17]
P17 qualify [particles, separate]
P18 contrast: less than [P13, P15]

P19 condition: as a result of [P10, P20]
P20 emit [sun, P29]
P21 time: P22 [P20]
P22 qualify [second, every]
P23 store [$energy]
P24 location: in [P23, P26]
P25 possess [$, P27]
P26 extent of [P25, all]
P27 conj: and [coal, petroleum, P28]
P28 qualify [fields, natural gas]
P29 contrast: more...than [energy, P24]

P30 qualify [P31, fantastic]
P31 qualify [possibility, P36]
P32 duplicate [$, P33]
P33 possess [sun, P34]
P34 qualify [method, P35]
P35 qualify [release, energy]
P36 result: thereby [P38]
P37 conj: and [P31, P36]
P38 revoluntionize [$, world]
P39 negate [P30]

P40 time: in the future [P41]
P41 possible [P42]
P42 derive from [$, energy, P43]
P43 location: in [hydrogen, sea water]

Macrostructure--Level II for text 501.9

P1 feel [$, P2]
P2 come from [P3, P4]
P3 possess [sun, energy]
P4 qualify [reaction, atomic]

P5 emit [P7]
P6 qualify [quantities, large]
P7 qualify [P6, energy]
P8 time: during [P5, reactions]

P9 release [$, energy]
P10 location: in [P9, reactions]

<P11 release [$, energy]
P12 location: $in [P11, P15]
P13 qualify [type, P14]
P14 qualify [other, any]
P15 qualify [P13, reaction]
P16 contrast: greater than [P10, P12]

P17 possible [P18]
P18 derive from [$, P20, sea water]
P19 qualify [quantities, large]
P20 qualify [P19, energy]
P21 time: in the future [P17]

Propositional Analysis of Questions for Text501.9.txt.

Question 13

P1 mention [$text, P2]
P2 qualify [water, sea]
P3 question: [P1, how much]

Question 14

P1 speak [$text, P6]
P2 release [P3]
P3 qualify [quantity, energy]
P4 qualify [reaction, atomic]
P5 location: in [P2, P4]
P6 contrast: greater than [P5, P7]
P7 qualify [types, other]
P8 question: [P6, how much]

Question 15

P1 reference [P2, ?]
P2 qualify [focus, primary]
P3 question: [P1, what]

Question 16

P1 describe [$, passage]
P2 manner [P1, best]
P3 question: how [P2]

Propositional Analysis of Text503.txt.

```
  P1 try to [P3, P6]
  P2 extent of [skeptics, most]
  P3 qualify [P2, even]
  P4 manner [P1, hard]
  P5 discount [possibility]
  P6 negate [P5]
 <P7 reference [possibility, P12]
  P8 cause: because [P1, P10]
  P9 appear to [$, $P2, P10]
 P10 share [P11]
 P11 reference, hope, P12
 P12 location: on [life, Mars]

 P13 conc: but [P15, P16]
 P14 reference [$, comedown]
 P15 time: in [P14, mid-1960's]
 P16 time:  when [P17]
 P17 qualify [scientists, P18]
 P18 involve in [$, P19]
 P19 qualify [exploration, Mars]
 P20 study [P17, P21]
 P21 qualify [photos, P22]
 P22 take by [P23]
 P23 qualify [some, P24]
 P24 qualify [flights, space]
 P25 qualify [P24, Mariner]
 P26 qualify [P25, early]

 P27 possess [<Mars, canals]
 P28 negate [P27]
<P29 cause:  [P13, P28]

 P30 possess [<Mars, seas]
 P31 negate [P30]
<P32 cause:  [P13, P31]

 P33 possess [<Mars, P34]
 P34 qualify [engineers, Martian]
 P35 qualify [P34, busy]
 P36 negate [P33]
<P37 cause:  [P13, P33]

 P38 possess [<Mars, P39]
 P39 qualify [Martians, warlike]
 P40 qualify [P39, menacing]
 P41 qualify: as [P38, huge]
 P42 qualify: as [P41, skyscrapers]
 P43 negate [P38]
<P44 cause:  [P13, P38]

 P45 possess [<Mars, P46]
 P46 conj: and [mountains, craters, P47, P48]
 P47 qualify [winds, cold]
 P48 qualify [storms, dust]
 P49 extent of [P45, just]
```

P50 cause: [P13, P49]

P51 contrast: as [$, P59]
P52 return to/with [P53, P54, P55]
P53 qualify [scouts, Columbus]
P54 possess [Isabella, court]
P55 reference [news, P57]
P56 turn out [world, flat]
P57 cond: after [P56, all]
P58 cond: if [P52]
P59 qualify [P58, almost]

P60 remind, P61, $, P62
P61 qualify [astronomers, hopeful]
P62 photograph from [Mariner IV, P65, P68]
P63 number of [percent, one]
P64 extent of [P63, mere]
P65 qualify [P64, P66]
P66 qualify [surface, Martian]
P67 extent of [miles, 2,000]
P68 qualify [P67, away]

P69 conj: and [$P60, P70]
P70 point out [$, $P61, P71]
P71 shoot [P72, P75]
P72 qualify [satellite, P73]
P73 qualify [weather, P74]
P74 qualify [Tiros, Earth-orbiting]
P75 number of [pictures, 20,000]
P76 extent of [P75, over]
P77 uncover [$, P79]
P78 qualify [evidence, any]
P79 qualify [P78, life]
P80 location: on [P77, Earth]
P81 conj: before [P71, P77]

P82 concession: but [$P69, P83]
P83 cond: still [P84]
P84 wilt [P85, P86]
P85 qualify [enthusiasm, public]
P86 qualify [exploration, Martian]

P87 touch down [Viking I]
P88 location: on [P87, P89]
P89 qualify [Plain, Chryse
P90 time: in [P88, August]
P91 cond: by the time [P87, P92]
P92 seem to [$, P93]
P93 qualify [care, at all]

P94 reference [J. Richard Keefe, P95]
P95 qualify [one, P96]
P96 qualify [scientist, Viking]
P97 declare [P94, P98]
P98 disgust at [$P94, P99]
P99 call [$94, P105]
P100 qualify [response, P101]
P101 qualify [public, blase...apathetic]

P102 conj: and [P100, P104]
P103 qualify [coverage, television]
P104 qualify [P103, skimpy]
P105 qualify [P102, P107]
P106 qualify [one, certainly]
P107 qualify [P106, P112]
P108 qualify [scientific, magnificent]
P109 qualify [accomplishment, technical]
P110 conj: and [P108, P109]
P111 qualify [history, human]
P112 location: in [P110, P111]

Macrostructure-Level I for text503

P1 want [P2, P3]
P2 qualify [skeptics, even]
P3 believe, P4
P4 location: on [life, mars]

P5 concession: but [P1, P9]
P6 qualify [spacecraft, Mariner]
P7 qualify [photos, P8]
P8 take by [P6]
P9 create [P7, disappointment]
P10 time: when [P9, P11]
P11 find [$, P13]
P12 qualify [signs, life]
P13 negate [P12]

P14 contrast: as [$P11, P15]
P15 cond: if [P16]
P16 discover [Columbus, P17]
P17 qualify [world, flat]

P18 point out [astronomers, P28]
P19 photograph [$, P23]
P20 number of [percent, one]
P21 qualify [P24, only]
P22 possess [Mars, surface]
P23 qualify [P20, P22]
P24 conj: and [P19, P26]
P25 take [$, P26]
P26 number of: [picture, P27]
P27 extent of: over [20,000]
P28 cond: before [P29, P24]
P29 find [$, P31]
P30 qualify [evidence, life]
P31 qualify [P30, any]

P32 concession: however [P18, P36]
P33 fade [P34, P35]
P34 qualify [enthusiasm for, public]
P35 qualify [exploration, Martian]

P36 land [Viking I]
P37 location: on [P36, Mars]
P38 time: when [P36, P39]
P39 care [P40]
P40 extent of [people, few]

P41 qualify [scientist, Viking]
P42 number of [P41, one]
P43 remark [$P41, P44]
P44 disgust at [$, P50]
P45 qualify [lack, P46]
P46 qualify [response, public]
P47 conj: and [P45, P50]
P48 qualify [coverage, television]
P49 extent of [P48, skimpy]

P50 qualify [P47, P54]
P51 number of [P53, one]
P52 qualify [accomplishment, important]
P53 extent of [P52, most]
P54 location: in [P51, P55]
P55 qualify [history, human]

Macrostructure--Level II for text503

P1 reveal [P2, P4]
P2 qualify [photos, Mars]
P3 qualify [signs, life]
P4 negate [P3]
P5 time: when [P1, P6]
P6 result [disappointment]

P7 concession: although [P12, P13]
P8 number of [percent, one]
P9 extent of [P8, only]
P10 qualify [P9, P11]
P11 qualify [surface, Martian]
P12 photograph [$, P10]
P13 fade [P14]
P14 qualify [interest, public]

P15 land [Viking I]
P16 location: on [P15, Mars]
P17 cond: by the time [P16, P20]
P18 possess [people, interest]
P19 negate [P18]

Propositional Analysis of Questions for Text503.txt

Question 17

P1 qualify [satellite, weather]
P2 number of [P1, one]
P3 name [P2, ?]
P4 question: what [P3]

Question 18

P1 photograph [P2, P3]
P2 qualify [one, Mariner]
P3 qualify [surface, Mars]
P4 question: how much [P1]

Question 19

P1 diminish in [interest, Mars]
P2 qualify [P1, largely]
P3 cause: [P1]
P4 question: what [P3]

Question 20

P1 use [$, P2]
P2 qualify [mention, P3]
P3 qualify [world, flat]
P4 point up [$, ?]
P5 purpose: to [P1, P4]
P6 question: what [P5]

Propositional Analysis of Text504.txt

```
  P1 give [fungi, cheese, P2]
  P2 conj: and [flavor, odor, character]
  P3 prize [$P2, gourmet]
  P4 manner [P3, highly]
  P5 extent of [P4, so]

  P6 find [$, P9]
 <P7 isa [mold, fungus]
  P8 qualify [P7, such]
  P9 number of [P8, one]
 P10 location: in [P9, caves]
 P11 location: near [P10, P13]
 P12 qualify [village, French]
 P13 qualify [P12, Roquefort]
 P14 qualify [P6, first]

 P15 maintain [legend, P16, P30]
 P16 leave [P17, P18]
 P17 qualify [boy, peasant]
 P18 possess [$P17, P19]
 P19 consist of [lunch, P22]
 P20 qualify [piece, fresh]
 P21 qualify [P20, mild]
 P22 consist of [P20, P23]
 P23 qualify [cheese, goat]
 P24 location: in [P16, P25]
 P25 number of [caves, one]
 P26 conj: and [P16, P30]
 P27 find [$P17, P29]
 P28 conj: and [marbled, tart, redolent]
 P29 qualify [$P19, P28]
 P30 cond: on [return, P27]

 or

 P15 maintain [legend, P16, P30]
 P30 time: on [return, P27]

 P31 permit from [$, P32, P33]
 P32 qualify [cheeses, only]
 P33 extent of:  around [area, P34]
 P34 qualify [caves, particular]
 P35 bear [$32, P34]
 P36 qualify [name, Roquefort]
 P37 cond: to [P31, P35]

 P38 use [$, P39]
 P39 isa [ergot, P40]
 P40 qualify [fungus, rye]
 P41 time: as early as [P38, P42]
 P42 qualify [century, seventeenth]
 P43 facilitate [$P38, childbirth]
 P44 purpose: to [P41, P43]

 P45 possess [$P39, effects]
```

P46 number of [P45, one]
P47 reference [P46, P48]
P48 qualify [contraction, P49]
P49 qualify [muscles, involuntary]
P50 qualify [P49, uterus]
P51 qualify [P50, particularly]

P52 attract [ergot, interest]
P53 qualify [century, twentieth]
P54 time: in [P52, P53]
P55 qualify [P54, P56]
P56 extent of [more, once]
P57 cause: as [P56, P58]
P58 consist of [source, chemical]
P59 qualify [P58, P60]
P60 derive from [$, $P58, P62]
P61 qualify [drug, hallucinogenic]
P62 reference [P61, LSD]
<P63 contrast: once more [P57, P44]

P64 produce [fungi, P66]
P65 qualify [antibiotics, modern]
P66 extent of [P65, most]

P67 discover [P69, P68]
P68 number of [$P66, first]
P69 qualify [A. Fleming, P70]
P70 note [$, P80]
P71 halt [P73, P79]
P72 isa [genus, penicillium]
P73 qualify [mold, P72]
P74 contaminate [$P73, P75]
P75 qualify [culture, staphylococcus]
P76 grow on [$P75, P78]
P77 qualify [agar, nutrient]
P78 qualify [plate, P77]
P79 consist of [growth, bacteria]
P80 qualify [P71, completely]

P81 qualify [antibiotics, P82]
P82 discover [$, P83]
P83 extent of [hundreds, many]
P84 time [P82, now]
P85 reference [P81, P86]
P86 qualify [substance, P87]
P87 produce by [P91]
P88 qualify [organism, living']
P89 qualify [organism, living"]
P90 qualify [P89, another]
P91 injure [P88, P90]

Macrostructure--Level I for text504

P1 give [fungi, cheese, P2]
P2 possess [$cheese, P3]
P3 conj: and [flavor, odor, character]

P4 discover [$, P8]
P5 number of [P6, one]
P6 qualify [mold, such]
P7 location: in [P4, caves]
P8 location: near [P7, P10]
P9 qualify [village, French]
P10 qualify [P9, Roquefort]

P11 possible [P12]
P12 name from [$, P13, P14, Roquefort]
P13 qualify [cheeses, only]
P14 qualify [area, cave]

P15 use [$, P16]
P16 qualify [fungus, ergot]
P17 facilitate [childbirth]
P18 purpose: to [P15, P17]
P19 qualify [century, seventeenth]
P20 time: as early as [P18, P19]

P21 attract [ergot, P22]
P22 reference [interest, source]
P23 qualify [P22, P24]
P24 isa [LSD, drug]
P25 time: in [P21, P26]
P26 qualify [century, twentieth]

P27 produce [fungi, P29]
P28 qualify [antibiotics, modern]
P29 extent of [P28, most]

P30 discover [Alexander Fleming, P32]
P31 qualify [antibiotic, first]
P32 reference [P31, penicillium]
P33 note [$, P34]
P34 stop [P35, P36]
P35 qualify [mold, penicillium]
P36 qualify [growth, P37]
P37 qualify [bacteria, staphylococcus]
P38 time: when [P30, P33]

P39 extent of [antibiotics, hundreds]
P40 discover [$, P39]
P41 conj: and [P40, P48]
P42 reference [P42, substances]
P43 qualify [organism, living']
P44 number of [P46, one]
P45 injure [P43, P47]
P46 qualify [organism, living"]
P47 qualify [P46, another]
P48 produce by [P42, P45]

Macrostructure--Level II for text504

P1 give [P2, P4]
P2 isa [fungus, mold]
P3 isa [Roquefort, cheese]
P4 possess [P3, P5]
P5 conj: and [flavor, odor, character]

P6 qualify [fungus, ergot]
P7 use [$, P6]
P8 facilitate [childbirth]
P9 purpose: to [P7, P8]
P10 conj: and [P9, P11]
P11 become [$P6, P12]
P12 know-as [$P6, P13]
P13 consist of [source, LSD]

P14 produce [fungi, P15]
P15 reference, such as [antibiotics, P15]
P16 isa [penicillium, mold]
P17 qualify [P14, also]

P18 discover [$, P19]
P19 number of [antibiotics, hundreds]
P20 conj: and [P18, P21]
P21 involve [$, P22]
P22 injure [P24, P25]
P23 qualify [organism, living']
P24 number of [P23, one]
P25 qualify [$P23", another]

Propositional Analysis of Questions for Text504.txt

Question 21

P1 use [$, P2]
P2 reference [fungus, medicine]
P3 qualify [century, ?]
P4 time: as early as [P1, P3]
P5 question: what [P3]

Question 22

P1 discover [$, P2]
P2 number of [antibiotics, ?]
P3 question: how many [P2]

Question 23

P1 reference [passage, ?]
P2 qualify [P1, mainly]
P3 question: what about [P2]

Question 24

P1 mention [<text, LSD]
P2 qualify [P1, specifically]
P3 purpose: to [P2, P4]
P4 show [P5]
P5 ? [ergot]
P6 question: why [P3]

APPENDIX D

WORKSHEETS FOR QUESTION/TEXT AND QUESTION/PROPOSITIONAL MATCHING

I

QUESTION/TEXT WORD MATCHES
(Worksheet)

Question #:	Number of Word Matches					
	0	1-5	6-10	11-15	16-20	21-25
9		5				
10		2				
11	0					
12	0					
13		2				
14				11		
15	0					
16	0					
17		2				
18		2				
19	0					
20	0					
21	0					
22		4				
23	0					
24		2				

II

QUESTION/TEXT WORD MATCHES
(Worksheet)

Question #:	0	1-5	6-10	11-15	16-20	21-25
9			7			
10		3				
11	0					
12	0					
13		2				
14				13		
15	0					
16	0					
17		2				
18			7			
19	0					
20		3				
21			7			
22		4				
23	0					
24		2				

III

QUESTION/TEXT WORD MATCHES
(Worksheet)

Question #:	Number of Word Matches					
	0	1-5	6-10	11-15	16-20	21-25
9			7			
10		4				
11	0					
12	0					
13		2				
14						
15	0					
16	0					
17		2				
18				11		
19	0					
20	2					
21			7			
22		3				
23	0					
24			3			

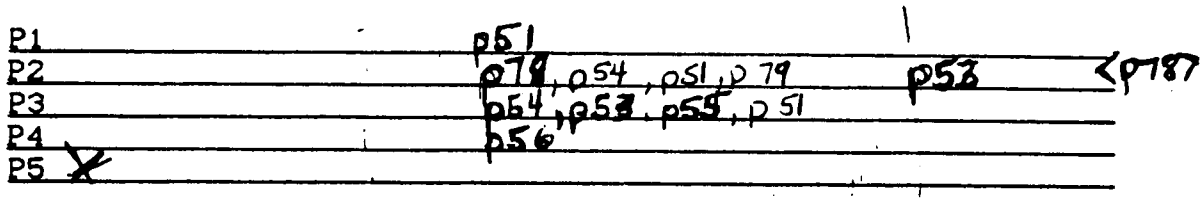
30

WORKSHEET

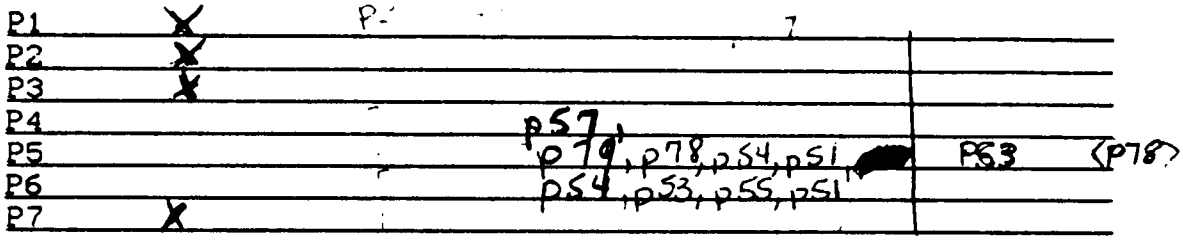
PROPOSITIONAL MATCHING
TEXTBASE
Text500

NO MATCH PARTIAL MATCH COMPLETE MATCH

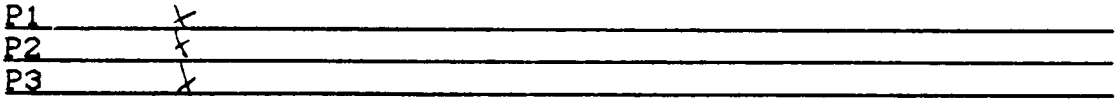
Q9



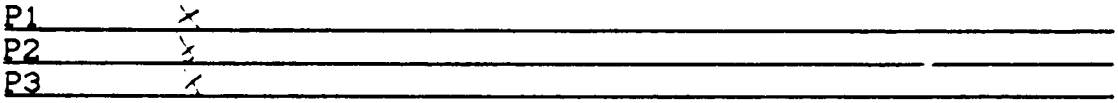
Q10



Q11



Q12



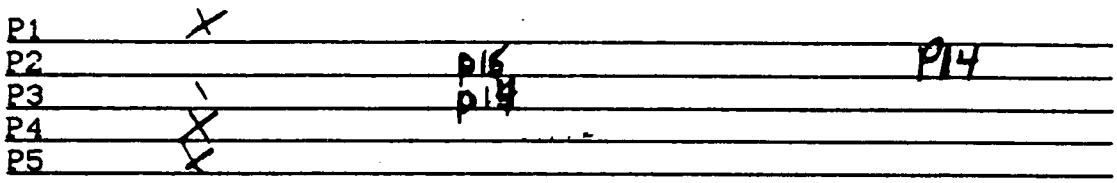
<synonomous not exact>

WORKSHEET

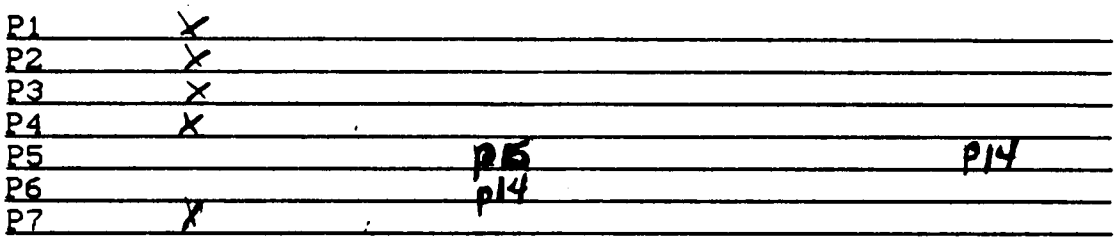
PROPOSITIONAL MATCHING
MACROLEVEL II
Text500

NO MATCH PARTIAL MATCH COMPLETE MATCH

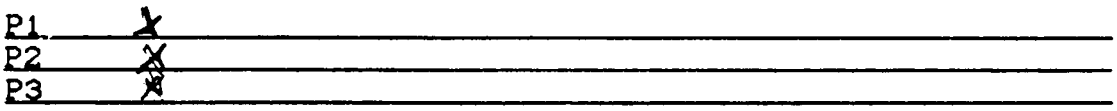
Q9



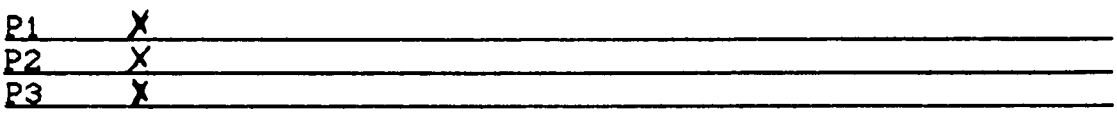
Q10



Q11

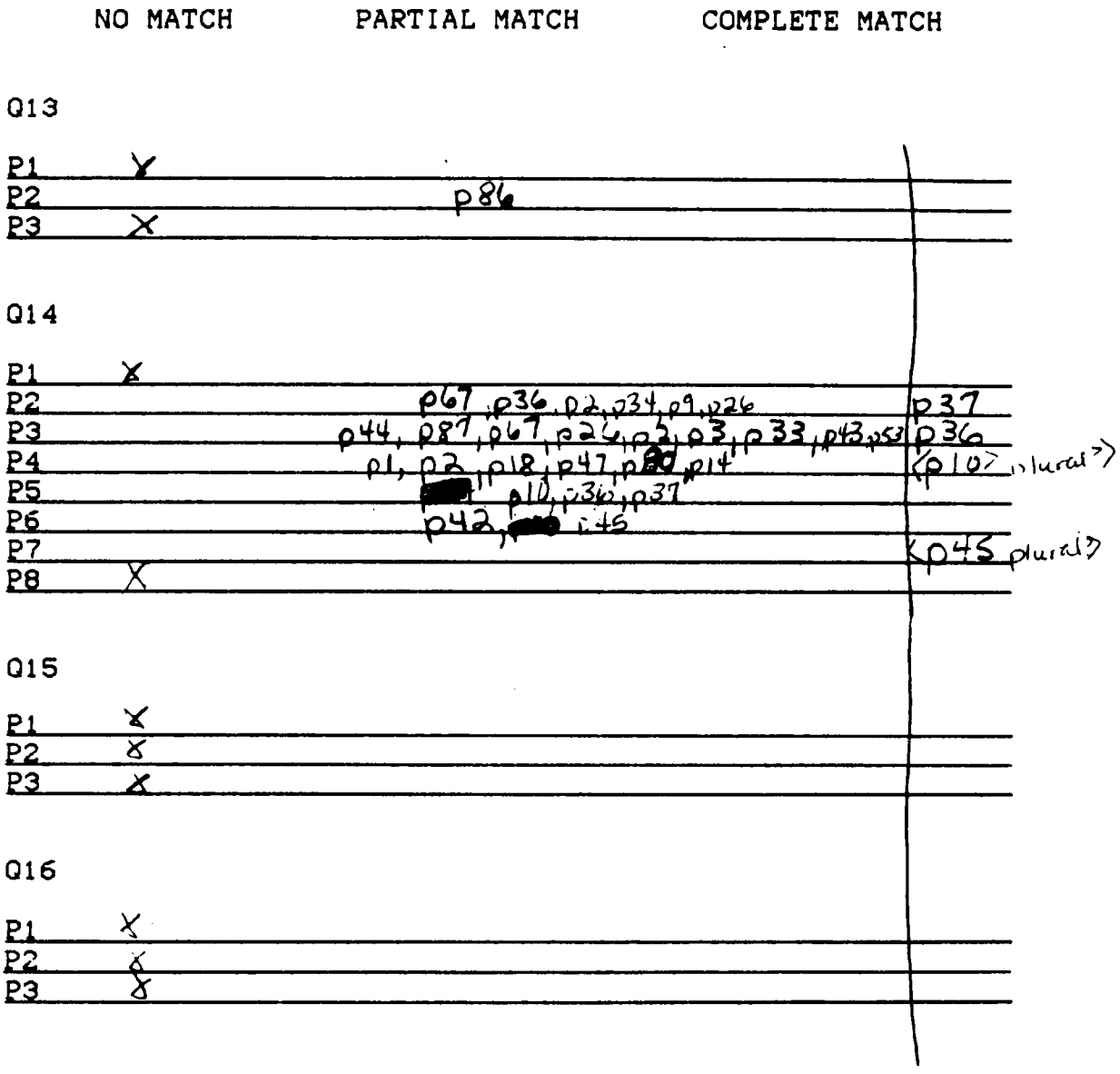


Q12



WORKSHEET

PROPOSITIONAL MATCHING
TEXTBASE
Text501.9



WORKSHEET

PROPOSITIONAL MATCHING
MACROLEVEL II
Text501.9

	NO MATCH	PARTIAL MATCH	COMPLETE MATCH
Q13			
P1	X		
P2		P18	
P3	X		
Q14			
P1	X		
P2		P11, P9, P6, P20,	<P11
P3		P3, P6, P20, P14, P7, P9, P11	<P7
P4		P8, P10, P15	P4
P5		P4, P8, P10, P12, P11	
P6		P6	
P7		P13, P14	<P13
P8	X		
Q15			
P1	X		
P2	X		
P3	X		
Q16			
P1	X		
P2	X		
P3	X		

WORKSHEET

PROPOSITIONAL MATCHING
TEXTBASE
Text503

NO MATCH PARTIAL MATCH COMPLETE MATCH

Q17

P1 p72, p73
P2 p64, p106, p63
P3 X
P4 X
~~P5~~

Q18

P1 <P217, p66
P2 <p627, p68, p106, p25
P3 p12, p19, p27, p30, p33, p38, p45, p66 <P667
P4 X

Q19

P1 p12, p19, p27, p33, p38, p45, p30 <P84>
P2 X
P3 X
P4 X

Q20

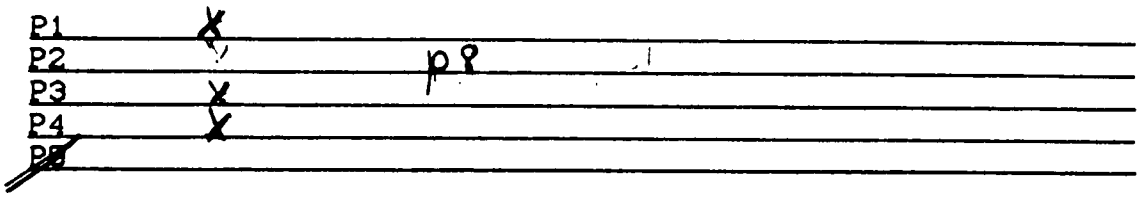
P1 X
P2 X
P3 p56
P4 X
P5 X
P6 X

WORKSHEET

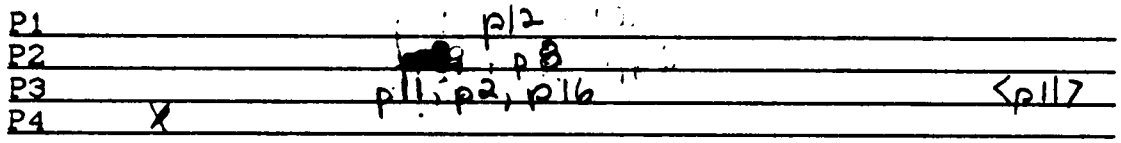
PROPOSITIONAL MATCHING
MACROLEVEL II
Text503

NO MATCH PARTIAL MATCH COMPLETE MATCH

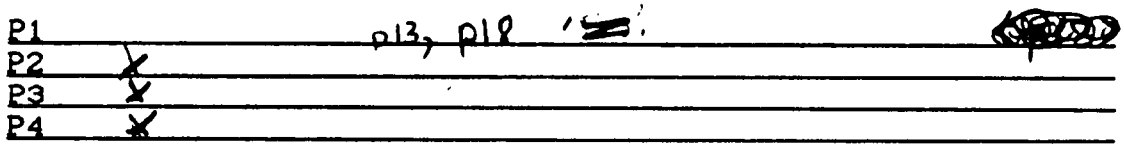
Q17



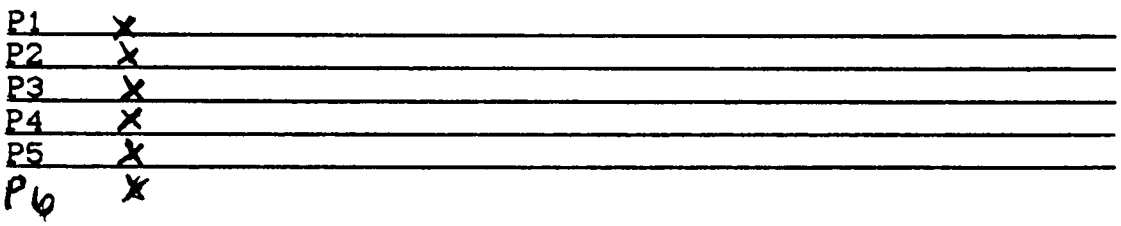
Q18



Q19



Q20



WORKSHEET

PROPOSITIONAL MATCHING
TEXTBASE
Text504

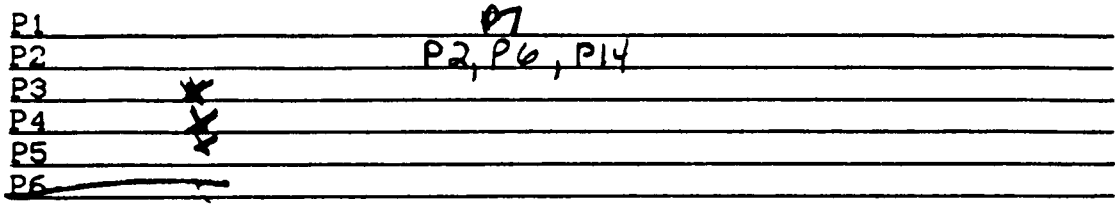
	NO MATCH	PARTIAL MATCH	COMPLETE MATCH
Q21			
P1		P38	
P2		P7, P40, P64 (plural)	
P3		P42, P53	
P4		P41	
P5	X		
~~P6~~			
Q22			
P1		P82	
P2		(P69)	
P3	X		
Q23			
P1	X		
P2	X		
P3	X		
Q24			
P1	●	P62	
P2	X		
P3	X	[redacted]	
P4		P39	
P5		P39	
P6	X		

WORKSHEET

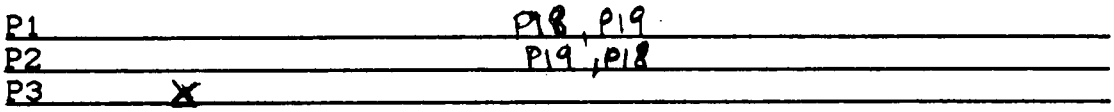
PROPOSITIONAL MATCHING
MACROLEVEL II
Text504

NO MATCH PARTIAL MATCH COMPLETE MATCH

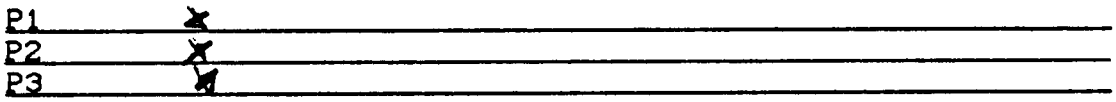
Q21



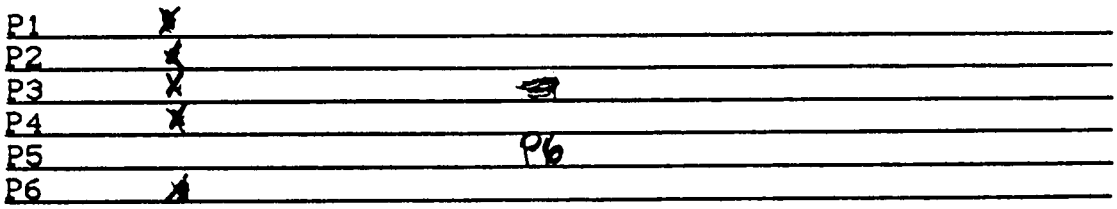
Q22



Q23



Q24



VITA

Mary Anna Lundy was born in Copperhill, Tennessee on August 5, 1945. She attended schools in Marion and Knox Counties and was graduated from Bearden High School in Knoxville in June 1963. In June 1969 she received a Bachelor of Science Degree with a major in English Education from the University of Tennessee, Knoxville.

She accepted an assistantship at the University of South Alabama in Mobile in the summer of 1977. In June 1978 she received a Masters of Science Degree with a major in Counselor Education.

In the fall of 1987, the author accepted an assistantship at the University of Tennessee, Knoxville. She received the Doctor of Education Degree with a major in Curriculum and Instruction in 1991. While serving as a graduate teaching associate, she taught both graduate and undergraduate courses. From August 1990 to August 1991, she served as the acting assistant director of the Reading Center.

Additional public education experience included teaching English and counseling, both at the secondary level. Elementary experience included working as a volunteer parent with four-year-olds in Anne Arundel County, Maryland and with second graders in Knox County, Tennessee. While at the Reading Center at the University of Tennessee, she

diagnosed and tutored both elementary and secondary students with reading problems.

The author received the Outstanding Person Award for the Department of Counselor Education at the University of South Alabama, Mobile in 1978. In 1991, she received the Chancellor's Citation for Extraordinary Professional Promise from the University of Tennessee, Knoxville.

She is a member of Phi Delta Kappa, Pi Lambda Theta, the International Reading Association and the College Reading Association. She is also a certified professional counselor for the state of Tennessee.