AN ABSTRACT OF THE THESIS OF

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A theory describing the use of schemata for representing prose in semantic memory was adapted and applied in assumptions regarding the recall of descriptive texts. Different texts that discussed the same general topic were defined as similar, and it was assumed that similar texts could share the same schema representation in memory while dissimilar texts could not. In each of five trials, university students were asked to read, and after two minutes, write from memory a presented text. Correct free recall of the words in each text was the dependent measure, and differential effects of prior trials were sought under three presentation conditions. Each condition was specified by the similarity of texts presented in successive trials. One condition presenting similar texts, included a topic shift after the third trial. Comparisons were made between this condition and two control conditions: a condition with similar presentations without a topic shift; and a condition with dissimilar presentations. Assumptions regarding the mediation of transfer effects in the recall of texts sharing a schema

specified recall probabilities across trials in each condition. None of the predicted trends in performance were substantiated as significant differential effects of prior trials were not obtained. Also, recall performances in the three conditions were indistinguishable.

MEMORY SCHEMATA FOR DESCRIPTIVE TEXTS

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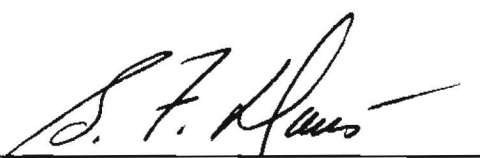

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Chapter 1

INTRODUCTION

This chapter is devoted to the general background and theoretical framework concerning the role of semantic memory in mediating proactive transference effects found in the performance of college students in a task of reading and recalling descriptive texts. The significance of this study, and specific statement of the problem, the null hypothesis, and the assumptions of the study will be discussed. The limitations imposed on the study by uncontrolled variables as well as terms identified as needing further clarification will be defined and included in this chapter.

Theoretical Formulation

Language use has long been considered a hallmark of intelligence. Investigators interested in intelligent behavior, be it that of a person, animal, or machine, have increasingly speculated about how language is understood. Language theorists tell us that during the syntactic analysis of a text a person will construct a "deep (semantic) structure of the discourse."[1] Though much less is known about the construction and use of semantic structures than about the rules of syntax,

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[1]Henry C. Ellis, Fundamentals of Learning, Memory, and Cognition (Dubuque, Iowa: Wm. C. Brown Company, 1978), pp. 160-166.

several theorists have proposed formulations that attempt to explain some of the psychological processes involved.

Semantic Memory

In order to account for the semantic complexity of discourse, many theorists stress the importance of assumptions regarding the representation of meaning in memory. Comprehension of text is thought to involve some "higher order" mental structure or organization which can be used in a problem solving fashion to negotiate subtle nuance.[2]

The mental structure usually referred to as providing such organization is the structure of semantic memory. Semantic memory has been equated with an individual's personal knowledge of concepts and their interrelationships. As concepts are learned, they are thought to become represented in memory as being related to certain other concepts in memory. The resulting network(s) of interrelated concepts provide memory structures which serve the representation of meaning in that a particular concept can be defined through its relationships with other concepts.[3]

While many theorists can accept the utility of semantic networks for explaining the representation of meaning in memory, they part company when they make additional assumptions regarding the nature of the concepts represented. There are a number of studies, most notable among them the research on word association and semantic differential, which make assumptions about the representation of discrete words.

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[2]Ibid., pp. 266-267.

[3]Walter Kintch, The Representation of Meaning in Memory (Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1974), pp. 9-10.

Many investigators of prose memory proceed from assumptions about the representation of similar units of study. As an example Kintch states that, "(m)any concepts in semantic memory may be expressed in the surface structure of a discourse as words or phrases," and he proceeds to speculate about a subset of semantic memory which he calls the "lexicon." His approach is to examine the relationships that may exist in prose among "word concepts" that are divorced of syntax. Kintch assumes that a reader constructs a subjective "propositional text base" where English syntax is replaced by a syntax of predicate calculus.[4]

It would seem that the study of memory for prose and other forms of discourse would require larger units of analysis. One could re-phrase Kintch's statement and propose that there may be concepts in memory that can be expressed as paragraphs, books, or perhaps even libraries. Minsky has argued that, "the chunks of reasoning, language, memory . . . ought to be larger . . . in order to explain the apparent power and speed of mental activities."[5]

While Minsky considers a reader's local or sentential analysis an important area for research, he emphasizes that one "must not assume that the transient semantic structure built during an syntactic analysis (what language theorists today call the 'deep structure' of a sentence) is identical with the larger (and 'deeper') structure built up incrementally as each fragment of a coherent linguistic communication operates upon it." He suggests that in understanding discourse the

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[4]Ibid., pp. 10-39.

[5]Marvin Minsky, "A Framework for Representing Knowledge," The Psychology of Computer Vision, ed. P. Winston (New York: McGraw-Hill, 1975), p. 211.

synthesis of word or phrase relationships may be a necessary but transient phase. As sentences are understood these substructures must be transferred to a developing representation of theme or topic. In turn, "the theme of a paragraph is as likely to be a scene as to be an action, as likely to be a characterization of a person as to be something he is doing."[6]

The conception of the representation of personal knowledge offered by Minsky is broad and inclusive enough to permit assumptions about memory for larger units of prose. He proposes that, "when one encounters a new situation . . . one selects from memory a substantial structure called a frame . . . a remembered framework to be adapted to fit reality by changing details as necessary . . . a data (memory) structure for representing a stereotyped situation, like being in a certain kind of livingroom, going to a child's birthday party, or presumably reading a particular type of prose."[7]

When applied as a representation for prose events, Minsky's "frame" has a certain intuitive appeal. Within the various genre distinguishable in prose, one might expect to find common features that occur frequently enough to be considered stereotypic of a class. One might also expect that a widely read individual might have available in memory a representation of a stereotypic story, newspaper article, technical report, and so forth.

Frame-like formulations are not entirely new to the psychology of memory. Bartlett concluded that in recalling stories his subjects

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[6] Ibid., pp. 235-236.

[7] Ibid., p. 212.

constructed story "schemata" which persisted in memory and facilitated recall. Over time his subjects recalled the "gist" of a story. The "gist" was considered an empirical approximation of the schema where fragments of a story unimportant to the schema were not recalled, and less familiar concepts in a story were changed in preference for more familiar concepts.[8]

Recently Thorndyke and Hayes-Roth have proposed that similar information in different texts may share the same schema.[9] While their assumptions were related to schemata for representing sentences in prose, their assumptions can be expanded and related to a schema for prose passages.

Whether it is called a propositional text base, a frame, or a schema, there is a basis in theory for assuming that a reader constructs or has available in memory a representation of prose which can be used to facilitate his acquisition and recall of materials read. Such an assumption has important implications for studies that attempt to investigate the semantic structure of memory for prose through the examination of proactive transference effects.

Proactive Transference Effects

In verbal learning psychology, proactive transference refers to an interaction of past and present learning where it is assumed that past learning may influence the acquisition and retention of new

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[8]F. Bartlett, Remembering: A Study in Experimental and Social Psychology (Cambridge: Cambridge University Press, 1932, 1961).

[9]P. Thorndyke and B. Hayes-Roth, "The Use of Schemata in the Acquisition and Transfer of Knowledge," Rand Paper P-6046, Rand Corporation, Santa Monica, California, 1978.

learning. To demonstrate proactive transference, differential effects of past learning in the retention of present learning must be obtained in a study where the relationship between past and present learning is specified. In the absence of a detailed record of a learner's past experience this relationship is most often specified by providing prior training events within the study itself. Hence, the interaction is frequently called a transfer of training.[10]

A transfer of training has both direction and magnitude. Transfer effects may be positive or negative, or there may be no observed effect. The magnitude of transference effects has been related to the amount of prior training.[11] The direction of effect is usually related to the dimensions or characteristics of training events. That is, positive transfer is noted when the characteristics of prior training events appear to facilitate or increase retention for new learning. Negative transfer is indicative of characteristics that inhibit or decrease retention for new learning. Minimal effects may be observed when there is no prior training, where the characteristics of training events have little influence on new learning, or when positive and negative transfer offset each other in retention measures.[12]

A specialized proaction procedure, originally used by Wickens and his associates,[13] has occassionally been applied in research on

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[10]John Jung, Verbal Learning (New York: Holt, Rinehart and Winston, Inc., 1968), pp. 7-8.

[11]B. J. Underwood, "Retroactive and Proactive Inhibition After 5 and 48 Hours," Journal of Experimental Psychology, 3 (1948), pp. 29-38.

[12]Ellis, op. cit., pp. 247-248.

[13]D. D. Wickens, D. G. Born, and C. K. Allen, "Proactive Inhibition and Item Similarity In Short-Term Memory," Journal of Verbal Learning and Verbal Behavior, 2 (1963), pp. 440-445.

memory for prose. Typically in Wickens' experiments subjects were asked to learn a series of word lists. Retention of each list was tested before the next list of the series was presented. In this situation retention scores may show the effects of transfer training on prior lists. If so, the magnitude of transference effects may be expected to increase or "build up" across the series as each successive list is preceded by an increasing number of prior lists. Proactive transfer may be expected to be minimal in the retention of the first list of the series, as retention there can be affected only by pre-experimental events.

Only inhibition effects were reported by Wickens, where the relationship between old and new learning was specified by the similarity or dissimilarity among the respective words of a presented series. Words were considered similar when they belonged to the same conceptual category. Learning early words in the series inhibited retention of subsequently learned words when the respective words were similar. Shifting the presentation in later lists of the series to words from a different category produced an increase in retention for the shift trial. Wickens attributed the increase to a "release from proactive inhibition."[14]

The categorical specificity of proactive inhibition was taken to be related to the "psychological dimensions along which words became represented in memory." Since conceptual category, a semantic dimension of the memorial representation of the training events, had

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[14]D. D. Wickens "Encoding Categories of Words: An Empirical Approach to Meaning," Psychological Review, 77 (1970), pp. 1-15.

mediated differential inhibition, the Wickens' technique provided an empirical approach for studying semantic memory structures related to discrete words.[15]

Attempting to extend Wickens' procedure to the study of inhibition effects in prose retention, investigators have presented prose passages in place of word lists. Most have varied the conceptual category of detail words within the passages.[16] One group has varied the topics of passages.[17] In the latter case the expectation was that if the subject matter of successive passages was from the same general topic area inhibition would result due to the similarity of topics. Shifting to a different general topic was expected to produce a release from inhibition which would be indicated by an abrupt increase in retention for the shifted trial. The results of that study relating to release phenomona were anomalous.

The Problem

Much of the importance of list learning experiments was predicated on the conviction that the results established with simpler forms of learning material would apply in the learning of more complicated material. Several investigators have reasoned that if

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[15] Ibid.

[16] B. S. Musgrave and J. C. Cohen, "Relationships Between Prose and List Learning," Verbal Learning Research and the Technology of Written Instruction, eds. E. Z. Rothkopfe and P. E. Johnson (New York: Teachers College Press, 1971), pp. 74-89.

[17] Gary B. Blumenthal and Donald Robbins, "Delayed Release from Proactive Interference with Meaningful Material: How Much Do We Remember After Reading Brief Prose Passages?" Journal of Experimental Psychology: Human Learning and Memory, 3 (1977), pp. 754-761.

differential inhibition effects could be obtained in the retention of prose words, a Wickens' type procedure might provide an empirical approach for studying the underlying semantic structures related to prose comprehension.

A review of the literature revealed that the complexity of prose training events has made isolating inhibition effects difficult. Apparently memorial representations of prose may have features that mediate differential facilitation as well as features that mediate inhibition. These offsetting effects have been confounded in retention measures. Where Wickens' procedure has been applied in the study of prose retention, the presence of both facilitation and inhibition has been made more obvious. Yet, it remains unclear whether these effects can be properly attributed to a transfer of training from prior passages, or to a transfer from learning prior test questions.

In this study, testing artifacts were avoided by using a free recall measure. Some of the assumptions and procedures of Thorndyke and Hayes-Roth, relating to the free recall of prose sentences, were adapted and applied to prose passages. These assumptions and procedures were incorporated in a Wickens' type procedure where the relationships among successive passages were specified by whether or not passage topics were subordinate to the same general topic.

The relationships among successive passages were specified under three conditions of presentation. Two of these conditions consisted of presenting passages that were similar or dissimilar to other passages in a series. In a series of similar passages each trial presented a different but similar text. The series of dissimilar passages

contained texts that were dissimilar to each and every other text in the series.

The presentations in the remaining condition were the same as the presentations in the similar condition mentioned above except that a topic shift was introduced in the fourth trial of presentation. A topic shift referred to a change in general topic. This changed the relationship between previous and following passages in a series to one of dissimilarity. In the shift trial the general topic common to previous passages was changed to a different general topic, and the new general topic remained common to following passages.

Statement of the Problem

Are there significant differences as measured among university students in their correct free recall of descriptive texts that are similar or dissimilar to other texts in a presented series, where the topics of later texts are changed to a different general topic, and in a series where the general topic is not changed?

Statement of the Hypothesis (Null Form)

There are no significant differences as measured among university students in their correct free recall of descriptive texts that are similar or dissimilar to other texts in a presented series, where the topics of later texts are changed to a different general topic, and in a series where the general topic is not changed.

Assumptions of the Study

This study was designed to investigate proactive transference effects found in the performance of university students in a task of

reading and recalling descriptive texts. It was implicitly assumed that the student groups participating in this study would serve as a representative sample of the population of university students in the state of Kansas.

Some of the theoretical assumptions of Thorndyke and Hayes-Roth[18] that they related to the representation prose sentences in memory were adapted and relate here to the representation of descriptive texts. These assumptions are listed below.

1. Comprehension of a text depends upon a reader's constructing or having accessible a subjective structure for representing the interrelated concepts explicit and inferred in the text. This representation, called a schema, can be used at a later time to aide the reader in reproducing the words of the text, provided that the schema remains accessible in memory at the time of recall.
2. Schemata for representing descriptive texts have a hierarchical structure in that concepts are represented as subordinate to increasingly more general concepts and eventually are subordinate to a topic concept. Topic concepts are in turn subordinate to more general topic areas of an individual's reading experience. All concepts in a schema can, therefore, be associatively connected to a general topic.
3. A schema has a strength associated with its existence in memory.

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[18]Thorndyke, et. al., op. cit., pp. 9-11.

4. Repeated activations of a schema produce increments in its strength, and therefore, its accessibility.
5. The incremental effect of an activation on the strength of a schema is a decreasing function of its prior strength. That is, a weak schema benefits more from an activation than a strong one.
6. A schema is activated either directly, by apprehension of the information it represents in a text, or associatively, by a related concept.
7. The accessibility of a schema is defined as the probability that it can be activated, either for use in comprehending a text or for retrieving a text from memory. Accessibility of a schema is an increasing function of its strength and recency of activation, and the salience of corresponding features in the text.
8. A schema can be used to represent a configuration of interrelated concepts from a particular text. When this occurs, details in the text that instantiate a general concept in the schema are associatively connected to a general topic area of an individual's reading experience.
9. A schema representation can be shared by numerous configurations of concepts from different texts that have the same general topic in common. When this occurs, details from various texts that instantiate a general concept in the schema are all associatively connected to the common general topic. This produces competition for association with the general topic among the various instantiating details.

10. Different texts that do not have the same general topic in common do not share the same schema representation. When this occurs, a different schema can be used to represent the configurations of concepts in each text. If so, details in each text are associatively connected to different general topics.
11. The discriminability among detail concepts that compete for association with the same general topic is an inverse function of the number of competing concepts, the temporal proximity of their occurences, the similarity of the concepts, and the retention interval of the concepts.
12. The probabilities of recalling a text whose representation utilizes a shared schema is a combined function of the accessibility of the schema and the discriminability of the texts in which the schema has been applied.

These assumptions describe the mediations of transfer effects when successive texts either share or do not share the same subjective representation in memory. It was assumed that texts with similar topics would share the same schema. Recall probabilities for any one text were described as a combined function of positive and negative transfer from prior texts. Positive transfer was assumed to increase over trials as the schema was formed for representing successive texts. Negative transfer was assumed to increase as more and more detail concepts from an increasing number of texts competed for association with the same schema. Implicitly, details could not compete for association with a schema until the schema had become established in memory. Increases in negative transfer would, therefore, lag increases in positive transfer,

and, over a series of trials, give the combined function a quadratic trend.

Disrupting the similarity relationship of successive texts by introducing a topic shift would require a new schema for texts in shifted and subsequent trials. Over the five trials in the study the recall function would take on an apparent cubic trend due to the partial repetition of quadratic tendencies.

Purpose of the Study

The primary purpose of this study was to investigate transference effects found in the performance of university students in a task of reading and recalling descriptive texts that were presented in a series. The theory of Thorndyke and Hayes-Roth was adapted and related to a schema for representing descriptive texts. The predictions of the theory were tested in an experiment that combined procedures similar to those of Thorndyke and Hayes-Roth and procedures similar to those of Wickens.

Of interest was the comparison of correct free recall performances obtained under the conditions of similar and dissimilar presentations described above. Also of interest was a comparison of correct free recall performances obtained under the condition of similar presentations with a topic shift and under the condition of similar presentations without a topic shift.

According to the assumptions of the study, similar presentations provided the conditions in which the representations of successive texts in a series could share the same schema. Similar presentations also provided the conditions under which details of the various texts might compete for association with the same general topic. The

condition of dissimilar presentations and the occurrence of a topic shift were the conditions where the representations of successive texts in a series could not share the same schema.

The theory of Thorndyke and Hayes-Roth as adapted in this study makes specific predictions about recall performances across a succession of five trials within each of the conditions of presentation. These predictions are listed below.

1. Correct free recall scores for successive texts in the condition of similar presentation, without a topic shift, were predicted to initially increase above first trial performance at a decreasing rate, then decrease asymptotically at a decreasing rate.
2. Correct free recall scores for successive texts in the condition of dissimilar presentations were predicted to neither increase nor decrease from first trial performance levels. That is, the recall of any one text was predicted to be no better or no worse than the recall of any other text in that condition.
3. Correct free recall scores for successive texts in the condition of similar presentations that included a topic shift were expected to vary as predicted for similar presentations (prediction number 1.) until the topic shift was presented.

Since the relationship between the text in a shift trial and texts in previous trials was one of dissimilarity,

4. the correct free recall scores for a shift trial were predicted to be no different than recall scores obtained in the condition of dissimilar presentations.

Since the relationship between the text in a shift trial and the texts in trials following after the shift trial was one of similarity,

5. correct free recall scores for successive texts presented subsequent to the shift trial were expected to vary as predicted for similar presentations (prediction number 1, above).

Except for the predictions related to shift trial performances, no prediction was made specifying points of inflection where performance trends could be expected to change direction. Also, asymptotic performance levels were not specified.

Significance of the Study

This study was essentially a partial replication and extension of previous research by Wickens and by Thorndyke and Hayes-Roth. As such, it provided evidence related to the applicability of their procedures and assumptions to an examination of larger units of study, specifically descriptive texts.

It was expected that the trade-off between facilitation and inhibition predicted by Thorndyke and Hayes-Roth might clarify anomalies found in other research that had used Wickens' procedure with prose learning materials. Therefore, the two procedures were combined to converge on issues related to release phenomena.

The two conditions of similar presentations, the one with and the one without a topic shift, most closely parallel the presentations in other research using textual materials in a Wickens' type procedure. Comparing these conditions would reveal differences in performances due to a topic shift. Studies that had neglected positive carry-over effects expected to obtain increased performance in a shift trial.

According to the predictions of this study such a coincidence is at best fortuitous. Prediction 1. was based on the assumed trade-off between positive and negative transference. If this prediction held true in one instance, prediction 4. would remain the only reliable prediction of performance change due to a topic shift.

In this study a "release" from transference effects was viewed as a release from facilitation as well as a release from inhibition. Such a release was expected to be revealed by comparing performances obtained in the shift trial condition and performances obtained in the condition of dissimilar presentations.

Definition of Terms

The study contains many terms which have a variety of meanings for different people. Several of these terms needed further clarification and definition. These terms have been defined as follows:

Correct Free Recall Score (CFR Score)

A CFR score was the number of words scored as correctly recalled from a text in a particular presentation trial by a particular subject. Only words that were explicitly presented in the text of a trial were scorable as correct. The words could be reproduced in any order. If a particular word was reproduced more than once, each reproduction was scorable only to the extent that the word had appeared a like number of times in the presented text.

Base Level CFR

Base level CFR referred to the level of correct free recall performance that was obtained when CFR scores were not influenced by

carryover effects from prior texts. Base level CFR for a particular subject is defined as equal to that subject's CFR score for the first trial of a series.

Specific Topic

A specific topic refers to a topic that was described in a particular text. As such, the specific topics used in this study were defined by the several texts presented. (See Appendix B)

General Topic

A general topic referred to a general topic area under which two or more specific topics were subsumed. As such, the general topics used in this study were defined by the specific topics of texts that were presented as subordinate to the general topics. (Appendix B groups the texts used in the study by general topic.)

Similar Texts

Texts having specific topics that were subordinate to the same general topic were defined as similar.

Dissimilar Texts

Texts having specific topics that were subordinate to different general topics were defined as dissimilar.

Topic Shift

A topic shift referred to a change of general topic within a series of similar texts. The general topic common to texts presented before the topic shift was changed to a different general topic and the new general topic remained common to texts presented after the topic shift.

Shift Trial

The shift trial was the presentation trial in which the topic shift occurred.

Limitations of the Study

This study was limited to the measurement and analysis of the performances of university students in a task of reading and recalling descriptive texts. Students who participated in the study were chosen from psychology classes and English composition classes at a university in Kansas. Only students who claimed English as their native language participated.

The texts presented for recall may be found in Appendix B. The original articles were re-written to adjust their length to approximately one hundred words. While there was a considerable range in general topics, no attempt was made to sample the population of descriptive texts. Inferences were to be made only about the similarity relationships devised among the texts as they were presented.

Chapter 2

REVIEW OF RELATED LITERATURE

This chapter presents a review of the literature reporting studies that investigated proactive transference in the retention of prose. The research will be traced from early experiments with simpler forms of learning material to more recent studies where a variety of methods have been used to study the conditions under which these phenomena may be obtained with prose material. Discussion of the research will focus on methods, with an attempt to identify the variables that have been used to obtain transference effects as well as factors that may potentially obscure these effects in a study of retention for prose.

Historically, words and nonsense syllables have been used most frequently in memory experiments. Papers by Underwood[1] and by Wickens, Born and Allen[2] represent classic examples of research in memory for such materials and have established important variables involved in proactive transference. In the Underwood studies, subjects were required to learn a number of similar lists prior to learning a target list. The lists contained simple items such as words or nonsense

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[1]B. J. Underwood, "Retroactive and Proactive Inhibition After 5 and 48 Hours," Journal of Experimental Psychology, 38 (1948), pp. 29-38.

[2]D. D. Wickens, D. G. Born, and C. K. Allen, "Proactive Inhibition and Item Similarity In Short-Term Memory," Journal of Verbal Learning and Verbal Behavior, 2 (1963), pp. 440-445.

syllables, and retention of the target list was tested. Underwood demonstrated that the greater the number of lists learned prior to learning a target list, the greater was the decrement in retention for the target list. The prior lists apparently inhibited acquisition and retention of the later list after five and forty-eight hours. While that evidence applied to long term memory, Keppel and Underwood demonstrated that proactive inhibition in short term memory was affected by prior learning as it had been in long term memory. To do so, they used a rehearsal interference task which prevented subjects from rehearsing list items during short retention intervals.[3]

Wickens used a similar distraction technique in showing proactive inhibition to be class specific. In these experiments, subjects learned a series of lists where the respective items of first few lists were taken from the same category. Lists following later in the series were changed to contain items from a different category. The presentation of each list was separated by a distraction task, and the retention of each list was measured before the next list in the series was presented. Wickens consistently found that retention decreased across the first three or four lists, exhibiting what has been called a "build up" of proactive inhibition. Subjects' retention for the list in the shift trial, where the category of list items changed, increased relative to subjects who had not experienced a "shift." Retention decreased again on lists following the shift trial as retention for items from the new category began to be inhibited. The return to high performance in the

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[3]G. Keppel and B. J. Underwood, "Proactive Inhibition in Short-Term Retention of Single Items," Journal of Verbal Learning and Verbal Behavior, 1 (1962), pp. 153-161.

shift trial was interpreted as a "release from proactive inhibition." Wickens concluded that items from the same category inhibited each other more because they were psychologically similar.[4]

Many investigators studying memory for prose have attempted to generalize the results of list learning experiments to prose material. One of the earliest to extend the study of proactive inhibition to prose was Slamecka. He used learning passages consisting of twenty-word sentences in a serial anticipation procedure. The words of his sentences appeared in the window of a memory drum one at a time at a three second rate. Subjects learned zero, one, two, or three prior passages before learning and recalling a target passage. His data showed that proactive inhibition increased with the number of prior passages.[5]

While Slamecka's study tended to extend Underwood's finding to prose materials, other investigators considered prose learning to be qualitatively different from list learning, and they argued that theories established with simpler forms could not possibly hold for connected discourse. Studying prose memory under "conditions more likely to be found in a classroom," Ausubel and his associates failed to find proactive transference effects. Subjects read a "potentially interfering" passage about Christian beliefs prior to reading an

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[4]D. D. Wickens, "Encoding Categories of Words: An Empirical Approach to Meaning," Psychological Review, 77 (1970), pp. 1-15.

[5]N. J. Slamecka, "Proactive Inhibition of Connected Discourse," Journal of Experimental Psychology, 62 (1961), pp. 299-301.

expository passage about Buddhism.[6] No evidence of proactive inhibition was detected on a recognition test of the Buddhism material. When subjects read either a 2100-word "confusably similar" passage on Buddhism or an "unrelated" 1500-word passage on drug addiction prior to learning a 2200-word passage concerning the history, doctrine, and ethical teachings of Zen Buddhism, no differences were found.[7] These findings were taken as support for Ausubel's contention that proactive inhibition was not a powerful factor in "meaningful" learning. A crucial assumption in these experiments concerns the similarity relationship between his passages. The precise nature of this relationship was never specified. Also, judgments of topic similarity are subject to error in that subjects may not use the topical aspects as functional stimuli in learning the material.

Prior to the 1970's, it could have easily been concluded that the evidence for extending the results of the Underwood experiments to prose was equivocal. However, that evidence was not only sparse, but methodologically inadequate. One could look to the research on retroaction, but a similar summarization would apply. Realizing this state of affairs, several investigators since have emphasized the need for developing experimental techniques that would arrange optimal interfering conditions, and provide for an analysis of prose recall that would more closely parallel analyses in non-prose experiments.

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[6] D. P. Ausubel and E. Blake, "Proactive Inhibition in the Forgetting of Meaningful School Material," Journal of Educational Research, 52 (1958), pp. 145-149.

[7] D. P. Ausubel, M. Stager, and A. J. H. Gaite, "Proactive Effects in Meaningful Verbal Learning and Retention," Journal of Educational Psychology, 60 (1969), pp. 59-64.

A more precise specification of the similarity of passages has been provided in a series of studies by both Crouse[8] and Anderson and Myrow.[9] Essentially, they have developed prose studies that parallel transference studies with paired-associate lists. Their stimuli were defined as the test-item stems of their recall instrument. Stimulus and response similarity was determined from a content analysis of the passages in relation to the test items. In other words, they defined similarity by specifying test questions that could be answered on the basis of information in the passage. In accord with Osgood's predictions of transference in paired-associate learning,[10] if the questions to be answered were the same or similar for successive passages, and the answers to those questions were identical in two passages, then facilitation was expected. If the questions were different for successive passages and the answers were also different in two passages, then no transference, or very slight inhibition, was expected. When the questions were the same or similar for successive passages, but the answers were different for two passages, then a potentially strong inhibiting situation was established. Crouse found only weak proactive effects.[11]

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[8]J. H. Crouse, "Transfer and Retroaction in Prose Learning," Journal of Educational Psychology, 61 (1970), pp. 226-228.

[9]R. C. Anderson and D. L. Myrow, "Retroactive Inhibition of Meaningful Discourse," Journal of Educational Psychology, Monograph Supplement, No. 1 (1971), pp. 81-94.

[10]C. E. Osgood, "The Similarity Paradox in Human Learning: A Resolution," Psychological Review, 56 (1949), pp. 132-143.

[11]Crouse, loc. cit.

Other investigators have emphasized a need for care in the construction of the prose materials used. They have attempted to develop material that would lend itself more readily to the experimental procedures used in list learning. Leading in this effort, Musgrave and Cohen[12] have suggested a method for analyzing a prose passage into list learning components. In describing her method, Musgrave states, "prose study materials that are relevant here typically present names to be associated with values on a set of attributes." Materials were schematized as a names by attribute matrix array where the cell entries were the "attribute values."[13] The sentences of a passage were seen as the basic associative unit and retention of attribute values (the objects of sentence predicates) was the measure of interest. Predictions concerning simple prose could be tested with material in both list and prose form.[14]

The prose forms that have been tested with this procedure were indeed simple. In general, passages were little more than lists of sentences. Facts presented were somewhat independent, with integration of information being required only to establish continuity in intersentential nominal and pronominal reference. These materials fall short of the range of complexity that can be obtained in prose.

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[12]B. S. Musgrave and J. C. Cohen, "Relationships Between Prose and List Learning," Verbal Learning Research and the Technology of Written Instruction, eds. E. Z. Rothkopfe and P. E. Johnson (New York: Teachers College Press, 1971), pp. 74-89.

[13]B. S. Musgrave, "Short-Term Memory with Different Organizations of Prose Paragraphs," Psychonomic Science, 29 (1972), pp. 397-399.

[14]Susan M. Shimmerlik, "Organization Theory and Memory for Prose: A Review of the Literature," Review of Educational Research, 48, No. 1 (Winter, 1978), p. 106.

Materials developed in the manner just described were used by Musgrave in a presentation sequence like that of Wickens. According to her model, she developed materials describing two sets of six college men. Each man was described in a four sentence paragraph on each of four descriptive dimensions. Illustrating two of her descriptor categories for each set, the six men of one set were described as playing a particular musical instrument and driving a particular make of car. The six men of the second set were described as having visited a Latin American country and enjoying a particular game. A series containing paragraphs describing men of one set was shifted to paragraphs from the other set. After a rehearsal interference task, subjects were asked to recall the key descriptor word in each sentence and its order of presentation before the next paragraph in the series was presented. Correct words were scored additional points if they were recalled in the order of their presentation in a paragraph. Repetition of paragraphs describing men on the same attributes at first produced slight improvement, then decrement in recall scores. Shifts to paragraphs from the alternate set of materials resulted in somewhat better recall, which again improved over early trials with repetition of changed materials, and then declined.[15]

A somewhat similar pattern of retention performance was obtained in three experiments reported by Blumenthal and Robbins.[16] The learning materials in these experiments were of a higher level of complexity than

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[15]Musgrave, loc. cit.

[16]Gary B. Blumenthal and Donald Robbins, "Delayed Release from Proactive Interference with Meaningful Material: How Much Do We Remember After Reading Brief Prose Passages?" Journal of Experimental Psychology: Human Learning and Memory, 3 (1977), p. 754.

those of Musgrave. According to Blumenthal, "passages were similar to those found on some standardized examinations and were approximately one page in length." Subjects were presented five trials. Each trial presented a passage, followed by a crossword puzzle task, followed by a multiple choice test. Before the first experimental trial was presented, a practice trial was given, and though it included a test, the results of the practice tests were not reported. While each trial presented a different passage, passages that dealt with the same general topic were assumed to be similar.

Performance declined over the four experimental trials where no change in the general topic occurred or where a change occurred on the last trial. A group that had a topic change in the fourth trial showed improved performance, not on the trial of the change, but on the trial following the change. The authors were surprised that categories so broadly defined as their general topics had mediated in the buildup of inhibition. They were also puzzled at the apparent "delay" in the release from proactive inhibition. The authors suggested that "the relationship of their study to the Wickens type phenomena was merely procedural and that very different theoretical issues were being addressed." They did not elaborate on what those issues might have been.

The results of Musgrave's study and those of Blumenthal and Robbins are similar in several respects. Both had extended the Wickens' list learning results to prose material by finding a buildup of and a release from proactive inhibition. Yet, in both studies the release phenomena was not as immediate for prose as it had been for Wickens' material. The similarity, or lack of similarity, in the patterns of

retention performance found in the two studies would have been more certain had Blumenthal and Robbins reported the results of their practice trial. Their practice passage dealt with the same general topic as did the passages of the first experimental trials and likely produced transference effects in later passages. Had there been improved performance in trial number one over performance in the practice trial, the pattern of scores in both studies would have been strikingly similar. The pattern of results in the two studies would then have suggested that retention in trials early after the first and shifted trials improved, or was facilitated, before decrements attributable to inhibition became apparent.

Discussing her results, Musgrave suggested that the repetition of categories across trials produce facilitation as well as inhibition. After post-experimental interviews with her subjects, she concluded that "they were using the categories as an organizational framework (aiding) both perceptual input and memorial output, and needed more than one trial to discover . . . what the categories were."[17]

An alternative explanation of Musgrave's results is more adequate. It seems likely that her subjects were learning the sentences in the paragraphs, and in doing so, were associating the objects of the sentence predicates with the verbs in the sentences. They may have required more than one trial to learn these associations which would aide their recall of both the correct word and the order of presentation. Indeed, they may have known the order of presentation before learning the correct word. Decrements in performance would have been

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[17]Musgrave, loc. cit.

incurred due to competition among different predicate objects for association with the same verb. Shifting the presentations to a different category of predicate objects necessitated a shift to a different verb which required a new association to be formed.

In discussing their results, Blumenthal and Robbins mentioned that while their passages differed along content lines, there may have been structural similarities between them. However, they insisted that while there was some basis for expecting transfer resulting from similar structure, this variable could not have explained a delayed release from proactive inhibition.

Ignoring the possibility that retention scores may have been facilitated as well, Blumenthal and Robbins attributed increased retention to a release from inhibition. However, Bower had previously demonstrated that passages could be devised with certain constructions facilitating and other constructions inhibiting retention, as well as constructions that were ineffective for producing transference effects in the retention of other passages. Bower found that the net effect of such constructions upon retention varied systematically with the proportions of the three constructions among the test items for to-be-remembered passages.[18]

Following Wickens' example, Blumenthal and Robbins attempted to identify a release from transference effects by comparing the performance of subjects experiencing a topic shift with the performance of subjects who had not experienced a topic shift. This was not an

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[18]Gordon H. Bower, "Selective Facilitation and Interference in Retroaction of Prose," Journal of Educational Psychology, 66 (1974), pp. 1-8.

adequate control group where it could be assumed that transference effects included facilitation as well as inhibition. A more appropriate control group would be one whose performances across trials did not vary appreciably from base level performance in the initial trial of a series. Comparisons with such a control group would reveal increases in performances due to facilitation as well as decreases due to inhibition.

Essentially the same strategy as that suggested by Bower for generating transference effects was used by Thorndyke and Hayes-Roth to study proactive transference in prose. Subjects were presented one of five target passages, each of which discussed a different general topic. Preceding a target passage, one, two, three, four, or eight training passages were studied which discussed the same general topic as the target passage. The training passages included three sentence-type conditions. Sentences in the Repeated condition were identical in both training and target passages. Changed sentences were also identical in both target and training passages, with the exception that certain detail words were changed relative to corresponding details among all other passages. For Unrelated sentences, there was no syntactic or semantic relationship among corresponding sentences in the training and target passages. Since the mean number of Unrelated items correctly recalled did not vary as a function of prior training, these scores were averaged across training conditions and treated as a base or "zero" level of training. The recall of changed sentences in the immediate

test condition initially increased from base level, then decreased, then reached asymptote near base level.[19]

Finding inhibition effects in the retention of prose learning material has been difficult. The most compelling explanation of this state of affairs is Bower's suggestion that prose materials may have features that give rise to offsetting positive and negative transference and that their weak net effects may obscure important differences. Studies that have used Wickens' procedure have been more successful in finding transference effects. Sensitive to the gradual buildup of transference effects, applications of this procedure have produced performance patterns that tend to confirm Bower's suggestion. However, performances resulting from a shift in the similarity relationships of successive passages are more difficult to interpret. Increased performances of subjects experiencing a shift, relative to controls not experiencing a shift, cannot be interpreted as a release from inhibition if there is a possibility that the increase is due to facilitation.

It is clear that testing procedures have a powerful influence upon the results of transfer studies. Requiring subjects to learn associations between text details and test item stems does more than destroy the spontaneity of a subjects recollection. Cued recall, measured repeatedly over trials, selectively doubles the presentation of certain aspects of a text over other aspects. There is also a possibility that carry over effects may result from a transfer of learning similar test items rather than from learning similar texts.

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[19]P. Thorndyke and B. Hayes-Roth, "The Use of Schemata in the Acquisition and Transfer of Knowledge," Rand Paper P-6046, Rand Corporation, Santa Monica, California, 1978.

Free recall measures avoid these difficulties, but incur others. Conventional free recall requires subjects to respond with the exact items presented for recall, but allows the items to be recalled in any order. As such, free recall is a quasi-verbatim recall measure. Educators interested in insuring that students understand what they learn are more comfortable with measures of "substance" retention rather than verbatim recall. Again the outcomes of substance recall are dependent on the scoring procedures adopted. These procedures commonly require a number of judges to rate retention protocols. Judgments frequently focus on the synonymity of words where meaningfulness of a text is assumed to be carried by the individuals words.

Substance recall measures have been found to correlate highly with verbatim recall measures.[20] Also, if it is assumed that the meaningfulness of a text is carried by the relationships among the words of a text, and if it is further assumed that the representation of these relationships in memory serves to aide a subject in his recall of the exact words of a text, a free recall measure can be taken as an indirect measure of understanding.

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[20]D. J. King, "On the Accuracy of Written Recall: A Scaling and Factor Analytic Study," Psychological Record, 10 (1960), pp. 113-122.

Chapter 3

METHODS AND PROCEDURES

The comparisons of interest in the study were made by determining if there were significant differences in the mean CFR scores obtained within and between the three conditions of presentation. To obtain these scores subjects were assigned to one of the three conditions and participated in the study by reading and recalling a text in each of five trials in a condition. Subjects were instructed to reproduce from memory the text in each trial before the text in the next trial was presented. Each reproduction was scored for correct free recall (CFR). A minimum score of zero and a maximum score equal to the number of words in a particular text could be obtained. The data were subjected to analysis of variance to determine if there were significant differences in CFR within and between the groups assigned to the three conditions.

Materials presented to individual subjects were distributed in the form of a single instrument during regular class sessions. Subjects were assigned to the three conditions through a random distribution of the instrument. The instrument presented a specific sequence of tasks. Subjects studied a text for two minutes, performed a distraction task for two minutes, then were given four minutes to write from memory the text they had studied. The study-distraction-recall sequence was repeated in each of the five trials of a condition.

The texts presented in the instrument were ordered to maintain the similarity relationships among the texts which characterized each condition. The texts were also counterbalanced to equate the texts on such factors as reading difficulty, word frequency, text length and other factors not related to topic similarity.

The distraction task was designed to prevent a subject's subvocal rehearsal of a text during the two minute retention interval. This was a speeded task which consisted of adding numbers.

Population and Sample

Seventy-five students participated as subjects in the study. All were enrolled in either developmental psychology or English composition courses at a state university. Subjects were randomly assigned to the three conditions of presentation. Only students who claimed English as their native language were selected to participate. Aside from this specific criterion, subjects were selected on the basis of availability and their willingness to participate in the tasks presented to them.

Materials and Instrumentation

The apparatus consisted of a booklet constructed of a cover sheet and fifteen pages all of which were 8½ by 11 inches and attached by a single staple in the upper left hand corner of the booklet. The single-spaced typewritten cover sheet contained a brief description of the study and the tasks to be performed as well as instructions for carrying out the tasks. Page one of the booklet contained a double-spaced typewritten text approximately one hundred words in length. Page

two contained a five column by twenty row array of one digit numbers. Page three was blank. This sequence of presentation (text followed by numbers followed by a blank page) was repeated throughout the remaining pages of the booklet.

The materials used in the study consisted of twenty-five texts and five arrays of numbers. The texts along with their sources are displayed in Appendix B where they are arranged by general topic. The original articles were re-written to adjust their length to approximately one hundred words. The five arrays of numbers are displayed in Appendix C in the order that they were presented.

In collating the booklets, texts were ordered according to the schedule displayed in the table in Appendix A. The table indicates the specific texts and their order of presentation in each condition of the study. The rows of the table represent the twenty-five booklets used in each condition. The columns represent the five presentation trials in the three conditions. The particular text used in any trial of any booklet can be read from the table where each text is represented by a letter-number code. The code indicates a particular text by its general and specific topic as it is referenced in Appendix B. The letter indicates the general topic of the text. The letter-number combination indicates the specific topic of the text.

This schedule shows how general and specific topics were ordered in the booklets to maintain the similarity relationships among the texts that characterized each condition. The schedule also shows the counterbalancing of texts. Each text was presented an equal number of times among the 75 subjects. Each text was presented an equal number of

times in each condition. Among the 25 booklets for each condition, each text appeared once in each trial.

Design of the Study

The experimental design consisted of one qualitative independent variable, one quantitative independent variable, and one quantitative dependent variable. The levels of the qualitative independent variable were fixed by the experimenter at three conditions of presentation which were measured in independent groups of subjects assigned to each condition. The levels of the quantitative independent variable were repeated measures fixed by the experimenter at the number of previous trials presented; zero through four. The dependent variable was a numerical score obtained by tallying the words a subject correctly recalled in a trial.

This design assumed that the functional relationships existing between the two independent variables and the dependent variable were due to the fixed effects of the independent variables. The design allowed each subject in the groups assigned to the levels of the qualitative independent variable to contribute one score in the dependent variable at each level of the quantitative independent variable. Each subject contributed five scores to the subject group totals. Significant differences found in comparing groups of scores representing the levels of the qualitative independent variable were assumed to be due to the qualitative differences existing between the fixed effects of the conditions of presentation. Significant differences found in comparing groups of scores representing the levels of the quantitative

independent variable were assumed to be due to the quantitative differences existing between the fixed effects of prior presentation.[1]

Data Collection

Subjects were selected on a voluntary basis from two sections of a Developmental Psychology course, and from three sections of an English Composition course, with the criterion that English was their native language. With two exceptions, all subjects were presented the instrument in the presence of the experimenter during regular class sessions. The subject given the final booklet, and one other subject who came to class after the first group administration had begun were administered the instrument individually by the experimenter outside of a class setting.

The seventy-five booklets to be used in the study were arranged in a stack for distribution. The order of the booklets in the stack was random without replacement. The booklets were distributed from the top of the stack as subjects made themselves available. The order of the stack of unused booklets was maintained until the last booklet was completed.

After booklets were distributed to the subjects, the experimenter read the cover sheet aloud to the group or individual while they read it to themselves. The instructions were further clarified by the experimenter answering any questions the subjects had regarding the tasks to be performed. Progress of the subjects through the tasks in the fifteen pages of the instrument was paced by the experimenter

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[1]Roger Kirk, Experimental Design: Procedures for the Behavioral Sciences (Belmont, California: Brooks/Cole Publishing Company).

according to the instructions. Timing of the tasks of each page was timed using a Compass Instrument stop watch. Subjects were allowed two minutes to study a text, two minutes to add numbers, and four minutes to write the text they had just read. Upon completion of the last trial, the instruments were collected for scoring.

Subjects wrote from memory their reproductions of a presented text on the blank page supplied in each trial of the instrument. Scoring was accomplished by comparing a presented text with a subject's reproduction of it to determine the number of words correctly recalled. Only those words explicit in a presented text were acceptable in its reproduction for scoring. Any word order was acceptable. Words that appeared more than once in a reproduction were tallied as correct if they appeared a like number of times in the presented text. Words repeated in excess of their frequency of appearance in a presented text were not tallied as correct. Errors in spelling were judged acceptable on the basis of their phonetic approximation to the exact word. Synonyms were not tallied as correct.

The tally for a reproduction was used as the CFR score for that trial. This procedure produced 375 CFR scores.

Chapter 4

ANALYSIS OF THE DATA

This chapter presents the analyses of the data collected in the study. The veracity of the dependent measure is addressed in a discussion of subject responses. Data analysis follows and includes a presentation of the statistical techniques used as well as the results of the analyses.

Response Analysis

The correct free recall scores used in the study were considered fairly accurate measures of each subject's memory of the texts. It was expected that subjects would find that the easiest and most effective mnemonic strategy for reproducing the texts would be to recall each text as a connected discourse. Other than determining its presence and frequency in the original text, no judgment was made, in tallying CFR scores, regarding how a subject's word pertained to the original text. Obviously, some words, especially "non-content" words, could have been tallied when rendered without a subject having read the original text. However, there were no random listings of words that might have been attempted without having read a presented text. One subject did experiment with counting and listing words, but abandoned that strategy after the first trial. Another subject devoted the final trial to a critique of the experimental tasks. These responses were scored in accordance with the scoring standards of the study, which in both

instances resulted in CFR scores considerably below performance levels achieved by these subjects in other trials. Aside from these exceptions, subjects seemed to be trying to reproduce each text by approximating the original discourse.

Most subjects were observed to quit writing before the four minute time limit. Among the few exceptions only three instances were noted in which continued productive writing was interrupted by the time limit. Here an artificial ceiling was induced for CFR scores obtainable by these subjects in interrupted trials. However, it is doubted that continued uninterrupted writing by these individuals would have changed the overall results of the study.

Statistical Analysis

The statistical techniques used for the analysis of the data collected in the study were analyses of variance and planned comparisons based upon a mixed, three (between subjects) by five (within subjects) factorial analysis. By applying F-tests in these analyses, the means of two or more groups of scores could be tested to determine if they were significantly different from a level expected by chance. To test the comparisons of interest, the analysis initially focused on an examination of simple main effects of the interaction of treatments in the factorial. In addition to planned analyses, tests of non-interacting effects of factors were eventually conducted and these results are included in this chapter.

All analyses were based on the integral relationship between mean and variance. By performing a systematic analysis of the variance of two or more groups of scores, conclusions could be drawn regarding

the similarity of group means. It was assumed that the total variance in the data could be partitioned into component variances that could be attributed to various sources. All component variances were assumed to be due in part to unsystematic variance from errors in measurement. Depending on their source, some component variances were assumed to be due in part to the systematic variation of treatment factors as well as error variance. The variances in CFR scores due to the manipulation of treatments alone were evaluated by dividing, in F-ratios, component variances estimated for treatment sources by appropriate component variances estimated as error variance.[1]

The value of F-ratios obtained for treatment sources were compared to a tabled value for the distribution of F-values. If the obtained F-ratio exceeded the tabled value at the .05 significance level, it could be said that there was a ninety-five percent chance that the value indicated a treatment effect large enough to make a real difference in the means of the scores being compared. If the value of an obtained F-ratio did not exceed the tabled value, it was assumed that the differences between the two mean squares in the ratio were due to chance error alone and not due to treatment effects. In other words the F-test accepted or rejected the null hypothesis of no differences between treatment means other than chance error. If such differences were statistically significant, the null hypothesis would be rejected.[2]

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[1]Geoffrey Keppel, Design and Analysis: A Researcher's Handbook (Englewood Cliffs, New Jersey: Prentice-Hall Inc., 1973), pp. 433-455; see also B. J. Winer, Statistical Principles in Experimental Design (New York: McGraw-Hill Book Company, 1962, 1971), pp. 518-589.

[2]Ibid., pp. 60-68.

The study included three factors which contributed to the variability of CFR scores in the data: the conditions of presentation (factor A) consisted of three levels which were measured in independent groups of subjects; prior presentation (factor B) consisted of five levels which were repeated measures observed of the same subjects; the third factor, subjects (factor S), was a random factor with twenty-five levels nested in each level of conditions of presentation.

These three factors and the interactions that could occur among them identify the five component sources of variance for an overall analysis of variance in the data.[3] However, it was not necessary to examine all possible sources of variance to test the predictions of the study. The predictions implied that the variability in the data would be concentrated in the interaction of the factors representing the independent variables. Specifically, it was predicted that the variability due to levels of prior presentation would be different in each condition of presentation, and these differences in variability would account for most of the total variance. For this reason, the analysis was initially confined to an analysis of simple main effects.[4]

Differences Within Subject Groups

The assumptions of the study predicted that the variability due to the repeated factor in conditions of similar presentations without a topic shift (see prediction number 1 in Chapter 1), would be significant and have a significant quadratic trend component. For similar presentations with a topic shift (see predictions 3, 4, and 5), this

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[3] Ibid., p. 433.

[4] Ibid., pp. 89-93.

variability was predicted to be significant and, because of the shift, have a significant cubic trend component. For dissimilar presentations (see prediction number 2), the variability due to the repeated factor was predicted to be nonsignificant.

The data collected in the study are described in Table 1. Means and standard deviations describing the groups of CFR scores tallied for each trial are presented by subject group. While apparent differences in mean performances within each subject group were suggestive of predicted trends, statistical analysis proved otherwise.

Table 2 summarizes the analyses of the simple main effects of prior presentation (factor B). In these analyses, calculations were performed as if on three single factor experiments, one for each subject group. Component sources of variance were identified in each subject group that would reflect the variability of scores over levels of factor B, and mean squares were generated for each source. Mean squares estimating variance due to this repeated factor were evaluated with error mean squares that reflected an interaction of the subjects in each group with the repeated factor. In other words, two mean squares, one estimating variance due to factor B and one estimating error variance, were calculated for each subject group. The pairs of mean squares were compared in F-ratios to determine, for each subject group, whether or not there were significant differences in the means of the five groups of scores representing the levels of prior presentation.[5]

As indicated in Table 2, none of the values obtained for F-ratios in these analyses were significant. The differences within

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[5] Ibid., pp. 207-234.

Table 1

Mean Correct Free Recall as a Function of Trials Under Three Conditions of Presentation

		Trials				
		1	2	3	4	5
Group 1	Mean	35.16	36.28	35.68	36.24	37.64
Similar Presentations With Topic Shift	(S.D.)[a]	(16)	(15)	(16)	(18)	(17)
Group 2	Mean	35.56	40.60	38.76	37.24	34.32
Similar Presentations Without Topic Shift	(S.D.)	(15)	(14)	(17)	(16)	(17)
Group 3	Mean	35.56	47.56	40.56	42.72	43.00
Dissimilar Presentations	(S.D.)	(14)	(17)	(14)	(14)	(14)

[a]Standard deviations rounded to nearest whole number.

Table 2

Prior Presentation Effects Under Three Conditions of Presentation

Source	SS	df	MS	F
Group 1				
B	85.840	4	21.46	< 1
BS	14934.960	96	155.5725	
Group 2				
B	623.328	4	155.832	1.1876
BS	12595.872	96	131.207	
Group 3				
B	1670.688	4	417.672	2.3666*
BS	16945.312	96	176.5137	

*$p < .10$

subject groups, apparent in Table 1, were due to chance alone. By not rejecting the null hypothesis in these analyses, it was concluded that, within each subject group, the means of CFR scores tallied for each trial were equal. This statistical equivalence precluded the need for further analysis in regard to predicted trends.

Differences Between Subject Groups

The assumptions of the study also predicted that each condition of presentation would effect performance in different ways at specific levels of prior presentation. These assumptions related to the effects of a topic shift as revealed by differences in group performances in trial four. To examine these differences, comparisons of trial four scores were planned between the subject group assigned to the condition of similar presentations with a topic shift (Group 1 in Table 1) and each of the other two subject groups.

Comparisons between treatment means are conducted much like the analyses that have been discussed except that calculations are performed on weighted means. To obtain a comparison between specific means, the means at each level of a factor are weighted and summed across the levels of the factor. Weighting is accomplished by multiplying the means by a set of numbers called coefficients. Any number may be used as a coefficient, however to qualify as a comparison, at least two numbers in a set of coefficients must be numbers other than zero, and the sum of the coefficients must equal zero. The pairing of a coefficient and a mean is dictated by the particular comparison desired. Positive weighted means are compared with negative weighted means in the summation process. A zero coefficient eliminates a mean from the comparison.

The comparison between Group 1 and Group 2 was intended to reveal differences attributable to the topic shift. The comparison between Group 1 and Group 3 was to test the prediction of no differences between these groups at trial four. Both comparisons (between Groups 1 and 2, $F(1,72) < 1$; between Groups 1 and 3, $F(1,72) < 1$) were not significant. The means of CFR scores obtained by the three subject groups in trial four were statistically equal. Since there were no within-subject-group differences, the two comparisons effectively demonstrated no differences between groups at all levels of prior presentation.

The two comparisons, together with the analysis of the simple main effect of prior presentation, accounted for all differences that could occur in the interaction of factors representing the independent variables. The analyses of theoretic interest were complete.

Non-Interacting Effects

Since there might have been differences in CFR scores attributable to non-interacting effects of factors in the factorial, an omnibus F-test was conducted to test all possible sources of variance in the data. Here a non-significant interaction of conditions of presentation and prior presentations, $F_{AB}(8,288) < 1$, verified previous analyses. Differences due to levels of prior presentation averaged over subject groups, $F_B(4,288) = 2.033$, $p > .05$, were due to chance as were differences in group scores averaged over trials, $F_A(2,72) = 1.689$, $p > .05$.

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter provides a summary of the study. Conclusions are presented and discussed with respect to the assumptions and procedures of this and other studies. Recommendations for further research in this area of investigation are also included in this chapter.

Summary

A theory offered by Thorndyke and Hayes-Roth proposed that knowledge of prose information is acquired and retained with the construction of a schema; a structure in semantic memory which provides an internal representation of textual materials read. An integral feature of this theory is that similar texts can share the same schema representation, and when this occurs certain costs and benefits accrue with respect to recall probabilities as more and more texts share the same schema. This study examined the applicability of such a theory for predicting the recall of descriptive texts that presumably could or could not share such a schema.

In each of five trials, university students were asked to read, and after two minutes, write from memory a presented text. Correct free recall of the words in each text was the dependent measure, and differential effects of prior trials were sought under three presentation conditions. Each condition was specified by the similarity of texts presented in successive trials. One condition which presented

similar texts included a topic shift after the third trial. The topic shift disrupted the similarity relationships devised among previous presentations. Comparisons were made between this experimental condition and two control conditions: one a condition with similar presentations without a topic shift; the other a condition with dissimilar presentations. Assumptions regarding the mediation of transfer effects in the recall of texts sharing a schema, allowed for the prediction of performance trends across trials in each condition. Comparisons between conditions examined the effects of a topic shift.

Conclusions

Topic similarity, as defined in the study, did not mediate net transfer effects large enough to produce reliable differences in correct free recall. There were no differences in recall scores as a function of the number of prior presentations. Therefore, trends predicted to occur in the two similar conditions could not be substantiated. Indeed, the recall of similar texts was indistinguishable from the recall of texts for which topic similarity had been disrupted.

The differences in CFR scores sought in the study were seen as reflecting the combined effects of positive and negative transfer. Finding predicted trends, and therefore, support for assumptions about the buildup of and release from transfer effects, depended on net differences reaching significance. They did not.

The only predictions upheld in the study were those pertaining to performances in the dissimilar condition and the shift trial. These were predictions of the null hypothesis and could not be interpreted as supporting the assumptions of the study unless the predicted trends were

Some procedure for measuring or estimating the separate effects of positive and negative transfer could provide for analyses less dependent upon net effects and yield more conclusive results. The present study could be replicated with the inclusion of additional subject groups that are presented identical texts. Identical texts would presumably share the same schema, while their details would not compete for association with the schema. Performances of such groups, affected only by positive transfer, could then be compared to the recall of groups presented similar texts. If texts were equally represented in the identical and similar groups, differences found in their comparison could be attributed to negative transfer.

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APPENDIXES

APPENDIX A

Schedule of Text Presentation in Each Booklet and General Topics

Table 3

Schedule of Text Presentation in Each Booklet

	Group 1 Similar-Shift					Group 2 Similar-No Shift					Group 3 Dissimilar				
	Trial					Trial					Trial				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	A1	A2	A3	B4	B5	A1	A2	A3	A4	A5	A1	B2	C3	D4	E5
2	A2	A3	A4	B5	B1	A2	A3	A4	A5	A1	B2	C3	D4	E5	A1
3	A3	A4	A5	B1	B2	A3	A4	A5	A1	A2	C3	D4	E5	A1	B2
4	A4	A5	A1	B2	B3	A4	A5	A1	A2	A3	D4	E5	A1	B2	C3
5	A5	A1	A2	B3	B4	A5	A1	A2	A3	A4	E5	A1	B2	C3	D4
6	B1	B2	B3	C4	C5	B1	B2	B3	B4	B5	B1	C2	D3	E4	A5
7	B2	B3	B4	C5	C1	B2	B3	B4	B5	B1	C2	D3	E4	A5	B1
8	B3	B4	B5	C1	C2	B3	B4	B5	B1	B2	D3	E4	A5	B1	C2
9	B4	B5	B1	C2	C3	B4	B5	B1	B2	B3	E4	A5	B1	C2	D3
10	B5	B1	B2	C3	C4	B5	B1	B2	B3	B4	A5	B1	C2	D3	E4
11	C1	C2	C3	D4	D5	C1	C2	C3	C4	C5	C1	D2	E3	A4	B5
12	C2	C3	C4	D5	D1	C2	C3	C4	C5	C1	D2	E3	A4	B5	C1
13	C3	C4	C5	D1	D2	C3	C4	C5	C1	C2	E3	A4	B5	C1	D2
14	C4	C5	C1	D2	D3	C4	C5	C1	C2	C3	A4	B5	C1	D2	E3
15	C5	C1	C2	D3	D4	C5	C1	C2	C3	C4	B5	C1	D2	E3	A4
16	D1	D2	D3	E4	E5	D1	D2	D3	D4	D5	D1	E2	A3	B4	C5
17	D2	D3	D4	E5	E1	D2	D3	D4	D5	D1	E2	A3	B4	C5	D1
18	D3	D4	D5	E1	E2	D3	D4	D5	D1	D2	A3	B4	C5	D1	E2
19	D4	D5	D1	E2	E3	D4	D5	D1	D2	D3	B4	C5	D1	E2	A3
20	D5	D1	D2	E3	E4	D5	D1	D2	D3	D4	C5	D1	E2	A3	B4
21	E1	E2	E3	A4	A5	E1	E2	E3	E4	E5	E1	A2	B3	C4	D5
22	E2	E3	E4	A5	A1	E2	E3	E4	E5	E1	A2	B3	C4	D5	E1
23	E3	E4	E5	A1	A2	E3	E4	E5	E1	E2	B3	C4	D5	E1	A2
24	E4	E5	E1	A2	A3	E4	E5	E1	E2	E3	C4	D5	E1	A2	B3
25	E5	E1	E2	A3	A4	E5	E1	E2	E3	E4	D5	E1	A2	B3	C4

General Topics

A Energy Resources in the United States
B Cacti as House Plants
C Astral Constellations
D Liver Disorders
E Early British Poets

APPENDIX B

Texts Organized by General Topic

Text A1

Coal is the most plentiful fossil fuel in the world. It has potential for filling a growing proportion of the demand for energy. But problems plague this promising old fuel. The United States has over a quarter of the world's known coal reserves. In addition, the U.S. has an estimated 1.7 trillion tons of deposits at depths of less than 3,000 feet. Unfortunately, much of this coal is not accessible with present technology or at present prices. Coal provides only a fifth of the energy we use each year. Several environmental concerns are associated with increased production and use of coal. These include changes in climate, caused by increased carbon dioxide from burning coal, and the emissions from coal stacks that erode buildings, poison lakes, and damage human lungs.[1]

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[1]"An Atlas of Energy Resources," National Geographic Special Report, February, 1981, p. 63.

Text A2

In 1859, outside Titusville, Pennsylvania, "Colonel" Edwin Drake punched a hole some 70 feet deep, struck oil, and gave birth to America's oil binge. Petroleum quickly became the foremost fuel for lighting and lubrication; the earliest uses for this black milk of the earth that would ultimately nourish the world's largest industry. Within a century after the Pennsylvania discovery, oil shouldered aside coal as the leading source of energy. By 1948, the U.S. had become a net importer of oil. During the past three decades, we tripled our appetite for oil. Its extreme cheapness encouraged wasteful use. Today Americans consume more than a fourth of world wide production.[2]

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[2]Ibid., p. 59.

Text A3

The energy uranium holds is awesome. A pound of enriched fuel contains nearly three million times the energy available in a pound of coal. Using uranium requires elaborate precautions in plant construction and operation and in the safe disposal of waste. Efforts to improve the efficiency of reactors include recycling of spent uranium. Nearly one-third of the fuel used in a conventional operation is not consumed. Breeder reactors, which produces more fuel than they use, could increase reactor fuel 70-fold. But breeders produce plutonium, only a few pounds of which are needed to make a powerful bomb. Fear of nuclear weapons proliferation and doubts intensified by the Three Mile Island accident, make the future of nuclear power unclear.[3]

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[3]Ibid., p. 67.

Text A4

Geothermal energy is one of our most plentiful resources, yet most of this energy can never be used. Earth heat results from the radioactive decay of rocks, which raises the earth's temperature an average 25 degrees Celsius with each kilometer of depth. Some of this energy can be recovered from hot springs or geysers, where heated ground water returns to the surface. Wells can be drilled to reach hot water trapped at deeper levels. It may also be possible to pump cool water down to hot dry rock and recover it again as hot water. Advances in this technology are needed to make geothermal energy competitive with conventional sources of energy.[4]

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[4] Ibid., p. 64.

Text A5

Every year the sun drenches the U.S. with 500 times more energy than we consume. If we could tap only a tenth of that, our entire energy demand could be met with the rays striking just 2 percent of the nations surface. Solar energy is not just sunlight but includes many other resources. By heating the earth and its atmosphere, the sun generates wind, waves, rainfall for rivers, and ocean-temperature differences. The sun also helps grow trees for firewood and plants that can be converted to alcohol.[5]

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[5]Ibid., p. 69.

Text B1

The Pereskia cactus is sometimes called Barbados gooseberry or lemon vine. It is native to the hills of Mexico, the West Indies, and South America. This is an unusual cactus, whose spines are all but hidden in the leaf axils. First the leaves are green, next they turn yellow, and finally, in full sun they turn deep pink, while the undersides of the leaves are purple. If conditions are right, the plant becomes a vine and slowly climbs up the window frame. As a vine, it may be trimmed and pruned to fit any space desired. It prefers full sunlight and ordinary sandy garden soil.[6]

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[6]Jean Hersey, The Woman's Day Book of House Plants (New York: Simon and Schuster, 1965), p. 40.

Text B2

The "Old Man" cactus has a shaggy white mane of long waving "hair" which tumbles down from the top of a cylindrical stem. Each year the hair-like spines grow thicker, longer and wavier, until it becomes a rather enchanting tangle. Out of these tousled locks, and as a complete surprise, come two-inch rose colored flowers, that have a sweet and elusive scent all their own. To coax the cactus into bloom, grow it in a container much too small. Let the roots be cramped and pressed tightly together. This seems brutal, but actually the plant thus grown is sure to bloom.[7]

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[7] Ibid., p. 43.

Text B3

The Orchid cactus has no fierce thorns. This tropical beauty will produce flowers often a foot across. The blooms look something like a water lily. It has many petals and is filled with feathery stamens. The bloom may be orange, pink, red, or white and have a penetrating sweet scent. A mature plant seldom opens fewer than half a dozen flowers at once. It will tend to become huge, but may be pruned to fit any space. It prefers a sandy loam that should be kept rather dry, except when the plant is in bloom. A six to eight inch branch broken off and potted will become a flowering plant in a year or two.[8]

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[8] Ibid., p. 43.

Text B4

The half-inch thick stems of the Rat-Tail cactus are covered with bristly hairs and spill down from an upright column. This gives the plant a gay fountain-like effect. Once a year, in late winter, dramatic three-inch flowers star the prickly stalks. The blossoms are firm, shiny, thick-petaled, and have an exotic sweet scent. Each one lasts many days and they appear over the plant with no apparent rhyme or reason. A three to five inch stalk broken off and potted, with one end buried an inch or two deep, soon becomes a new plant.[9]

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[9]Ibid., p. 44.

Text B5

The "Sand Dollar" cactus comes from Mexico. It is a small green cushion of a plant, that reaches three to six inches in height. Rows of separate tufts of down reach from top to bottom in an almost geometric pattern over its bright green surface. Each year at the top of the plant and directly in the center, a single golden flower unfolds from a scarlet base. The flower is nearly as broad as the plant itself. It has many petals and an open flaring shape. The plant blossoms only once a year, but the flower will remain in bloom for several days.[10]

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[10]Ibid., p. 44.

Text C1

Canis Major contains Sirius, the "Dog Star," the brightest of all the stars. Finding Sirius is therefore easy. South of Sirius are three stars in a triangle with nearly equal sides. Three stars with Sirius form a rough rectangle. Sirius is one of the nearest stars and gives out twenty-six times as much light as the sun. The Dog Star gives its name to the dog days of summer when Sirius is too close to the sun to be seen.[11]

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[11]Samuel G. Barton and Wm. H. Barton, Jr., A Guide to the Constellations (New York: McGraw-Hill, 1943), p. 23.

Text C2

Cepheus is an inconspicuous constellation which lies in the midst of the Milky Way. It rotates closely about the pole star and no part of it ever sets below the horizon. It is in its best position in October, but as none of its stars are very bright, it may be hard to locate. Some of its stars form a crude square with a triangle resting on it. The fourth brightest star of the group is Delta Cephei, a double star which is taken as the type star for the large class of stars called "Cepheid variables."[12]

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[12]Ibid., p. 19.

Text C3

Orion is one of the finest constellations. It is in its best position in February, and can most readily be located by means of the three bright stars lying in a straight line in the middle of the constellation. These stars represent the "Belt of Orion", and are also known as the "Yardstick" from the fact that the line is three degrees long. The belt is surrounded by four bright stars which form a crude rectangle. Two first magnitude stars are at opposite corners of the rectangle. Rigel, which means foot, is below the belt. Betelgeuse, meaning armpit, lies above.[13]

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[13]Ibid., p. 23.

Text C4

Lyra is a small constellation which is at its zenith in August. Its brightest star, Vega, is the fourth brightest star of the heavens. Two much fainter stars form an equal-sided triangle with Vega. The northern star of the two is Epsilon Lyrae which appears, with good eyesight, to be two stars very close together. Telescopes show that each of these two are double stars. In other words, there are four stars in what appears to the naked eye as a single star. The motion of our sun through space is nearly in the direction of Vega.[14]

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[14] Ibid., p. 35.

Text C5

Cygnus is at its zenith in September. While its name means "swan", it is often called the "Northern Cross," because its brighter stars are arranged in the form of a cross or dagger. The whole constellation lies in the Milky Way which separates in two branches in Cygnus. The brightest star in Cygnus, Deneb, is at the top of the cross. The distance of Deneb is too great to be determined accurately. Since it is bright to us, it must be a star of enormous intrinsic brilliance. Indeed, it is ten thousand times brighter than the sun.[15]

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[15] Ibid., p. 37.

Text D1

Nutritional disease of the liver is seen particularly after prolonged and excessive use of alcoholic beverages, but may occur as a result of malnutrition from any cause. The dietary deficiency is not a lack of calories, but a lack of a few essential foodstuffs. Under these conditions massive amounts of fat accumulate in the liver cells. After a period of months or years the liver becomes distorted and the blood supply is altered. The small veins draining blood from the liver become narrowed and the flow of blood through the liver becomes impeded. Blood pressure rises causing massive hemorrhage. In late stages of the disease, the patient dies in hepatic failure.[16]

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[16]Milton R. Hales, "Liver Disorders," McGraw-Hill Encyclopedia of Science and Technology (New York: McGraw-Hill, 1977), pp. 636-637.

Text D2

Benign tumors are rare in the liver and when they occur they are usually small and of little significance. Malignant tumors of the liver appear to be increasing in frequency. They are not amenable to surgical treatment and are rapidly fatal. Such tumors usually arise from the liver cells themselves or from the bile ducts in the liver. They have little tendency to spread outside the liver, but cause death by massive replacement of functioning tissue with non-functioning tumor tissue. It is the growth of these tumors in the liver which is the ultimate cause of death in many people with cancer of the bowel, breast, lung, or other tissues.[17]

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[17]Ibid., p. 638.

Text D3

Prolonged obstruction to the drainage of bile from the liver results in scarring of the bile ducts. Behind the obstruction, the bile ducts become greatly dilated. Bile accumulates there, in tiny channels in the liver and within the liver cells themselves. Bacterial infection of the bile ducts is a frequent complication and is often recurrent. Eventually extensive connective tissue proliferation results, and liver function fails. Impaction of a gallstone in the common bile duct may start such a process, and tumors of the bile duct are common causes. Failure of the bile ducts to develop in the embryo has the same consequence and may lead to death in infancy.[18]

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[18] Ibid., p. 638.

Text D4

Toxic hepatitis is a type of liver injury caused by chemical agents ingested or inhaled into the body. There are many compounds which are capable of damaging the liver. They produce fatty accumulation and death of liver cells, often with a distinctive pattern. Because the liver has great powers of regeneration, complete healing, without residual effects, may follow moderate toxic-injury. If too severe, such insults may be rapidly fatal. Many drugs may be injurious to the liver in susceptible individuals. Fortunately, drug injuries are not often severe enough to be fatal.[19]

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[19]Ibid., pp. 637-638.

Text D5

The most important infectious disease of the liver is viral hepatitis. It may be caused by either of two related viruses. Infectious hepatitis is acquired from infected food or water. Serum hepatitis is acquired from blood serum from a person carrying the disease. These two agents produce the same changes in the liver. The effects of the virus on the liver are characterized by injury or death of liver cells. Drainage of bile through the tiniest bile channels is blocked and bile accumulates there, and in the liver cells themselves. In more severe cases, death of liver cells may be so wide spread that death of the patient occurs early in the illness.[20]

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[20] Ibid., p. 637.

Text E1

Alexander Pope was a poet, translator of Homer, and an editor of Shakespeare. He was born in London, the only child of a prosperous linen merchant. He had little regular education, and except for some lessons from a priest at Binfield, he was self-educated. Pope was a healthy child, but between twelve and sixteen Pott's disease aggravated by too much study, and too little fresh air and exercise, brought him near death, and left him stunted in growth, and hump-backed. Pope's reputation as a poet stood next after Shakespeare, Milton, and Dryden in the eighteenth century, but suffered severely in the nineteenth. His reputation has now been restored to its former place.[21]

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[21]Stanley S. Kunitz and Howard Haycraft, eds., British Authors Before 1800: A Biographical Dictionary (New York: The H. W. Wilson Company, 1952), pp. 412-415.

Text E2

Alexander Ross was a Scots poet born in Aberdeenshire the son of a tenant farmer. He attended the local school and graduated from Marischal College. For a time he was a private tutor and then became a parish schoolmaster. In person Ross was small, but neatly formed. By temperament he was lively and good humored. He was reader and precentor of the parish, session clerk, and notary public as well as schoolmaster. Nevertheless he found plenty of time for reading and study, and wrote a great deal of poetry. He is best known for his poem "Helenore" which is four thousand lines of Highland Scots dialect.[22]

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[22] Ibid., p. 441.

Text E3

Matthew Prior, poet and diplomat, was born in East Dorset, the son of George Prior, a carpenter and joiner. While he was still a small child the family moved to London. He was sent to Westminster School, but was taken out on his father's death and apprenticed to his uncle, a tavern keeper. He entered Cambridge, became King's Scholar, secured his B.A. and upon graduation was made a fellow. Like many self-made men Prior was an opportunist and very adaptable to the wishes of the great. When chosen as ambassador to France, he refused confirmation because of his humble birth. Prior is thought to be among the easiest, richest, and most charmingly humourous of English lyrical poets.[23]

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[23]Ibid., p. 420.

Text E4

Richard Lovelace, poet, was born in Woolwich, of an old Kentish family. He was the son of Sir William Lovelace who was killed in Holland in 1628, leaving a large family of whom Richard was the eldest. Only two years after he entered Oxford he was given an M.A. degree at the solicitation of a lady of the court who was struck with his "most amiable and beautiful person, innate modesty, virtue and courtly deportment." He must have had some learning also, for he was incorporated in Cambridge eleven years later. With a few exceptions such as "To Althea, from Prison" ("Stone walls do not a prison make"), the great mass of his work is frigid, tasteless and tortured in style.[24]

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[24] Ibid., pp. 326-327.

Text E5

William Drummond, Scottish poet and historian, was born near Edinburgh, the eldest son of Sir John Drummond. He was educated at Edinburgh high school and studied law in Paris. After his father died in England, Drummond quit his study of law and retired to his father's estate where he spent the remainder of his life. He was a recluse and a melancholy man by nature, and this tendency was reinforced by the death of his sweetheart just before their marriage. Drummond sought in his study and writing to find a solution to his personal problems. When he had solved them to his own satisfaction he ceased to write about them.[25]

[25] Ibid., pp. 162-163.

APPENDIX C

Number Arrays Used in Distraction Tasks in Order of Presentation

9 3 4 7 8 =

9 7 4 2 6 =

1 6 7 2 5 =

1 2 5 6 8 =

5 9 6 3 4 =

1 6 2 7 9 =

8 4 2 1 7 =

6 3 9 1 7 =

3 2 1 4 9 =

5 7 6 9 8 =

1 8 9 7 9 =

2 6 3 8 9 =

2 3 4 6 7 =

6 2 3 8 1 =

3 7 8 5 9 =

7 9 2 9 1 =

5 6 2 1 8 =

9 4 5 7 2 =

1 6 9 8 5 =

3 1 6 9 2 =

4 6 9 8 3 =

4 2 5 3 7 =

3 2 9 9 7 =

9 5 9 3 7 =

3 1 6 2 4 =

1 7 3 9 2 =

7 9 4 6 2 =

9 8 1 9 5 =

5 2 4 2 9 =

4 9 1 7 4 =

7 9 8 3 8 =

8 3 1 1 4 =

9 7 4 5 3 =

9 9 5 6 7 =

4 2 3 4 9 =

1 3 8 9 5 =

9 7 1 2 2 =

1 6 6 4 3 =

4 5 5 9 3 =

2 9 1 5 3 =

6 7 1 9 9 =

9 2 9 4 3 =

7 9 7 8 4 =

8 7 7 5 6 =

3 4 8 7 6 =

1 1 9 5 6 =

5 2 2 7 4 =

9 7 6 9 6 =

9 4 9 2 3 =

9 1 9 9 9 =

9 2 9 3 5 =

6 1 7 1 6 =

7 3 3 2 9 =

4 2 1 9 5 =

2 6 7 8 6 =

1 2 4 1 9 =

9 6 9 3 8 =

1 9 4 7 4 =

3 5 8 1 3 =

4 5 3 7 5 =

5 3 7 4 2 =

6 3 3 8 9 =

3 5 3 5 8 =

6 3 4 3 3 =

9 8 2 5 3 =

9 2 6 3 2 =

6 4 5 5 2 =

8 5 9 7 2 =

5 8 5 4 1 =

3 4 8 5 2 =

9 3 9 2 1 =

6 2 9 5 3 =

9 8 4 5 9 =

9 7 9 8 5 =

1 8 5 8 9 =

7 2 8 4 7 =

8 8 7 6 4 =

4 5 1 7 5 =

9 6 7 6 8 =

4 3 1 6 7 =

8 4 3 7 9 =

3 6 6 7 1 =

9 7 2 8 5 =

1 9 1 5 8 =

5 5 1 9 7 =

5 3 8 1 2 =

5 1 8 6 3 =

3 5 9 1 7 =

9 3 6 1 8 =

9 2 9 6 9 =

4 9 8 3 4 =

8 4 6 7 1 =

7 9 6 9 1 =

7 5 9 3 6 =

6 2 3 7 4 =

4 9 1 4 7 =

9 6 9 4 7 =

8 7 2 5 8 =

7 4 2 1 9 =

6 2 5 6 8 =

APPENDIX D

Booklet Cover Sheet

PLEASE: Do NOT open this booklet until asked to do so.

The purpose of this study is to see how well people can add numbers and remember what they have read. Since timing of your activities on each page of this booklet is critical to the study, please do not open the booklet or turn pages until you are asked to do so.

The 15 pages of this booklet include five short pages of text, five pages of numbers, and five blank pages which appear alternately throughout. These pages are arranged in a repetitive sequence; text followed by numbers, followed by a blank page, followed by another text and so forth. You will be asked to read a text, add the numbers, and then write from memory the text you have just read.

You will be allowed 2 minutes to study each text. Read a text as many times as you wish and study it well because you will be asked to remember it later.

You will be allowed 2 minutes to add numbers. Each number page has 20 rows of numbers. Add the numbers of each row in your head and write the total to the right of the equal sign. If you are unable to add all the numbers in the time allowed do not be concerned. You are not expected to. However, if you do complete them please do not turn the page until asked to do so.

Upon turning to a blank page you will have 4 minutes to write from memory the text you have just read. You may write the words of the original text in any order but try to use the exact words. Do not be concerned about spelling errors. Very few people are expected to recall a text completely. Don't be discouraged but rather consider the task a challenge and give it your best effort. Do not refer back to the original text.

Are there any questions?

Never turn the pages backward.