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THE ROLE OF PRIOR KNOWLEDGE AND ELABORATION IN TEXT
COMPREHENSION AND MEMORY: A COMPARISON OF SELF-GENERATED
ELABORATION VERSUS TEXT-PROVIDED ELABORATION

by

Sung-il Kim

A dissertation submitted in partial fulfillment
of the requirements for the degree

of

DOCTOR OF PHILOSOPHY

in

Psychology

UTAH STATE UNIVERSITY
Logan, Utah

1992

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Sung-il Kim

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ABSTRACT

The Role of Prior Knowledge and Elaboration in Text
Comprehension and Memory: A Comparison of Self-Generated
Elaboration versus Text-Provided Elaboration

by

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Utah State University, 1992

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A series of six experiments investigated the effect of text-provided elaborations and prior knowledge on memory for text. In all experiments, subjects read 28 episodes, half of which were associated with well-known individuals, and the other half were associated with unknown individuals. In Experiment 1, text-provided elaborations enhanced recall only when the reader did not possess a high level of prior knowledge. The findings from Experiment 1 were hypothesized to be the result of readers generating relevant elaborations during text comprehension. Experiment 2 supported this hypothesis by providing evidence of self-generated elaborations. Experiment 3 provided evidence that this generation process occurred "on-line." The results from Experiments 4 and 5 extended these findings by showing that readers with high prior knowledge automatically generate

causally relevant elaborations when the sentences have a low relation. The findings of Experiment 6 suggest that distinctive text-provided elaborations are more effective than normal text-provided elaborations only when readers have high prior knowledge.

(107 pages)

INTRODUCTION

One important question in the study of human learning, memory, and text comprehension is how information should be presented so that it is better understood, learned, and retained. The central notion has been that a text should provide elaborations of the target (to-be-learned) information.

Elaboration is defined as the process of adding information to target information such that the target information is further supported. This concept of elaboration has become the major theoretical explanation for differences in memory performance. Many researchers have argued that elaborations facilitate retention of target information (e.g., Anderson, 1983a; McDaniel, Dunay, Lyman, & Kerwin, 1988; Stein, Littlefield, Bransford, & Persampieri, 1984). However, some studies indicate that elaboration is not always beneficial or may debilitate the retention of target information (e.g., Bradshaw & Anderson, 1982; Reder & Anderson, 1982; Walker, 1986).

Such conflicting findings emphasize the fact that there is not as yet enough known about the impact of elaboration on memory. Therefore, there is a great need for exploring the conditions under which effective elaborations are more likely to be produced and the factors (e.g., prior knowledge) that may influence the effect of elaborations. Furthermore, it is also important to distinguish the

different types of elaborations and to investigate the effect of each type of elaboration independently.

REVIEW OF LITERATURE

Anderson's Elaboration Model

Elaboration is the process of adding information that supports, clarifies, or further specifies the information to be learned. The addition can be a logical inference, a continuation, an example, a detail, or anything else that serves to embellish the target information (Gagne, 1985; Reder, Charney, & Morgan, 1986).

The elaboration model proposed by Anderson (Anderson, 1983a, 1983b) assumes that long-term memory is a network of interconnected propositions. When a person reads a passage, new propositions are added to this memory network. Both target information and elaborations are encoded as propositions during reading. The model predicts that the target information encoded with relevant elaborative propositions will be recalled better at the time of retrieval than target propositions encoded in isolation. There are two reasons that elaborated memory traces are more easily recalled. First, a relevant elaboration might produce greater network redundancy in memory, such that the target information is stored in memory as part of an associative network of information. If the target information cannot be directly accessed, then it can be indirectly accessed via the path of the associated elaborations. Second, the relevant elaboration may facilitate the reconstruction of memory. If target

information is forgotten, it may be inferred or reconstructed through recall of the associated elaborations.

Role of Prior Knowledge

Elaborations are often generated by the reader. They can be generated in response to instructions to elaborate (e.g., Stein & Bransford, 1979) or spontaneously (e.g., Bower, Black, & Turner, 1979). In the Bower et al. (1979) study, subjects read short stories about common situations such as visiting a doctor. All of the familiar stories were considered to be a part of everyone's prior knowledge and therefore likely to produce self-generated elaborations. When subjects recalled the stories, about 20% of what was recalled were self-generated elaborations consistent with, but not contained in, the stories. These data suggest that subjects elaborated on the stories while reading them. They used their prior knowledge of what typically happens in everyday events to generate elaborations.

Subjects with greater knowledge in a domain are more likely to generate elaborations than subjects with less knowledge (e.g., Chiesi, Spilich, & Voss, 1979). Thus, it would be expected that subjects with more prior knowledge should exhibit greater frequency of recall of the target information (e.g., Glaser, 1985; Van Dusen & Kim, 1990). This facilitative effect can be explained by the elaboration model. Familiar material should be easier to encode and retrieve than unfamiliar material because there is

information already present in memory to generate elaborations. Furthermore, the existing prior knowledge already has many alternate retrieval paths that can be connected via associations to the target information. Thus, prior knowledge can produce a memory trace with more related elaborations and associate the elaborations in a meaningful way (Kim & Kiewra, 1990).

Self-Generated Elaboration in Text Comprehension

Several studies have investigated inference making or elaborative processing performed during text comprehension (e.g., Black & Bern, 1981; Keenan, Baillet & Brown, 1984; Singer & Ferreira, 1983). It is generally accepted that readers spontaneously integrate the information expressed in related ideas resulting in abstract semantic memory representations that contain more information than actually presented in the text. Myers, Shinjo, and Duffy (1987) argued that readers make inferences to establish coherence of a text and that the internal representation of the text includes these inferences that arise out of the interaction between the information presented in the text and the reader's existing prior knowledge.

Keenan et al. (1984) created sentence pairs which varied across four levels of causal relatedness. After reading the sentence pairs, subjects were asked to recall the first sentence of the pair given the second sentence as

a cue. Unexpectedly, recall was better for the moderately related sentence pairs (83%) than for the highly related pairs (69%). That is, the pairs which had the strongest causal relations did not produce the best memory. This finding was replicated with a larger stimulus set by Myers et al. (1987). Duffy, Shinjo, and Myers (1990) developed an elaboration hypothesis, which is compatible with Anderson's (1983a) elaboration model, to account for the recall advantage for the moderately related sentence pairs. According to this hypothesis, the moderately related sentence pairs require subjects to generate causal bridging elaborations in order to fully comprehend the meaning of the pair. Self-generated elaborations which are stored with a sentence pair facilitate recall for that pair. This facilitation occurs because the generated elaborations provide additional retrieval pathways from one member of the pair to the other. These additional pathways increase the likelihood that one sentence will be a successful recall cue for the other.

When Does the Reader Generate Elaborations?

Although the evidence suggests that any kind of meaningful self-generated elaboration facilitates memory, the reader does not seem to always generate elaborations. Duffy et al. (1990) found that subjects who were explicitly instructed to study the pairs of sentences for a cued recall

test did not spontaneously adopt an elaboration strategy. A similar result was obtained by Pressley, McDaniel, Turnure, Wood, and Ahmad (1987). Subjects who were instructed to study individual sentences for a later recall test (intentional learning task) remembered 49.8% while subjects who merely answered "why" questions during reading (incidental learning task) remembered 56.1%. The supplementary analysis of subjects' protocol revealed that subjects in the intentional learning condition did not generate elaborations spontaneously while subjects in the incidental learning condition generated elaborations that were prompted by questions.

O'Brien and Myers (1985) found enhanced recall for passages that contained a target sentence that was difficult to comprehend compared to the same passages with a sentence that was easily comprehended. This finding contrasts with previous research (e.g., Bransford & Johnson, 1972; Miller & Kintsch, 1980) which has shown that memory performance drops markedly when texts are very difficult to comprehend.

O'Brien and Myers suggest that this difference reflects the nature of the relationship between comprehension and memory. For a text to be fully comprehended, a reader must be able to integrate incoming text with either previously processed information (provided-elaboration) or prior knowledge (generated-elaboration). When a text lacks coherence, a reader must generate the necessary links through elaborative

processing. When successful (as was presumably so in this case), these elaborations provide an increase in the number of possible retrieval pathways that will facilitate recall performance. If a reader cannot successfully maintain coherence, comprehension and subsequent memory performance will suffer.

Therefore, the critical factor in the recall of text seems to be whether or not the difficulty of the text is resolvable so that coherence can be established. The resolvability depends on the ability of the reader to elaborate. The more relevant prior knowledge of the text readers have, the easier to elaborate and the more likely they are to resolve the difficulty of coherence. As a result, the reader that effectively elaborates will better comprehend and recall the text.

Text-Provided Elaboration

Often, the reader need not rely on prior knowledge to elaborate text information. Many times the text itself explicitly presents elaborations of the main points. Many studies have focused on the beneficial effects of text-provided elaborations on memory performance (e.g., Anderson & Reder, 1979; Craik & Tulving, 1975; Stein & Bransford, 1979). However, closer examination of the findings from these studies suggests that text-provided elaborations facilitate retention only when the elaborations are semantically congruous with the target information. In a

series of studies, Stein and his associates (e.g., Stein et al., 1982; Stein et al., 1984) found that subjects asked to learn simple target facts (e.g., the tall man bought the crackers) recalled fewer facts than those who studied each target fact along with a relevant elaboration (e.g., the tall man bought the crackers that were on the top shelf). The elaboration "on the top shelf" supported the buyer being tall and therefore facilitates recall. However, when the text-provided elaborations were irrelevant (e.g., the tall man bought the crackers that were on sale), they actually hindered recall of the target facts. The elaboration "on sale" was unrelated to the target information of the buyer being tall.

Other studies have provided significant evidence of the debilitating effect of text-provided elaborations. Reder and Anderson (1980, 1982), for example, compared retention of the main points when presented in the original college textbooks with summaries of those textbook chapters. Students who read elaborated chapters performed worse than did students who read summaries (53.8% versus 73.8% recall). Under a variety of study conditions, retention intervals, and tests, students who read summaries of texts outperformed students who read the original text (Allwood, Wikstrom, & Reder, 1982). Reder (1982) hypothesized that text-provided elaborations in the original college textbooks contained poor elaborations which were not closely related to each

other or to the target fact, thereby contributing to their ineffectiveness.

Explaining the Ineffectiveness of Text-Provided Elaborations

These seemingly contradictory findings of the studies in the previous section to the facilitative effects of elaboration can be explained by interpreting the results in the context of the self-generated elaboration experiment findings. In the study by Bradshaw and Anderson (1982), for example, they attempted to devise specially related elaborations which were causally related to the target fact based on the findings of several studies showing that causal relations improve memory for text (e.g., Trabasso & Sperry, 1985; Trabasso & van den Broek, 1985). Subjects were exposed to 28 target facts, each about a well-known individual (e.g., Newton became emotionally unstable and insecure as a child). One group (the single sentence condition) received the target fact only, whereas a second group (the elaboration condition) received the target fact and two text-provided elaborations causally related to the target fact (e.g., Newton's mother had remarried and left him with his grandfather. Newton became irrationally paranoid when challenged by colleagues). Results indicated that such text-provided elaborations did not increase recall of target facts when the names of the well-known individuals were given as cues ($t = 1.33$). Other studies (e.g., Walker,

1986) have also suggested that text-provided elaborations decrease the probability of recall of the target information.

However, in their studies, subjects in the single-sentence condition already had prior knowledge about the well-known individuals before the experiment. Therefore they might have generated elaborations based on their prior knowledge, thereby creating multiple pathways to the target information. This explanation was tested in an experiment by Kim and Kiewra (1990) where they minimized the prior knowledge and self-generated elaborations by using the names of unknown individuals as well as well-known individuals. They found text-provided elaborations were useful when prior knowledge was low and self-generated elaborations were unlikely. McDaniel, et al. (1988) also found that text-provided elaboration effects emerged only when subjects did not have prior knowledge and all of the elaborations were causally linked to the target information.

Self-Generated Elaboration versus Text-Provided Elaboration

There are a number of studies which provide evidence for the position that self-generated elaborations are more effective than those provided by the experimenter or the author (e.g., Pressley et al., 1987; Slamecka & Graf, 1978). Furthermore, Pressley et al. (1987) found that self-generated elaborations that were prompted by questions were

more potent than providing precise elaborations to learners ($t = 9.22$).

One possible explanation for the potent effect of self-generated elaborations is that self-generated elaborations are more congruent with the prior knowledge of the reader than are text-provided elaborations. Text-provided elaborations can be effective if they activate knowledge the reader possesses that makes the to-be-learned materials more meaningful. Because text-provided elaborations come from an external agent's knowledge base, their effectiveness depends largely on congruence between the prior knowledge of the person providing the elaboration and the reader.

Summary

This review of the literature has suggested that there are two types of elaboration. First, the text or learning materials can contain elaborations of the target information (text-provided elaboration), and second, the reader can generate elaborations (self-generated elaboration).

According to Anderson's (1983a) elaboration model, elaborations provide multiple retrieval pathways to the target information by creating more connections to the reader's prior knowledge and these connections will lead to improved recall. Many theorists have argued that text-provided elaborations facilitate retention of the target information. However, some recent studies have suggested that text-provided elaborations do not necessarily

facilitate retention, even if elaborations are related to the target concept. These contradictory findings may be due to the failure of these studies to control memory load, prior knowledge, or the use of poor elaborations. In order to examine the effect of text-provided elaboration, it is essential to control these confounding factors appropriately.

In contrast to the text-provided elaborations, there was considerable evidence which supported the facilitative effect of self-generated elaborations on retention. However, these studies have not investigated the naturally occurring elaboration process. The robust effects of self-generated elaborations have been exhibited only when direct instructions to specifically generate inferences or to answer precise questions have been used. However, as was shown earlier, readers do not always generate elaborations or draw inferences during reading. Thus, an important question is whether self-generated elaborations are the results of automatic processes or strategic processes. Research must establish the conditions under which readers generate elaborations.

Finally, it was shown that prior knowledge plays an important role in forming elaborations. However the role of prior knowledge in text-provided elaborations has generally been ignored. Additional studies should specifically analyze this interaction.

PURPOSE AND OBJECTIVES

Although numerous studies have investigated the effect of elaboration, there are still ambiguous and contradictory findings regarding the effectiveness of elaborations. This may be due to the failure to distinguish text-provided elaborations from self-generated elaborations. As indicated in the review, information is needed on the impact of prior knowledge on text-provided elaborations, the impact of the naturally occurring comprehension process on self-generated elaborations, the relatedness of elaboration to text, and the likelihood that readers will elaborate information. The purpose of this study was to establish the difference between self-generated elaborations and text-provided elaborations and to explore the effects of these factors on different types of elaborations.

To achieve this purpose the following six objectives were identified:

1. To investigate the interaction effect between elaborations and prior knowledge (Experiment 1).
2. To provide evidence that readers actually generate elaborations primarily based on prior knowledge (Experiment 2).
3. To examine the on-line processing occurring during text comprehension (Experiment 3).
4. To investigate the effect of relatedness between sentences on self-generated elaborations (Experiment 4)

5. To compare the naturally occurring versus task-induced elaboration generation process (Experiment 5).
6. To delineate the effectiveness of various forms of text-provided elaborations (Experiment 6).

To meet these objectives, six experiments were designed in which the level of prior knowledge was manipulated.

EXPERIMENT 1

Experiment 1 was conducted to investigate the interaction effect of prior knowledge and elaborations, both self-generated and text-provided elaborations. In previous work, Kim and Kiewra (1990) argued that text-provided elaborations enhance recall of the target information when prior knowledge is low. However, there were two methodological problems that may invalidate their conclusions. First, they used a plausibility judgment task which may not utilize the same processes as occur naturally in text comprehension. Second, subjects may have found it difficult to retrieve the correct target facts for the unknown names given as cues because there were weak associations between unknown names and facts. This experiment was designed to replicate and extend Kim and Kiewra's (1990) findings by utilizing a comprehensibility rating task rather than the plausibility judgment task and by presenting the first sentence in each episode as retrieval cues. Furthermore, the reading time for each sentence was measured to deduce the processing demand of different conditions from the time needed to read.

Method

Subjects. Twenty Utah State University undergraduates from an introductory psychology course, receiving course

credit for their participation, volunteered to serve as subjects.

Design. The experimental design was a modified Latin square design in which four groups of subjects (five per group), four sets of episodes (seven per set), and four experimental conditions were combined. Two levels of prior knowledge (high prior knowledge vs. low prior knowledge) and two levels of elaboration (elaborated vs. unelaborated) yielded four experimental conditions. The dependent variables were cued recall test scores, reading times, and comprehensibility ratings and response times.

Materials and apparatus. Four versions of narrative texts that vary on two dimensions, prior knowledge of the names in the text and text-provided elaboration, were used as reading materials. The texts were a set of fictitious episodes about 28 individuals. Half of these individuals were well-known figures (e.g., Abraham Lincoln). These well-known figures were chosen so that subjects had high prior knowledge (HPK) about them and could identify them.¹ The names of the remaining 14 individuals were common American names, with no famous referent, drawn from a telephone directory (e.g., Jonathan Hunter). These common names were chosen so that subjects had no or low prior knowledge (LPK) about them. Subjects were asked to identify any familiar names among the unknown names after the

experiment to ensure that they did not have any prior knowledge about the unknown individuals.²

Each name (either well-known or unknown) was presented in either an elaborated or unelaborated condition. In the elaborated condition, a target fact and three supportive facts about the well-known or unknown individual were presented. The three supportive facts and the target fact were causally connected so that each sentence was the cause of the next sentence.³

In the unelaborated condition, the same target fact about the well-known or unknown individuals was presented but with only the first supportive fact. Thus, each target fact was presented in four different ways: HPK/elaborated, HPK/unelaborated, LPK/elaborated, LPK/unelaborated. An example of material used in each of these four conditions is provided in Table 1. (See Appendix A for the complete set of experimental materials.) An IBM personal computer was used to present the materials. The reading materials were presented to each subject individually in random order.

Procedure. The experiment consisted of two phases: (a) incidental learning phase, and (b) immediate test phase. In the incidental learning phase, the experimental instructions were first presented on the computer screen. The instructions were presented in the form of a cover story which informed subjects that the purpose of the experiment was to obtain normative data about story comprehension.

Table 1

Examples of Materials in Experiment 1

HPK/elaborated condition:

Thomas Edison began to work on a new project

Thomas Edison spent many days in his lab

Thomas Edison's wife was discontented with being neglected

Thomas Edison's wife became emotionally unstable

LPK/elaborated condition:

Arthur Colman began to work on a new project

Arthur Colman spent many days in his lab

Arthur Colman's wife was discontented with being neglected

Arthur Colman's wife became emotionally unstable

HPK/unelaborated condition:

Thomas Edison began to work on a new project

Thomas Edison's wife became emotionally unstable

LPK/unelaborated condition:

Arthur Colman began to work on a new project

Arthur Colman's wife became emotionally unstable

Note: Target fact is underlined.

Subjects were told that they would be shown a series of episodes, one sentence at a time. Subjects were instructed to read each sentence until it was understood and press a

space bar to view the next sentence. Subjects were also told that the last sentence of each episode would be underlined. After reading the underlined target fact, subjects were instructed to rate the comprehensibility of each episode using a 7 point scale (1 = very easy to comprehend, and 7 = very difficult to comprehend) by pressing the numbers on the computer keyboard. To control the various learning strategies that might be used by subjects, the instructions did not specify that retention tests would be administered about the episodes.

Following the instructions, subjects were presented with four practice episodes to get accustomed to using the computer keys. Next the experimental materials were presented. Each fact about an individual was presented, one at a time, on the middle of the screen. Each sentence was replaced with the next sentence once the subject had pressed the space bar. The reading time for each sentence was recorded by the computer. The supportive facts were always presented before the target fact. The target fact was underlined so that the subject knew that all the facts about one individual had been given. After the underlined target fact, the statement "please make a comprehensibility rating of the episode" was displayed. The subjects were required to press the number (1 through 7) on the computer. Once subjects responded, the first supportive fact of the next episode was presented.

In order to reduce potential primacy and recency effects, 16 filler sentences about eight other individuals were also used in addition to the 28 experimental episodes. Half of the filler sentences were presented at the beginning of the incidental learning phase and the other half were presented at the end. These filler sentences were not used in the recall tests.

Each subject received 14 target facts with elaborations and the other 14 target facts without elaborations. Half of each of the episodes were about well-known individuals: the other half were about unknown individuals. The order of presentation of the 28 episodes was randomly assigned to each subject.

After subjects read and rated each of the 28 episodes, they were immediately given the unexpected cued recall test booklet which contained the first sentences of each episode as retrieval cues. Subjects were told to write down whatever provided facts they could remember about each individual. Subjects were allowed to work at their own pace during the cued recall test.

Results

Scoring. The cued recall data were scored for presence of the gist of the target fact. Subjects were credited one point if their response reflected the general meaning of the original target fact. Protocols that contained errors in tense or used synonyms were not marked incorrect as long as

the general meaning of the target fact was maintained. Cued recall protocols were scored independently by two judges whose inter-rater reliability coefficient reached over .95 in all six experiments.

Recall performance. To determine the main and interactive effects of prior knowledge and elaboration, a 2 x 2 ANOVA was conducted on the cued recall test scores. The ANOVA revealed a significant main effect for prior knowledge, $F(1,19) = 154.27, p < .001$. More target facts were recalled in the HPK condition than in the LPK condition. Although the main effect of elaboration was not significant, the interaction effect for prior knowledge by elaborations was significant, $F(1,19) = 8.53, p < .01$. Fisher LSD tests indicated that HPK readers retained about the same number of target facts in both elaboration conditions, whereas LPK readers retained more target facts in the elaborated condition than in the unelaborated condition ($p < .05$). Figure 1 illustrates the interaction effect. The mean percentage of correctly recalled target facts is provided in Table 2.

Reading times. A 2 x 2 ANOVA revealed that the main effect of prior knowledge on reading time for the first sentence (supportive fact) of each text was highly significant, $F(1,19) = 26.30, p < .001$. The first sentences in the HPK condition were read faster than the sentences in the LPK condition. The main effect of

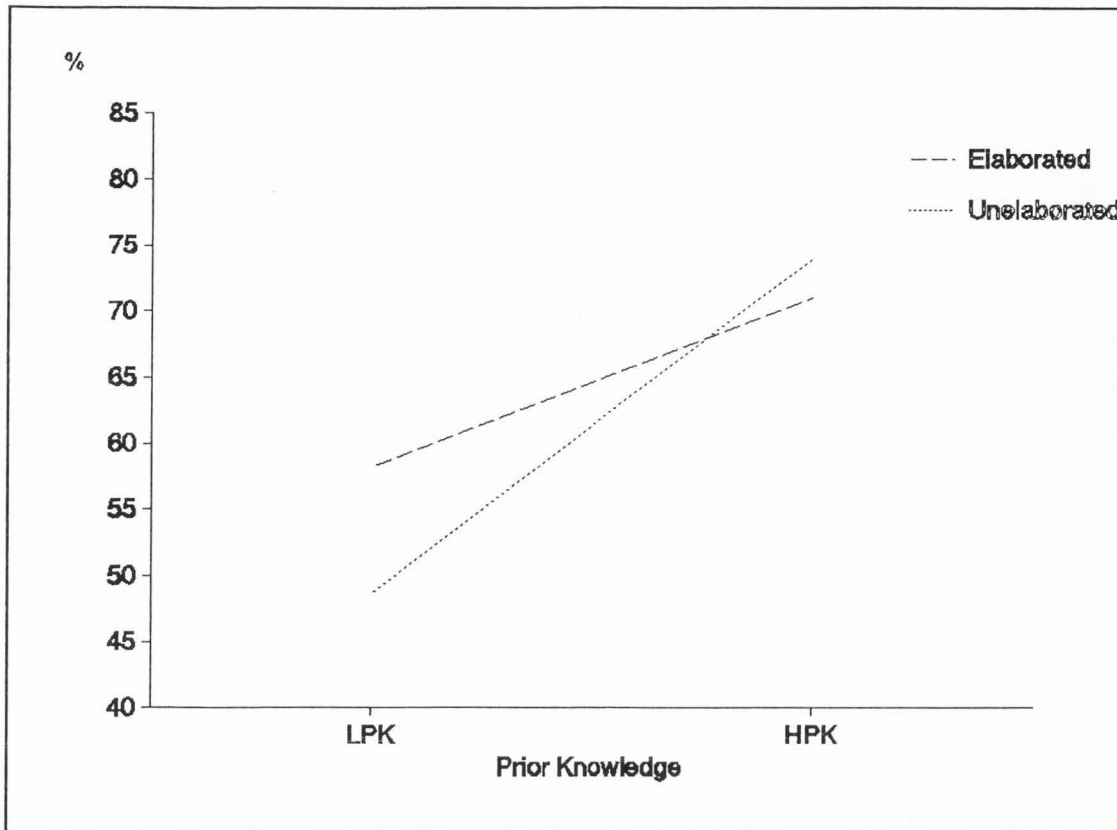


Figure 1. Mean percentage of correctly recalled target facts as a function of prior knowledge and elaboration in Experiment 1.

Table 2

Mean Percentage of Correctly Recalled Target Facts in Experiment 1

Elaboration	Prior knowledge	
	LPK	HPK
Elaborated	58.2 (18.9)	71.0 (17.6)
Unelaborated	48.7 (31.9)	74.0 (21.1)

Note: Standard deviations are provided in the parentheses.

elaboration and interaction effect were not significant, indicating that there was no reading time difference for the first sentence between elaborated and unelaborated condition.

In contrast, the main effect of text-provided elaboration on reading time for the target fact of each episode was significant, $F(1,19) = 19.93, p < .001$, indicating that the elaborated target facts were read much faster than the unelaborated target facts. The main effect of prior knowledge and interaction effect were not significant. Mean reading times for the first sentences and target sentences appear in Table 3.

Table 3

Mean Reading Times (msec) for First Sentence and Target Sentence in Experiment 1

Elaboration	First Sentence		Target Sentence	
	LPK	HPK	LPK	HPK
Elaborated	4520 (1536)	3457 (1186)	3221 (958)	2974 (868)
Unelaborated	4318 (1526)	3561 (1239)	3732 (1083)	3809 (1190)

Note: Standard deviations are provided in the parentheses.

Comprehensibility ratings. A 2 x 2 ANOVA revealed that prior knowledge had a significant effect on subjects'

comprehensibility ratings, $F(1,19) = 13.63, p < .005$, with subjects rating the texts more comprehensible in the HPK condition than in the LPK condition. Subjects also rated elaborated texts more comprehensible than unelaborated texts, $F(1,19) = 14.52, p < .001$. However, the elaboration by prior knowledge interaction effect was significant, $F(1,19) = 4.26, p < .05$. The rating difference between elaborated and unelaborated texts was greater under the LPK condition than the HPK condition, as indicated by Fisher LSD tests ($p < .05$). Figure 2 illustrates this interaction effect.

The presence of text-provided elaborations had a significant effect on subjects' comprehension rating times, $F(1,19) = 6.80, p < .05$. Subjects rated elaborated texts faster than unelaborated texts. Table 4 presents the mean comprehensibility ratings and response times for the rating.

Discussion

The results of Experiment 1 are consistent with the findings of Kim and Kiewra (1990). The interaction effect for prior knowledge by elaboration indicates that text-provided elaborations enhance recall of the target information only when readers have low prior knowledge (LPK). This may be the result of the proposed hypothesis that readers generate relevant elaborations when they have high prior knowledge (HPK) and thus the text-provided elaborations may be redundant for HPK readers. The text-

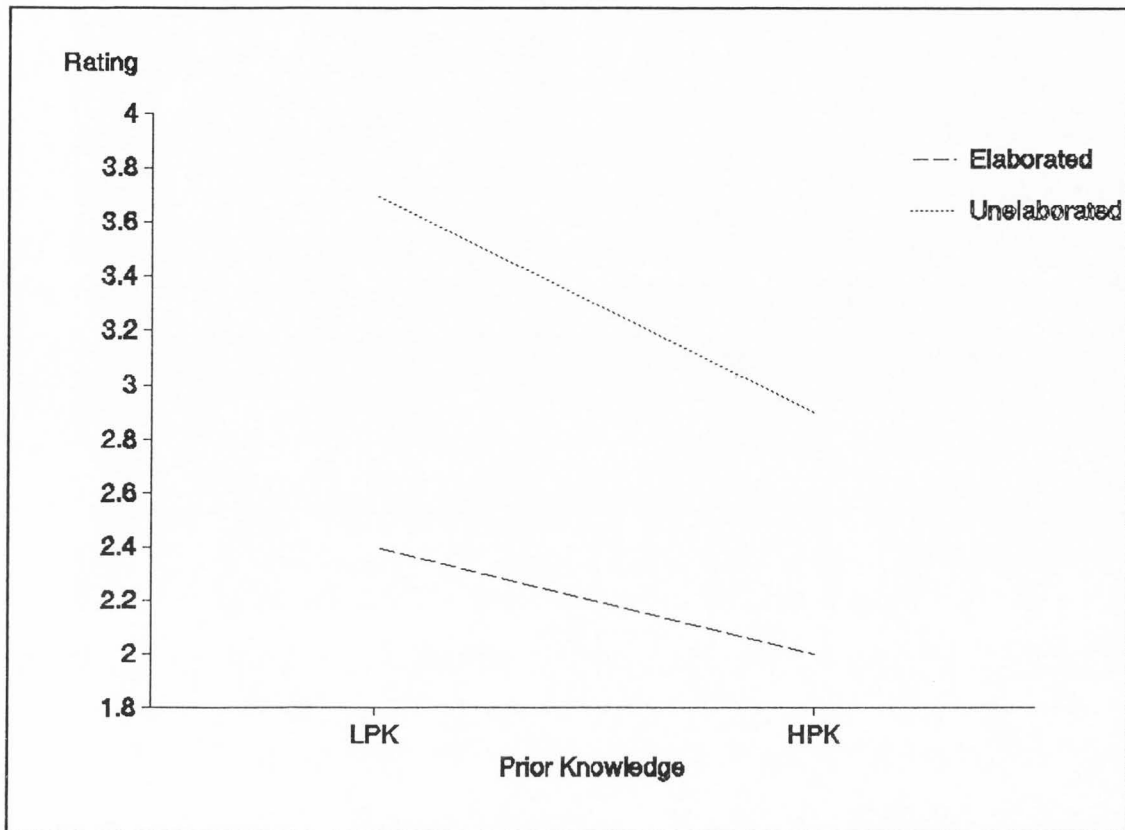


Figure 2. Mean comprehensibility ratings as a function of prior knowledge and elaboration in Experiment 1.

Table 4

Mean Comprehensibility Ratings (1 = easy to comprehend) and Response Times (msec) in Experiment 1

Elaboration	Rating		Response Time	
	LPK	HPK	LPK	HPK
Elaborated	2.4 (1.4)	2.0 (1.4)	1586 (787)	1424 (659)
Unelaborated	3.7 (2.0)	2.9 (1.7)	1914 (910)	2360 (1860)

Note: Standard deviations are provided in the parentheses.

provided elaborations do not offer "new or added" information and consequently retention does not improve. However, for the LPK reader the text-provided elaborations offer additional associations to the target information, beyond what is available from their limited prior knowledge. Therefore the LPK readers perform better in the elaborated condition.

Reading time data indicated that it took longer to read the unelaborated target fact than the elaborated one and comprehensibility rating time indicated that it took longer to rate unelaborated text than the elaborated text. These findings may suggest that readers spend more time or expend more cognitive effort to read the unelaborated target fact because they need to generate their own elaborations to maintain the coherence of the text. However, comprehensibility rating data, in which HPK readers rate elaborated texts more comprehensible than LPK readers, suggest that, despite their longer reading times for target facts, LPK readers may not be successful in generating relevant elaborations corresponding to HPK readers. The ability of HPK readers to generate elaborations seems to help them resolve the difficulty of the less coherent text that results in its being comprehensible.

EXPERIMENT 2

Experiment 1 provided evidence of the conditional effects of text-provided elaborations on recall. It was suggested that this finding might be a result of HPK readers generating more relevant elaborations than those provided by the text. The purpose of Experiment 2 is to provide direct evidence of these self-generated elaborations.

If, in fact, subjects are generating elaborations as they read the text, the self-generated elaborations should serve as good retrieval cues and thereby facilitate retention. To test this hypothesis, the third supportive fact of each episode from Experiment 1 was given as a retrieval cue. Although these supportive facts had not been presented for the unelaborated texts, it was hypothesized that subjects with high prior knowledge would generate elaborations similar to the text-provided elaborations based on their prior knowledge and encode these self-generated elaborations along with the presented target fact. However, for the LPK reader, there would be little or no self-generated elaboration and thus little additional information would be encoded. Therefore, it was predicted that for the unelaborated conditions these cues would be effective only when subjects had high prior knowledge.

Method

Subjects. Twenty Utah State University undergraduates from an introductory psychology course participated in the experiment. They received course credit for their voluntary participation.

Design and materials. The experimental design and materials were the same as that used in Experiment 1.

Procedure. The procedure closely followed that used in Experiment 1 except for one change: the cue used in the unexpected recall test was the third supportive fact from the elaborated version of each episode presented in Experiment 1.

Results

Recall performance. A 2 x 2 ANOVA on the cued recall scores revealed a significant main effect for prior knowledge, $F(1,19) = 7.18, p < .05$. More target facts were recalled in the HPK condition than in the LPK condition. The main effect for elaboration was highly significant, $F(1,19) = 74.44, p < .001$, with subjects recalling more target facts in the elaborated condition than in the unelaborated condition. Table 5 presents the mean percentage of correctly recalled target facts.

The main effect of elaboration is better understood in the context of the elaboration by prior knowledge interaction, $F(1,19) = 4.73, p < .50$, shown in Figure 3. Although significantly more target facts were recalled in

Table 5

Mean Percentage of Correctly Recalled Target Facts in
Experiment 2

Elaboration	Prior knowledge	
	LPK	HPK
Elaborated	67.7 (23.8)	77.1 (22.8)
Unelaborated	35.3 (25.4)	67.8 (25.0)

Note: Standard deviations are provided in the parentheses.

the elaborated condition than in the unelaborated condition for both levels of prior knowledge, recall differences between the elaborated and unelaborated conditions were significantly greater when prior knowledge was low than when it was high, as indicated by Fisher LSD tests ($p < .05$).

Reading times. A 2 x 2 ANOVA revealed that the main effect of prior knowledge on reading time for the first sentence of each text was highly significant, $F(1,19) = 30.76$, $p < .001$. The first sentences in the HPK condition were read faster than the sentences in the LPK condition. The main effect of elaboration and the interaction effect were not significant.

In contrast, the main effect of elaboration on reading time for the target fact of each episode was significant, $F(1,19) = 16.84$, $p < .001$, whereas the main effect of prior

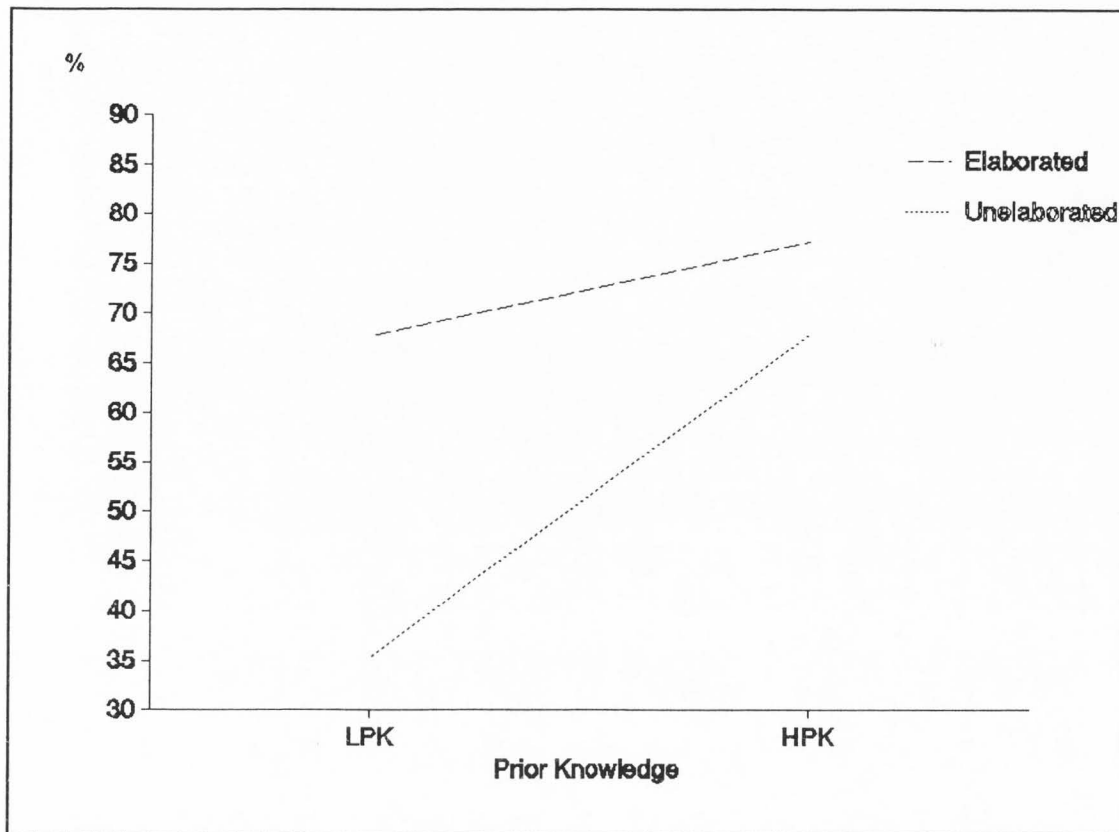


Figure 3. Mean percentage of correctly recalled target facts as a function of prior knowledge and elaboration in Experiment 2.

knowledge and the interaction effect were not significant. The elaborated target facts were read much faster than the unelaborated target facts. The mean reading times for the first sentences and target sentences appear in Table 6.

Comprehensibility ratings. A 2 x 2 ANOVA revealed that prior knowledge had a significant effect on subjects' comprehensibility ratings, $F(1,19) = 13.15$, $p < .005$, with subjects rating the texts more comprehensible in the HPK condition than in the LPK condition. Subjects also rated elaborated texts more comprehensible than unelaborated

Table 6

Mean Reading Times (msec) for First Sentence and Target Sentence in Experiment 2

	First Sentence		Target Sentence	
	LPK	HPK	LPK	HPK
Elaborated	4582 (1080)	3915 (1356)	3976 (1102)	3556 (1171)
Unelaborated	4555 (1081)	3875 (1081)	4540 (1334)	4481 (1262)

Note: Standard deviations are provided in the parentheses.

texts, $F(1,19) = 42.86$, $p < .001$. However, the elaboration by prior knowledge interaction effect was significant, $F(1,19) = 4.65$, $p < .05$. Fisher LSD tests indicated that the rating difference between elaborated and unelaborated texts was greater when prior knowledge was low than it was high ($p < .05$). Figure 4 illustrates this interaction effect.

The elaborations had a significant main effect on subjects' comprehension rating times, $F(1,19) = 30.10$, $p < .001$, indicating that subjects rated elaborated texts faster than unelaborated texts. Table 7 presents the mean comprehensibility ratings and response times for the rating.

Discussion

The results from Experiment 2 replicate the findings from Experiment 1. The findings on cued recall performance

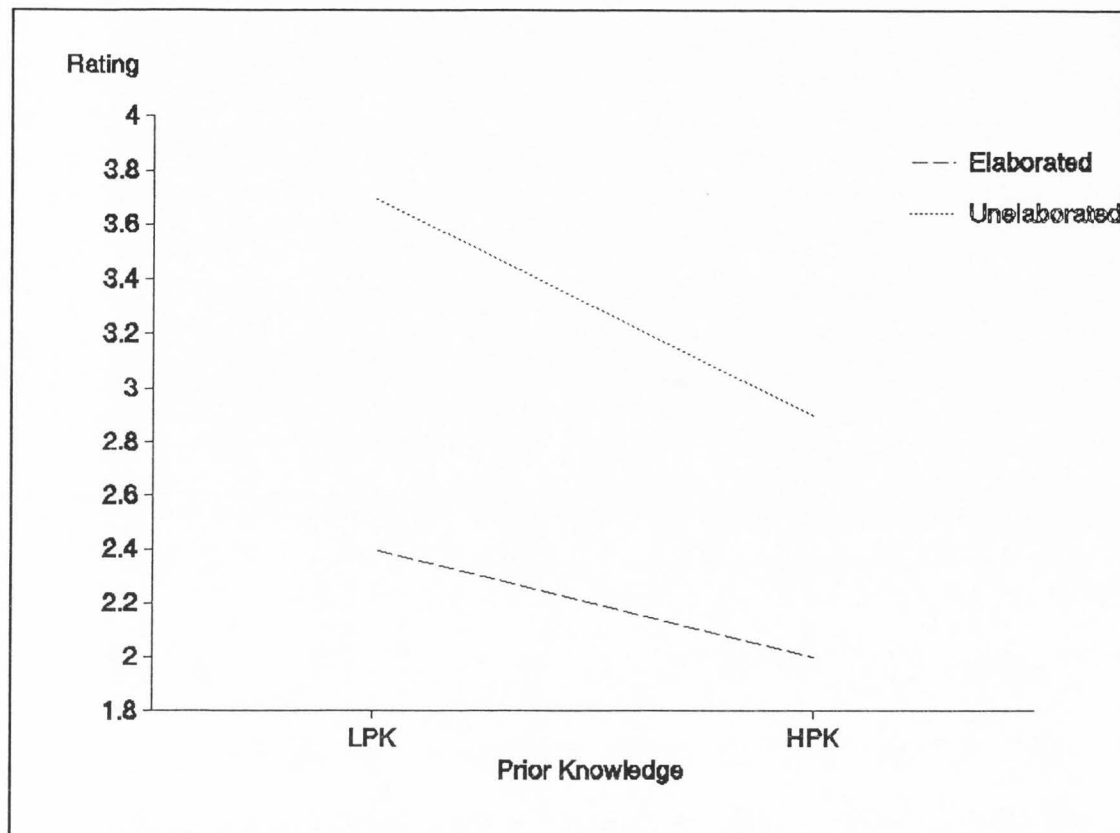


Figure 4. Mean comprehensibility ratings as a function of prior knowledge and elaboration in Experiment 2.

Table 7

Mean Comprehensibility Ratings (1 = easy to comprehend) and Response Times (msec) in Experiment 2

Elaboration	Rating		Response Time	
	LPK	HPK	LPK	HPK
Elaborated	1.8 (.69)	1.5 (.50)	1697 (835)	1465 (605)
Unelaborated	3.4 (1.2)	2.5 (1.1)	2186 (654)	2057 (733)

Note: Standard deviations are provided in the parentheses.

suggest that HPK readers do not perform significantly differently when reading the elaborated and unelaborated texts. This may be due to their ability to generate elaborations, similar to the third supportive facts in the elaborated text. These self-generated elaborations may be stored with the target fact in the memory. When the elaborations are provided as retrieval cues, readers easily activate the target fact in their memory representation. Even though there were no significant differences, HPK readers did recall more target facts in the elaborated condition than the unelaborated condition. This difference may be due to the fact that in the elaborated condition, the same text-provided elaborations (third supportive facts) which were presented at encoding were reinstated as retrieval cues at testing. This finding is compatible with the encoding specificity hypothesis (see Tulving, 1983), which suggests memory performance is enhanced when the encoding context is reinstated at retrieval.

In contrast to the finding for HPK readers, LPK readers showed a significant decline in recall performance when they read unelaborated texts. It may be that elaborations given as retrieval cues fail to activate the target fact because LPK readers do not generate such elaborations.

The reading times and comprehensibility data lend further support to these hypotheses just as in Experiment 1. HPK and LPK readers spend more time and expend more

cognitive effort in reading unelaborated texts and rate these texts less comprehensible than elaborated texts. Although the benefits of this additional processing, in terms of comprehensibility, are observed only for the HPK readers, these findings lend support to the hypothesis that HPK readers engage in a fundamentally different process during reading, namely an elaboration process.

EXPERIMENT 3

The findings from Experiment 2 suggest that HPK readers do generate elaborations. A related question is: When does the self-generated elaboration process occur, during comprehension or retrieval? It has been well documented that recall or recognition tasks cannot be used to assess processes that occur during encoding (Singer, 1990). Thus, it is necessary to use an alternative methodology to answer this question. One task that has been successful in investigating on-line processing is the lexical decision task (e.g., Glenberg, Meyer, & Lindem, 1987; Sharkey & Mitchell, 1985). In this task, subjects decide whether or not a letter string is a word. The letter string is embedded within the text, so that it is part of the comprehension process. The time to respond to the letter string is a measure of the level of accessibility for that word.

It is possible to use a modification of this technique to determine the accessibility of elaborations. The more accessible an elaboration, the more likely it is currently in short-term memory, and the quicker the response time. To measure the on-line processing of elaborations, the text-provided elaboration word was used for the letter string. If readers generate the same or similar elaboration concepts as the text-provided elaborations while reading the unelaborated text, they should be able to respond to the

lexical decision task as quickly in the unelaborated condition as the elaborated condition because the word will be in an active memory state. On the other hand, if readers do not generate elaborations while reading the unelaborated text, they will have to search their mental lexicon in long-term memory in order to decide whether the letter string is a word. Thus, their reaction times should be much longer than those reading the elaborated text where the word is currently active.

Experiment 3 used the lexical decision task to investigate the possibility of on-line elaboration generation using the conditions and materials from Experiment 1. It was hypothesized that HPK readers would generate elaborations similar to the text-provided elaborations, while reading the unelaborated text, and thus their lexical decision latencies would not be different from HPK subjects reading the elaborated texts. Furthermore, LPK readers who are unable to generate elaborations should take longer than all other groups to make lexical decision in the unelaborated condition, but their reaction time in the elaborated condition should be similar to the HPK reader in the elaborated condition.

Method

Subjects. Subjects were twenty Utah State University undergraduates from the same subject pool.

Design. The experimental design was the same as that used in Experiment 1. The dependent variables were decision latency and accuracy during the lexical decision task.

Materials and procedure. The texts were the same as those used in Experiment 1. Subjects were informed that they would be involved in an experiment concerning human comprehension processes. The sentences comprising each episode were presented on the screen one at a time, with subjects controlling the rate of presentation. After the underlined target fact was read, a lexical decision trial was initiated. A row of asterisks appeared in the center of the screen. After 950 ms, these asterisks were replaced by a letter string. The subjects' task was to verify whether or not the letter string was a word. On half of the trials, the letter string was a word, which came directly from the text-provided elaboration. On the other half, it was a nonword. If it was a word, they were to respond "yes" by pressing the designated key on the computer keyboard. If it was not a word, they were to respond "no" by pressing the other designated key. Reaction times were measured from the onset of the letter string to the subjects' response.

Results

Lexical decision latency. A 2 x 2 ANOVA revealed that reaction time was shorter in the elaborated condition than in the unelaborated condition, $F(1,19) = 3.75$, $p = .065$. Although the main effect of prior knowledge was not

significant, the interaction effect for prior knowledge by elaboration was significant, as shown in Figure 5, $F(1,19) = 4.47$, $p < .05$. Fisher LSD tests indicated that LPK readers' reaction times were much shorter in the elaborated condition than in the unelaborated condition ($p < .05$), whereas HPK readers' reaction times for the elaborated and unelaborated conditions were not significantly different. The mean lexical decision latencies and accuracy appear in Table 8.

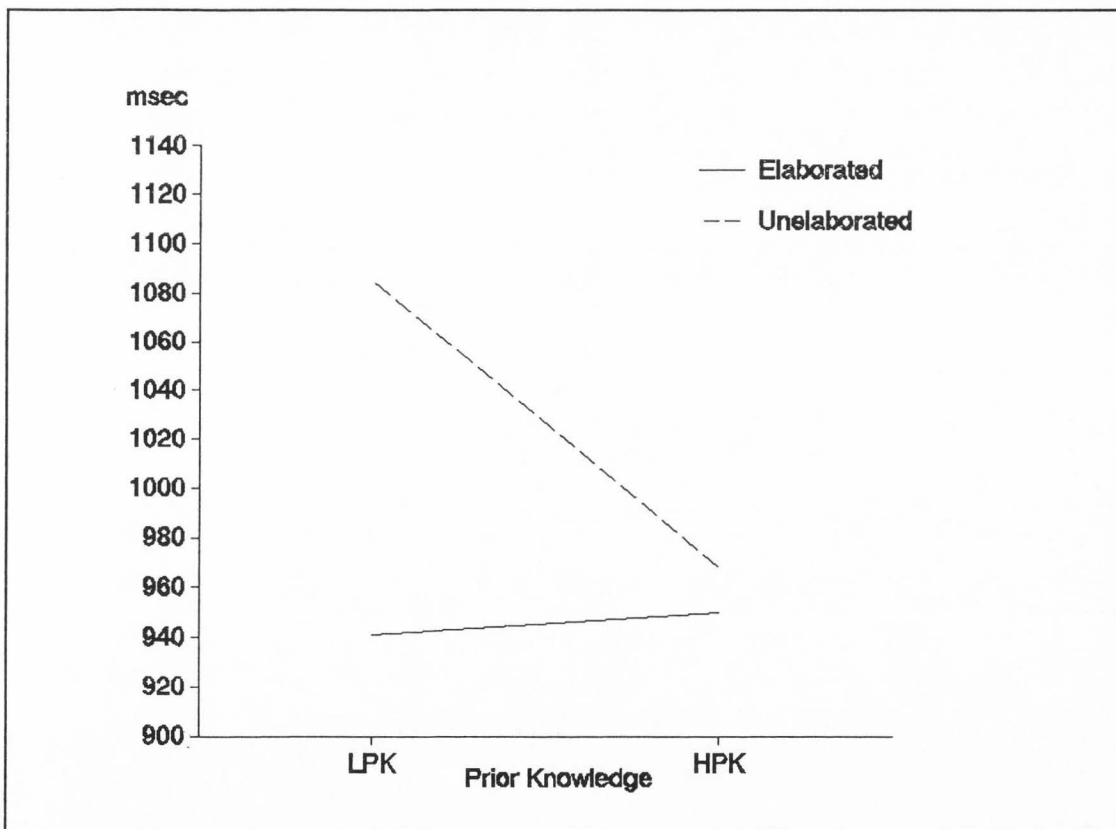


Figure 5. Mean lexical decision latencies as a function of prior knowledge and elaboration in Experiment 3.

Table 8

Mean Lexical Decision Latencies (msec) and Proportion Correct in Experiment 3

Elaboration	Latency		Accuracy	
	LPK	HPK	LPK	HPK
Elaborated	941 (30.3)	950 (35.5)	91.8 (13.8)	94.3 (8.6)
Unelaborated	1085 (45.5)	968 (27.9)	94.3 (7.2)	89.5 (8.0)

Note: Standard deviations are provided in the parentheses.

Accuracy. There were no significant differences for lexical decision accuracy.

Discussion

As predicted, the results from Experiment 3 confirm that self-generated elaborations occur during comprehension. The same lexical decision latencies between the elaborated and unelaborated conditions for HPK readers suggest that they generate elaborations while reading the unelaborated texts and this self-generated elaboration is in the working memory. In contrast, the fact that the lexical decision latencies for LPK readers were longer in the unelaborated condition than the elaborated condition suggests that LPK readers do not generate elaborations while reading unelaborated texts.

EXPERIMENT 4

The findings from Experiment 1, 2, and 3 have suggested that text-provided elaborations greatly enhance the recall of the target fact for LPK readers but that text-provided elaborations are redundant for HPK readers because they generate relevant elaborations on-line based on prior knowledge. However, the level of prior knowledge may not be the only factor which influences the likelihood of generating elaborations. Another factor which has been shown to influence elaboration generation is the structure of the text which can be varied by the degree of causal relatedness between the sentences. Recent studies have found that recall is better for moderately related sentence pairs than for the highly related pairs (Duffy et al., 1990; Keenan et al., 1984; Myers et al., 1987). It has been suggested that the difference stems from the facilitative effects of self-generated elaborations. It is assumed that the reader relates two sentences easily for highly related sentences, and thus additional elaborations are unlikely to be generated. In contrast, for moderately related sentences, it may be necessary for the reader to generate elaborations in order to comprehend the sentences fully.

Experiment 4 was conducted to explore the conditions under which self-generated elaborations are most likely to occur. The interaction of prior knowledge and sentence relatedness was investigated.

Method

Subjects. Subjects were twenty Utah State University undergraduates from the same subject pool.

Design. The experimental design was a modified Latin square design. The degree of causal relatedness between sentences (high relation vs. low relation) and the level of prior knowledge (HPK vs. LPK) yield four experimental conditions. The dependent variables were cued recall test scores, reading times, and comprehensibility ratings and response times.

Materials. The texts consisted of the same 28 episodes used in Experiment 1 except for the following changes: (a) all episodes consisted of two sentences (one supportive fact and one target fact); and (b) the degree of causal relatedness between the supportive fact and the target fact was varied. For the high relation condition, the supportive fact was the third sentence of the elaborated version in Experiment 1. Thus, for high relation condition, the first sentence was the direct cause of the second sentence. For the low relation condition, the supportive fact was the first sentence of the elaborated version in Experiment 1. Thus, the low relation condition was exactly the same as the unelaborated condition of Experiment 1. An example of the materials for Experiment 4 is provided in Table 9.

Procedure. The procedure was identical to that of Experiment 1.

Table 9

Examples of Materials in Experiment 4

HPK/High Relation condition:

Thomas Edison's wife was discontented with being neglected

Thomas Edison's wife became emotionally unstable

LPK/High Relation condition:

Arthur Colman's wife was discontented with being neglected

Arthur Colman's wife became emotionally unstable

HPK/Low Relation condition:

Thomas Edison began to work on a new project

Thomas Edison's wife became emotionally unstable

LPK/Low Relation condition:

Arthur Colman began to work on a new project

Arthur Colman's wife became emotionally unstable

Note: Target fact is underlined.

Results

Recall performance. A 2 x 2 ANOVA for recall scores revealed a significant main effect for prior knowledge, $F(1,19) = 36.07$, $p < .001$, indicating that more target facts were remembered in the HPK condition than in the LPK condition.

Although the main effect of relatedness between sentences was not significant, the relatedness by prior knowledge interaction was significant, as shown in Figure 6, $F(1,19) = 5.93$, $p < .05$. Fisher LSD tests indicated that there were no recall differences for HPK readers between high relation and low relation conditions. On the other hand, LPK readers recalled more sentences with high relation than sentences with low relation ($p < .05$). Table 10 presents the mean percentage of correctly recalled target facts in Experiment 4.

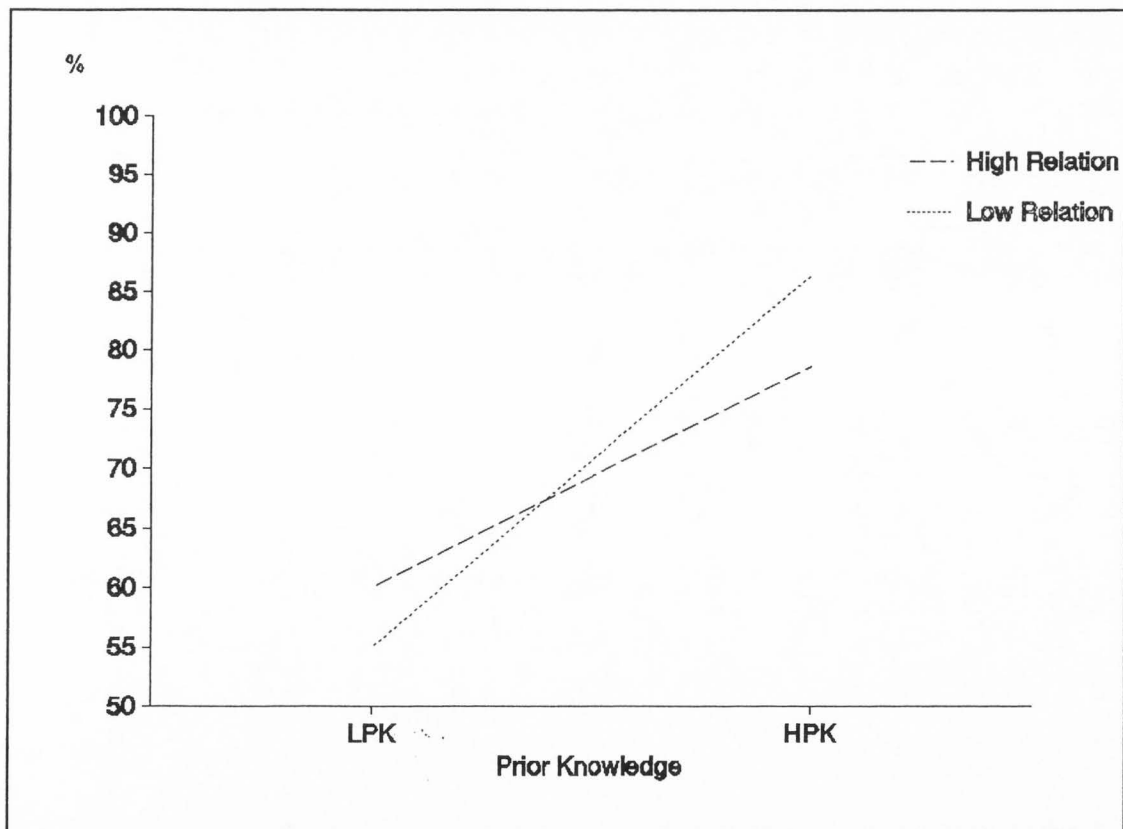


Figure 6. Mean percentage of correctly recalled target facts as a function of prior knowledge and sentence relatedness in Experiment 4.

Table 10

Mean Percentage of Correctly Recalled Target Facts in
Experiment 4

Relation	Prior knowledge	
	LPK	HPK
High Relation	64.3 (21.2)	78.6 (19.4)
Low Relation	50.4 (20.9)	86.4 (17.7)

Note: Standard deviations are provided in the parentheses.

Reading times. A 2 x 2 ANOVA revealed that the main effect of prior knowledge on the first sentence reading times was significant, $F(1,19) = 28.84$, $p < .001$. The main effect of relatedness and the interaction effect were not significant.

Reading times for the target facts were significantly faster in the high relation condition than in the low relation condition, $F(1,19) = 19.97$, $p < .001$. The mean reading times for the first sentences and target sentences appear in Table 11.

Comprehension ratings. A 2 x 2 ANOVA revealed that prior knowledge had a significant effect on subjects' comprehensibility ratings, $F(1,19) = 10.92$, $p < .005$. The significant main effect of relatedness, $F(1,19) = 7.04$, $p < .05$, is better understood in the context of the

Table 11

Mean Reading Times (msec) for First Sentence and Target Sentence in Experiment 4

Relation	First Sentence		Target Sentence	
	LPK	HPK	LPK	HPK
High	5475 (1195)	4539 (1189)	4633 (1306)	4449 (1092)
Low	5172 (1311)	4229 (1056)	5395 (1252)	4915 (1405)

Note: Standard deviations are provided in the parentheses.

relatedness by prior knowledge interaction, $F(1,19) = 7.23$, $p < .05$. Fisher LSD tests indicated that the high-related texts were rated more comprehensible than low-related texts in the LPK condition, whereas there was no difference between high-related texts and low-related texts in the HPK condition ($p < .05$). Figure 7 illustrates this interaction effect.

Relatedness between sentences had a significant main effect on subjects' comprehensibility rating times, $F(1,19) = 6.77$, $p < .05$, indicating that subjects spend more time to rate low-related texts than high-related texts. Table 12 presents the mean comprehensibility ratings and response times for the rating.

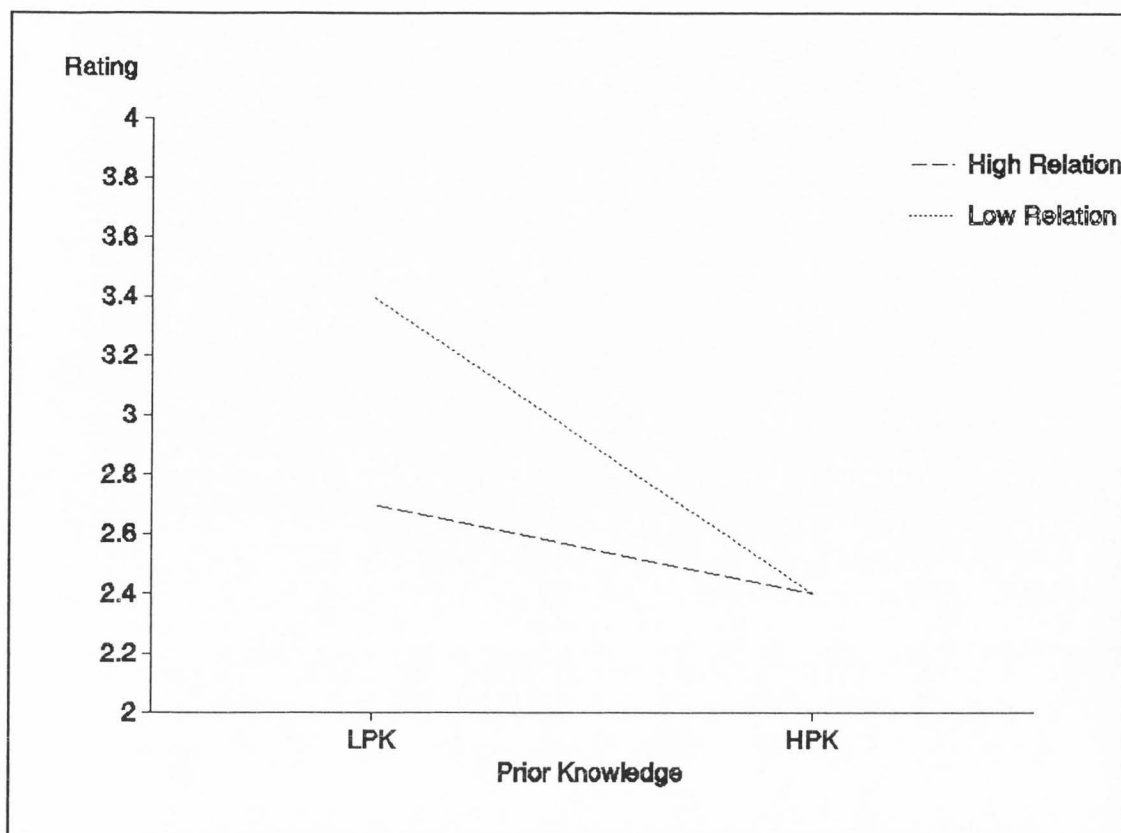


Figure 7. Mean comprehensibility ratings as a function of prior knowledge and sentence relatedness in Experiment 4.

Table 12

Mean Comprehensibility Ratings (1 = easy to comprehend) and Response Times (msec) in Experiment 4

Relation	Rating		Response Time	
	LPK	HPK	LPK	HPK
High Relation	2.7 (1.4)	2.4 (1.2)	1264 (594)	1370 (638)
Low Relation	3.4 (1.3)	2.4 (1.4)	1764 (1169)	1495 (679)

Note: Standard deviations are provided in the parentheses.

Discussion

The interaction effect for prior knowledge by sentence relatedness on recall indicates that HPK readers recall as many low-related sentences as high-related sentences, whereas LPK readers recall more high-related sentences than low-related sentences. This finding supports the hypothesis that HPK readers generate elaborations based on prior knowledge in order to maintain the coherence between low-related sentences. In generating elaborations to low-related sentences, HPK readers add these self-generated elaborations to their mental network and increase inferential redundancy. These additional associations can be used to facilitate recall. However, because LPK readers do not possess the knowledge necessary for elaboration generation, their networks formed during reading unelaborated texts are weak and incoherent. Thus, recall suffers due to the lack of association.

The finding that reading times for the target facts were longer in the low relation condition than the high relation condition suggests that it is necessary for readers to spend more time or exert more cognitive effort in order to comprehend weakly related texts. However, this increased effort benefits only the HPK reader as indicated in the comprehensibility ratings and response times. Once again, these additional findings suggest that HPK readers are successful in resolving the difficulty of the low-

related texts by generating elaborations, whereas LPK readers are unable to generate such elaborations.

EXPERIMENT 5

The review of the literature has suggested that the likelihood of generating elaborations may depend on the task a reader employs during reading. Previous studies have found a strong beneficial effect on retention when self-generated elaborations are induced by explicit instructions to write the elaborations (Duffy et al., 1990) or by precise questions to answer (Pressley et al., 1987). However, these tasks forced the subjects to engage in another type of learning activity, such as writing or answering, which might have been confounded with the reading activity. In addition, previous studies have failed to investigate the naturally occurring self-generated elaboration process that Experiments 1, 2, 3, and 4 suggest occur during reading.

Experiment 5 was conducted to compare the naturally occurring versus task-induced elaboration generation process. In order to avoid the confounding factors indicated above, half of the subjects were instructed to integrate the sentence pairs (generation task) in which they are engaged in only one type of activity while the others were instructed to comprehend the text (comprehension task). The instruction by prior knowledge interaction effect was investigated.

Method

Subjects. Subjects were forty Utah State University undergraduates from the same subject pool.

Design. The experimental design was a 2 x 2 mixed design with one between-subjects factor and one within-subjects factor. The between-subjects factor was the type of task (Generation vs. Comprehension); the within-subjects factor was the level of prior knowledge (HPK vs. LPK). Subjects were nested within the instruction factor. The dependent variables were cued recall test scores and reading times.

Materials. The texts were the 28 unelaborated episodes used in Experiment 1 which consisted of the first supportive fact and the target fact. Half of them were presented with well-known names and the other half with unknown names.

Procedure. Subjects in the generation condition were told that the purpose of the experiment was to find out how well they could create a complete picture of the text. They were instructed to integrate two sentences and to try to answer the question of why one sentence might lead to the next.

Subjects in the comprehension condition were told that the purpose of the experiment was to obtain normative data about text comprehension. Subjects were instructed to read each sentence until it was understood, and press a space bar to view the next sentence.

Sentences were presented one at a time with subjects controlling the rate of presentation. The reading times for each sentence were measured by the computer. All subjects were given a surprise cued recall test in which the first sentence of each episode was used as a cue.

Results

Recall performance. A 2 x 2 ANOVA revealed a significant main effect for instruction, $F(1,38) = 5.51$, $p < .05$, indicating that subjects in the generation condition remembered more target facts than in the comprehension condition. The main effect for prior knowledge was highly significant, $F(1,38) = 95.84$, $p < .001$ (see Appendix B for the ANOVA summary tables).

The interaction effect for instruction by prior knowledge was also significant, $F(1,38) = 9.54$, $p < .01$. Fisher LSD tests indicated subjects in the comprehension condition remembered as many target facts as subjects in the generation condition when they had high prior knowledge. However, for LPK readers, the recall performance was significantly worse in the comprehension condition than in the generation condition ($p < .05$). Table 13 presents the mean percentage of correctly recalled target facts in Experiment 5. Figure 8 illustrates the interaction effect.

Reading times. A 2 x 2 ANOVA revealed the significant main effect of prior knowledge on the first sentence reading times, $F(1,38) = 38.62$, $p < .001$. The main effect of

Table 13

Mean Percentage of Correctly Recalled Target Facts in
Experiment 5

Task	Prior knowledge	
	LPK	HPK
Generation	69.6 (23.7)	87.3 (16.6)
Comprehension	49.8 (24.8)	83.8 (15.4)

Note: Standard deviations are provided in the parentheses.

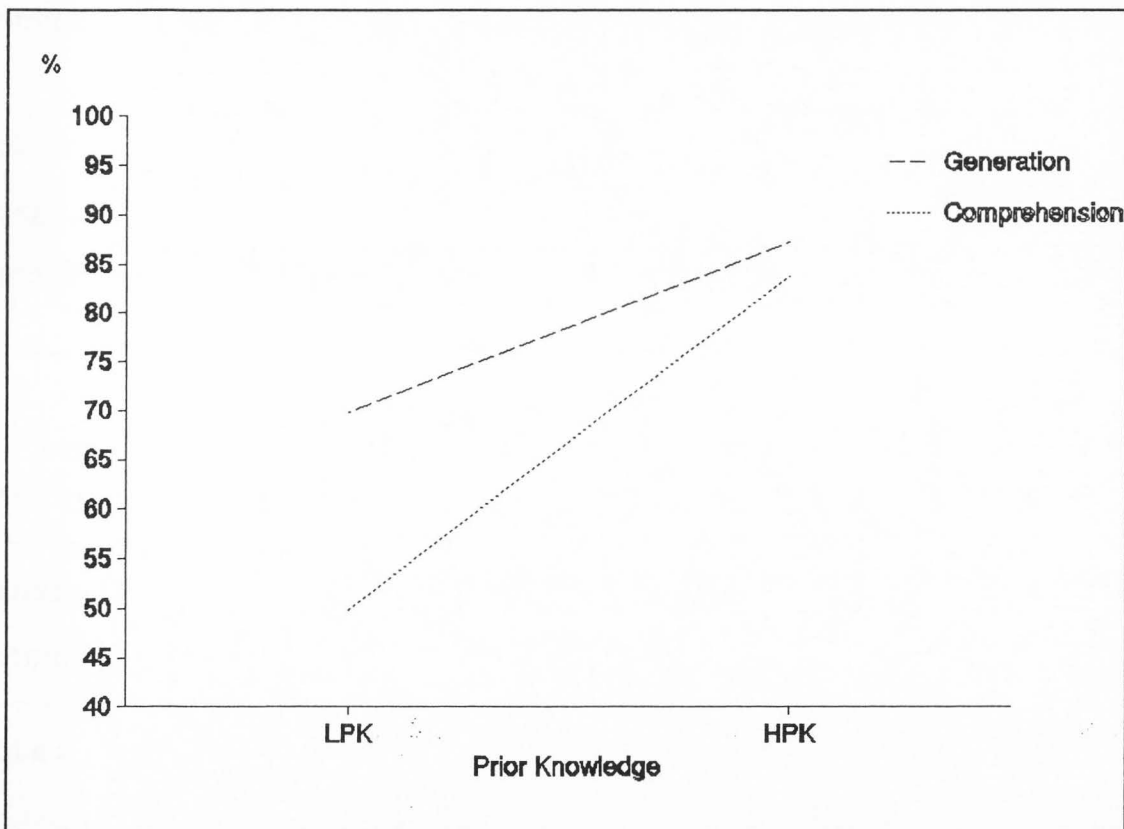


Figure 8. Mean percentage of correctly recalled target facts as a function of prior knowledge and task in Experiment 5.

instruction was also significant, $F(1,38) = 9.17, p < .005$. The reading time for the first sentence was longer when subjects were instructed to integrate texts than when they were asked to rate the comprehensibility of the texts.

Instruction had a significant main effect on the target fact reading times, $F(1,38) = 4.30, p < .05$. The target facts in the generation condition were read much slower than in the comprehension condition. The main effect of prior knowledge and the interaction effect were not significant. The mean reading times for the first sentences and target sentences appear in Table 14.

Table 14

Mean Reading Times (msec) for First Sentence and Target Sentence in Experiment 5

Task	First Sentence		Target Sentence	
	LPK	HPK	LPK	HPK
Generation	6844 (2900)	5463 (2224)	7457 (3169)	9005 (16688)
Comprehension	4637 (2096)	3755 (1317)	5135 (1906)	4681 (1712)

Note: Standard deviations are provided in the parentheses.

Discussion

Although reading times in the generation condition were much longer than in the comprehension condition, the recall

performance of HPK readers was not significantly different between the two conditions. This suggests that HPK readers spontaneously generate elaborations to comprehend text even if they are not asked to do so. On the other hand, LPK readers recalled more target facts in the generation condition than in the comprehension condition, which may be because LPK readers in the generation condition used the strategy to integrate the texts. The different performance of the two groups may suggest the presence of automatic processes in the performance of HPK readers and strategic processes in the performance of LPK readers. It may be that HPK readers automatically generate elaborations to maintain the coherence of the texts without using any specific strategy.

EXPERIMENT 6

The review of the literature indicated that the lack of facilitative findings for the effect of text-provided elaborations on retention may be a result of poorly constructed elaborations. Thus, an important question about text-provided elaborations is: How should the text-provided elaborations be constructed to facilitate retention of the target information? One suggestion has been that the text should present the target information in a context that makes the target information distinctive (McDaniel et al., 1988; Stein et al., 1984). Distinctive text-provided elaborations establish a unique relationship among the concepts in the text. Thus, the target information may be easily distinguishable from other information in memory.

The purpose of Experiment 6 was to compare the effect of distinctive text-provided elaborations on recall with that of normal text-provided elaborations.

Method

Subject. Twenty Utah State University undergraduates from the same subject pool participated in the experiment.

Design. The experimental design was a modified Latin square design. Four experimental conditions were the combination of two types of text-provided elaboration (normal vs. distinctive) and two levels of prior knowledge (HPK vs. LPK). The dependent variables were cued recall

test scores, reading times, and comprehensibility ratings and response times.

Materials. Two different versions of text-provided elaborations for each of the 28 episodes used in Experiment 1 were constructed. The elaborated versions from Experiment 1 served as the normal version. The distinctive text-provided elaborations were constructed by creating relations that were unique and nonoverlapping with prior knowledge.⁴ The target facts and the first supportive facts of each episode were identical across the versions and the causal relationships among sentences were maintained. An example of the materials is provided in Table 15. (See Appendix C for the complete set of distinctive version.)

Procedure. The procedure was identical to the elaborated condition procedure of Experiment 1.

Results

Recall performance. The main effect of prior knowledge on recall was significant, $F(1,19) = 9.33, p < .005$. Although distinctiveness of the text-provided elaboration had no significant effect on recall, the interaction effect for prior knowledge by distinctiveness was significant, $F(1,19) = 10.22, p < .005$. Fisher LSD tests indicated that HPK readers recalled more target facts in the distinctive condition than in the normal condition, whereas there was no recall difference between distinctive and normal conditions

Table 15

Examples of Materials in Experiment 6

HPK/Normal elaboration condition:

Thomas Edison began to work on a new project

Thomas Edison spent many days in his lab

Thomas Edison's wife was discontented with being neglected

Thomas Edison's wife became emotionally unstable

LPK/Normal elaboration condition:

Arthur Colman began to work on a new project

Arthur Colman spent many days in his lab

Arthur Colman's wife was discontented with being neglected

Thomas Edison's wife became emotionally unstable

HPK/Distinctive elaboration condition:

Thomas Edison began to work on a new project

Thomas Edison's wife decided to help him in his lab

Thomas Edison's wife received an electrical shock during the experiment

Thomas Edison's wife became emotionally unstable

LPK/Distinctive elaboration condition:

Arthur Colman began to work on a new project

Arthur Colman's wife decided to help him in his lab

Arthur Colman's wife received an electrical shock during the experiment

Arthur Colman's wife became emotionally unstable

Note: Target fact is underlined.

for LPK readers ($p < .05$). Table 16 presents the mean percentage of correctly recalled target facts in Experiment 6. Figure 9 illustrates the interaction effect.

Table 16

Mean Percentage of Correctly Recalled Target Facts in Experiment 6

Distinctiveness	Prior knowledge	
	LPK	HPK
Distinctive	44.1 (22.1)	73.9 (18.0)
Normal	44.1 (22.4)	65.0 (22.0)

Note: Standard deviations are provided in the parentheses.

Reading times. A 2 x 2 ANOVA revealed no significant effects for the first sentence reading times.

The level of distinctiveness was significant for the target fact reading times, $F(1,19) = 12.51$, $p < .005$, indicating that target facts were read faster under the distinctive condition than the normal condition. The main effect of prior knowledge and interaction effect were not significant. The mean reading times for the first sentences and target sentences appear in Table 17.

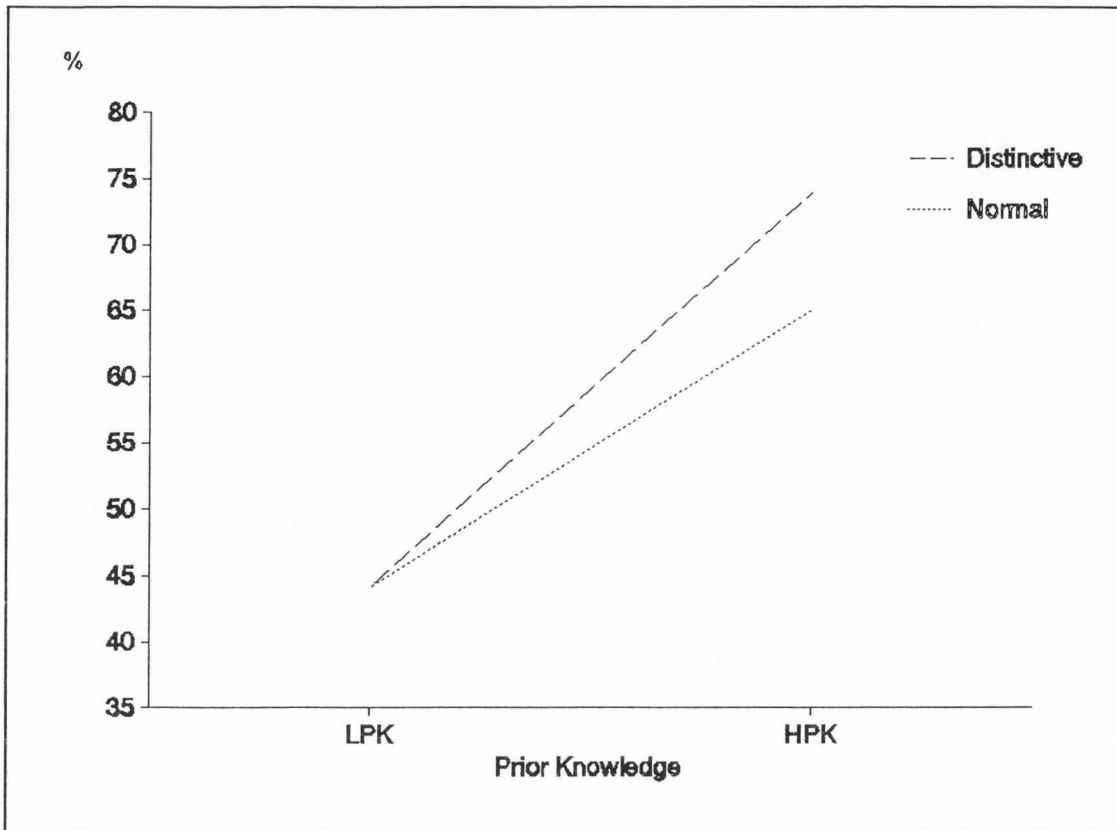


Figure 9. Mean percentage of correctly recalled target facts as a function of prior knowledge and distinctiveness in Experiment 6.

Table 17

Mean Reading Times (msec) for First Sentence and Target Sentence in Experiment 6

Distinctiveness	First Sentence		Target Sentence	
	LPK	HPK	LPK	HPK
Distinctive	2941 (618)	2858 (510)	3299 (1442)	3193 (1527)
Normal	3297 (709)	3070 (616)	3464 (1253)	3951 (1780)

Note: Standard deviations are provided in the parentheses.

Comprehensibility ratings. A 2 x 2 ANOVA revealed a significant main effect of prior knowledge on subjects' comprehensibility ratings, $F(1,19) = 9.10, p < .01$. Subjects also rated distinctive texts significantly more comprehensible than normal texts, $F(1,19) = 7.24, p < .05$. The interaction effect for prior knowledge by distinctiveness was not significant.

The level of distinctiveness approached significance for subjects' comprehensibility rating times, $F(1,19) = 3.59, p = .07$. Subjects spent more time (albeit, not significantly more time) to rate normal texts than distinctive texts. Table 18 presents the mean comprehensibility ratings and response times for the rating.

Table 18

Mean Comprehensibility Ratings (1 = easy to comprehend) and Response Times (msec) in Experiment 6

Distinctiveness	Rating		Response Time	
	LPK	HPK	LPK	HPK
Distinctive	2.1 (1.2)	1.4 (.58)	1254 (581)	1105 (553)
Normal	2.5 (1.1)	2.1 (.97)	1463 (980)	1470 (844)

Note: Standard deviations are provided in the parentheses.

Discussion

The results from Experiment 6 suggest that distinctive text-provided elaborations are more effective than normal text-provided elaborations only for HPK readers. The recall data showed that HPK readers recall more target facts with the distinctive text-provided elaborations than with the normal text-provided elaborations, whereas LPK readers recall about the same number of target facts regardless of the type of text-provided elaboration. It may be that HPK readers might have associated the unique distinctive text-provided elaborations with their prior knowledge and to their self-generated elaborations, which may in turn increase the network and inferential redundancy in their memory representation. In contrast, the normal text-provided elaborations may overlap their self-generated elaborations as demonstrated in Experiments 1, 2, and 3 and thus provide no additional associations.

The LPK readers, on the other hand, make equal use of the additional pathways to the target fact provided by both distinctive and normal texts because they do not have any prior knowledge to be associated with either type of text-provided elaboration. The shorter reading time for the target fact and shorter comprehension rating time for the distinctive condition suggest that distinctive texts are easy to read. This is also supported by the fact that subjects rate distinctive texts as more comprehensible.

CONCLUSIONS

Six important findings about elaborative processing during text comprehension can be drawn from the six experiments conducted in this study: (a) text-provided elaborations have their greatest effect on recall of target information only when readers have low prior knowledge and thus self-generated elaborations are unlikely, (b) readers with high prior knowledge may not require text-provided elaborations to comprehend text due to their ability to generate relevant elaborations, (c) the self-generated elaboration process occurs during comprehension (on-line processing), (d) the probability of generating elaborations depends on the degree of causal relatedness between sentences in the text and the amount of prior knowledge a reader possesses, (e) for readers with high prior knowledge, the self-generated elaboration process is an automatic process which occurs naturally during reading, but for readers with low prior knowledge elaborations are generated only when specific instructions are given, and (f) the distinctive text-provided elaborations are more effective than normal text-provided elaborations only when readers have high prior knowledge.

Three Components of Text Comprehension

The findings can be interpreted in terms of three components of text comprehension. These three components

include: the level of prior knowledge, text structure, and reading task.

Level of prior knowledge. The first component shown to influence text comprehension is the level of prior knowledge a reader possesses on the topic of the text. All six experiments confirm that prior knowledge has a powerful effect on memory performance. The beneficial effect of prior knowledge on memory is the result of self-generated elaborations. Essentially, prior knowledge can produce a memory trace with more relevant self-generated elaborations and can ensure that these elaborations are associated in a meaningful way with the target information, thereby providing multiple retrieval pathways increasing recall.

Text structure. The second component shown to influence text comprehension is the structure of text which can be varied by the presence and type of text-provided elaboration, and the degree of causal relatedness among sentences within the text. In Experiment 1, it was shown that text-provided elaborations are effective for increasing memory performance, but only when the amount of prior knowledge a reader possesses is low. When a reader has low prior knowledge, text-provided elaborations are associated with the target information, which increase network and inferential redundancy in memory representation, thereby improving recall. In contrast, when readers have high prior knowledge, text-provided elaborations are redundant because

readers generate relevant elaborations based on their prior knowledge.

Experiments 2 and 3 confirm that the self-generated elaborations are encoded with the target information in the text representation. Experiment 3 also shows that the self-generated elaboration process occurs during comprehension.

The degree of causal relatedness between sentences also interacts with the amount of prior knowledge a reader has to influence text comprehension. In Experiment 4, it was found that low-related sentence pairs were remembered better than highly related ones only when a reader had high prior knowledge. Since readers need to relate these sentences to understand the text and maintain the coherence of the text, they generate relevant elaborations based on their prior knowledge. In contrast, when readers process high-related sentence pairs, there is little need to generate elaborations and thus performance is not improved. However, when readers have low prior knowledge, high-related sentence pairs are understood and remembered better than low-related ones because high-related sentence pairs are more coherent than low-related ones. Since LPK readers do not have prior knowledge, they fail to generate elaborations even if they need to fill in the gap between low-related sentences.

A last characteristic of the text structure influencing text comprehension is the type of text-provided elaboration. Experiment 6 suggests that text-provided elaborations should

be constructed to make the texts distinctive, especially when they are to be processed by HPK readers. The beneficial effect of distinctive texts on an HPK reader's memory can be explained by distinguishing the text-provided elaborations from self-generated elaborations. Because HPK readers associate their prior knowledge with the distinctive text-provided elaborations which are unique and distinguished from their self-generated elaborations, their networks are expanded, thereby improving performance. In contrast, the normal text-provided elaborations do not increase recall performance because they do not provide associations beyond the self-generated elaborations. However, for LPK readers, it does not make any difference which type of elaboration is provided in the text because both types of text-provided elaboration will increase the number of additional pathways to the target information.

Reading task. The third component shown to influence text comprehension is the task a reader employs during comprehension. In Experiment 5, two types of tasks (a generation task and a comprehension task) were compared. The generation task, which requires readers to integrate the text, is effective only when readers have a low level of prior knowledge. When readers have high prior knowledge, they automatically generate elaborations to maintain the coherence of a text, effectively integrating the text without any specific instructions to relate the sentences.

Limitations and Suggestions for Future Research

The findings of this study have shown that prior knowledge, the relatedness of elaboration, and instructions influence text processing. However, there may be several other factors which influence text processing that were not included in this study, for example, reading ability and the type of text. Future experiments may extend this study by including these factors.

The findings from this study are also limited to the college student population, who have high reading skills and high levels of world knowledge. Therefore it is impossible to generalize the results to children's learning. It would be important to compare the results from this study with a similar study conducted with younger children. In addition, the reading materials used in this study are contrived episodes which are narrative in nature and relatively short. It is possible that an experiment using expository text would obtain different results. Therefore, as a next step in the development of the text processing model, it is imperative that research conduct studies with different types of text (e.g., expository text or real text) and students of different ages. The methodology employed in this study could be easily adapted for such future studies.

Educational Implications

The findings from this study can be applied to educational practices. One implication that could be drawn

is that when an author writes a textbook or a teacher gives a lecture, he/she should be aware of the level of prior knowledge the learner possesses. If the learner has a high level of prior knowledge, the information presenter may not need to provide elaborations of the main points because the learners may generate their own elaborations based on their prior knowledge. It may also be beneficial for the information presenter to use distinctive information when discussing the content of a lesson to increase the level of associations the learner will create.

In contrast, when teaching learners with little or no previous knowledge about the subject, the information presenter might be most effective when providing as many elaborations as possible. This additional information should be highly related to the main points while also embellishing these points so that the learner will build a coherent network that can be easily accessed during recall.

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ENDNOTES

¹ Forty students, not involved in any other way with the experiments, were asked to rate their level of prior knowledge about forty well-known individuals on a 5-point scale as well as 'fame' of those individuals. From this pilot test, the 28 individuals who rated most highly on both scales were included in this experiment.

² Less than .01% of unknown names were identified as familiar names and these data were not included in subsequent analysis.

³ Forty students who were in no other way involved with the experiments were asked to rate each episode on a 5-point scale with respect to how well each sentence may have caused the next sentence. These 28 episodes which were rated most highly were selected from a list of 40 episodes.

⁴ To validate the distinctiveness manipulation, a pilot study was conducted using forty subjects who were not involved in any other way with the experiment. They were asked to rate 28 episodes on a 5-point scale with respect to the following question: "How often have you encountered this situation in everyday life?" Half of them read distinctive texts and the other half read normal texts. A oneway ANOVA showed that distinctive texts were rated significantly more unusual than normal texts, $F(1,38) = 5.54, p < .05$.

APPENDICES

APPENDIX A

APPENDIX A
EXPERIMENTAL MATERIALS

The names in the parenthesis are the unknown names.

Muhammid Ali heard some strangers cursing at him.
Muhammid Ali became angry at the rude comments.
Muhammid Ali threw crushing blows at the strangers.
All of the strangers had severe pain in their jaws.
(Theodore Allen)

The burglar stole the money in front of Helen Keller.
A little while later Helen Keller realized the money was gone.
Helen Keller searched long and hard for the money.
Helen Keller became very unsure of her own judgement.
(Julie Jacobs)

Tom Cruise went to the mall to get his picture taken.
Some teenage girls saw Tom Cruise down the hall.
The teenage girls chased and mobbed Tom Cruise.
Tom Cruise had large rip marks in his clothes.
(Sam Jones)

Pope John Paul was seen with an attractive young woman.
The mass media revealed a scandal about Pope John Paul.
Many church members began to doubt Pope John Paul.
Many people stopped going to their church services.
(Bill Ray Shaw)

Jesus Christ didn't eat food for an entire week.
Many people brought food for Jesus Christ to eat.
Jesus Christ didn't accept the generous offering of food.
Many people respected Jesus Christ more than ever before.
(Morris Turner)

The merchant gave Abraham Lincoln too much change.
Abraham Lincoln felt bad for receiving too much change.
Abraham Lincoln graciously returned the money to the store.
The owner of the store was extremely happy.
(Jonathon Hunter)

Someone tried to bribe George Bush into revealing secrets.
George Bush strongly rejected the offer.
All of the Americans were proud of George Bush.
All of the citizens wrote letters of support to George Bush.
(Randy Sanders)

Roseanne Barr's family went out to eat at a nice restaurant.
Roseanne Barr's family ordered everything on the dinner menu.
Roseanne Barr's family emptied every order of food rapidly.
The restaurant ran out of food for the first time.
(Lucille Car)

Michael Jordan saw the boy's balloon rising out of reach.
Michael Jordan jumped straight up into the air.
Michael Jordan grabbed the balloon and returned it to the boy.
The little boy stood in shock and disbelief.
(Murcus Beckman)

William Shakespeare wrote love letters during his life.
William Shakespeare expressed great emotion in the letters.
A publisher printed the letters into a literature textbook.
High school students have become familiar with these letters.
(Timothy Lambertsen)

Thomas Edison began to work on a new project.
Thomas Edison spent many days in his lab.
Thomas Edison's wife was discontented with being neglected.
Thomas Edison's wife became emotionally unstable.
(Steven Wallace)

Phil Donahue wanted to speak with the President.
Phil Donahue called the President's White House officials.
Phil Donahue was able to interview the President.
The President appeared on the television show.
(Kent Roberts)

Danny Devito and family went horse back riding.
Danny Devito attempted to get onto a horse several times.
Danny Devito gave up getting onto the horse.
Danny Devito's oldest son helped him onto his horse.
(Joseph Anderson)

Martin Luther King went to South Africa.
Martin Luther King condemned the South Africans for racialism.
The South Africans became angry with Martin Luther King.
The South African Government refused to talk to Martin Luther King.
(Jarod Spencer Hull)

Charlie Brown received a comb for birthday gift.
The comb was not a useful gift for Charlie Brown.
Charlie Brown's guests laughed at the gift.
Charlie Brown thought his guest were making fun of him.
(Harold Walsh)

Sigmund Freud came across an insane man in the street.
Sigmund Freud counseled the insane man about his life history.
Sigmund Freud helped the insane man overcome his problems.
The insane man became a prominent citizen in the community.
(Walter White)

Madonna went to the banquet to eat dinner.
Madonna wore a very revealing low cut dress.
Most of Madonna's body parts were exposed to the public.
All of the banquet guests had an eye-opening experience.
(Joanna)

Bo Jackson came face to face with a ferocious lion.
Bo Jackson was chased by the fierce animal.
Bo Jackson gained speed and outran the lion.
Bo Jackson ended up miles away from any danger.
(Karl Miller)

Donald Trump was guided by the African native to a safe place.
Donald Trump was thankful for the help of the African native.
Donald Trump compensated the African native with a lot of money.
The African native became an owner of a chain of African hotels.
(Larry Greene)

Adolf Hitler was scratched by a town cat.
Adolf Hitler became angry for being scratched.
Adolf Hitler decided to take revenge on the cat owner.
All of the cat owners in town disappeared.
(Kevin Godfrey)

Albert Einstein never studied any of his school work.
Albert Einstein scored high on all of his tests.
Albert Einstein graduated with great honors at his school.
Albert Einstein's parents were very proud of his achievement.
(Dennis Griffin)

James Dean attended a school that had a short hair rule.
The teacher asked James Dean to get a haircut.
James Dean decided not to get his haircut.
James Dean's attendance in class dropped to zero.
(Bruce Hall)

Al Capone's daughter were kidnapped by gangsters.
Al Capone's men found out who kidnapped his daughter.
Al Capone did whatever necessary to save his daughter.
All of the gangsters were found dead.
(Don Phillips)

Mick Jagger celebrated his birthday party with his friends.
Mick Jagger indulged in an excessive amount of drugs at the party.
The police arrested Mick Jagger for drug abuse.
Mick Jagger was in jail for three weeks.
(Brad Russell)

Arnold Schwarzenegger shook the First Lady's hand firmly.
Arnold Schwarzenegger squeezed the First Lady's hand too hard.
The First Lady felt an extreme amount of pain.
The First Lady screamed radically at Arnold Schwarzenegger.
(David Butikoffer)

Eddie Murphy whispered to the governor during dinner.
The governor realized his whisper was a funny joke.
The governor began to laugh at Eddie Murphy's joke.
Eddie Murphy saw the governor spit out his food.
(Gordon Thompson)

John McEnroe and a friend played a game of checkers.
John McEnroe lost three straight games to his friend.
John McEnroe threw the checker board across the room.
John McEnroe's friend swore not to play with him again.
(Mark Broderick)

Marilyn Monroe worked at a beach as a lifeguard.
Marilyn Monroe fit nicely in her bikini.
Most of the men wanted to be close to Marilyn Monroe.
A lot of men pretended to be drowning.
(Angela Benson)

APPENDIX B

APPENDIX B
ANOVA SUMMARY TABLES IN EXPERIMENT 5

ANOVA Summary Table for Recall Performance

Source of Variation	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>p</u>
Instruction (I)	5448.72	1	5448.72	5.51	.023
Subject (S) / I	37599.21	38	989.45		
Prior Knowledge (PK)	26741.83	1	26741.83	95.84	.000
I x PK	2660.98	1	2660.98	9.54	.004
PK x S/I	10602.83	38	279.02		
Total	83053.57	79			

ANOVA Summary Table for Reading Times for First Sentence

Source of Variation	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>p</u>
Instruction (I)	1532820.32	1	1532820.32	9.17	.005
Subject (S) / I	6350647.63	38	167122.31		
Prior Knowledge (PK)	512354.56	1	512354.56	38.62	.000
I x PK	24877.65	1	24877.65	1.88	.175
PK x S/I	504098.92	38	13265.76		
Total	8924799.13	79			

ANOVA Summary Table for Reading Times for Target Sentence

Source of Variation	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>p</u>
Instruction (I)	4416632.64	1	4416632.64	4.30	.042
Subject (S) / I	38985587.20	38	1025936.51		
Prior Knowledge (PK)	119864.18	1	119864.18	0.19	.669
I x PK	401230.96	1	401230.96	0.62	.442
PK x S/I	24485342.72	38	644351.12		
<hr/>					
Total	68408657.70	79			

APPENDIX C

APPENDIX C
DISTINCTIVE VERSIONS OF MATERIALS IN EXPERIMENT 6

Muhammad Ali heard some strangers cursing at him.
Muhammad Ali pacified the strangers by giving them hard candies.
The hard candy chipped the teeth of the strangers.
All of the strangers had severe pain in their jaws.

The burglar stole the money in front of Helen Keller.
The burglar hypnotized Helen Keller.
Helen Keller did everything she was commanded.
Helen Keller became very unsure of her own judgement.

Tom Cruise went to the mall to get his picture taken.
Tom Cruise spilled solution on his pants in the photo lab.
The solution started to dissolve parts of Tom Cruise's pants.
Tom Cruise had large rip marks in his clothes.

Pope John Paul was seen with an attractive young woman.
The young woman tried to kiss Pope John Paul.
Pope John Paul retaliated by breaking the girl's nose.
Many people stopped going to their church services.

Jesus Christ didn't eat food for an entire week.
Jesus Christ saved all of the food he didn't eat.
Jesus Christ gave all of the food to his poor neighbors.
Many people respected Jesus Christ more than ever before.

The merchant gave Abraham Lincoln too much change.
Abraham Lincoln used the change to buy a lottery ticket.
Abraham Lincoln won the prize and gave half to the store owner.
The owner of the store was extremely happy.

George Bush was offered ten billion dollars for revealing secrets.
George Bush accepted the money with great appreciation.
George Bush donated the money to The Red Cross.
All of the citizens wrote letters of support to George Bush.

Roseanne Barr's family went out to eat at a nice restaurant.
Roseanne Barr's family began to argue with one another.
Roseanne Barr's family threw all of the food at each other.
The restaurant ran out of food for the first time.

Michael Jordan saw the boy's balloon rising out of reach.
Michael Jordan jumped straight up into the air.
Michael Jordan's pants fell to his ankles.
The little boy stood in shock and disbelief.

William Shakespeare wrote love letters during his life.
A school teacher secretly copied his love letters.
The teacher published Shakespeare's letters in his own name.
High school students have become familiar with the letters.

Thomas Edison began to work on a new project.
Thomas Edison's wife decided to help in his lab.
Edison's wife received an electrical shock during the experiment.
Thomas Edison's wife became emotionally unstable.

Phil Donahue wanted to speak with the President.
Phil Donahue pointed a gun at the President.
Phil Donahue forced the President to have an interview.
The President appeared on the television show.

Danny Devito and family went horse back riding.
Danny Devito teased his horse by holding food just out of reach.
Danny Devito's horse was angered and bucked him off.
Danny Devito's oldest son helped him onto his horse.

Martin Luther King went to South Africa.
Martin Luther King painted graffiti on the government buildings.
The South Africans became angry with Martin Luther King.
The South African Government refused to talk to Martin Luther King.

Charlie Brown received a comb for birthday gift.
Charlie Brown used the gift to comb his hair.
The comb turned Charlie Brown's head into a green color.
Charlie Brown thought his guests were making fun of him.

Sigmund Freud came across an insane man in the street.
The insane man knocked Sigmund Freud unconscious.
The insane man dressed in Sigmund Freud's clothes and portrayed him.
The insane man became a prominent citizen in the community.

Madonna went to the banquet to eat dinner.
One of Madonna's guests called her a fat pig.
Madonna smashed cake into the guests face.
All of the banquet guests had an eye-opening experience.

Bo Jackson came face to face with a ferocious lion.
Bo Jackson removed the lion's teeth and claws.
Bo Jackson began to pet the lion.
Bo Jackson was miles away from any danger.

Donald Trump was guided by the African native to a safe place.
The African native pulled a knife on Donald Trump.
The native stabbed Donald Trump in his side.
The African native became an owner of a chain of African hotels.

Adolf Hitler was scratched by a town cat.
Adolf Hitler took revenge by killing the cat owners one by one.
The cat owners were afraid of for their lives.
All of the cat owners in town disappeared.

Albert Einstein never studied any of his school work.
Albert Einstein's church prohibited the study of book.
Albert Einstein complied with the request of his church.
Albert Einstein's parents were very proud of his achievement.

James Dean attended a school that had a short hair rule.
James Dean's teacher shaved his head bald.
James Dean became extremely embarrassed.
James Dean's attendance in class dropped to zero.

Al Capone's daughter was kidnapped by gangsters.
Al Capone sent a package of poisonous snakes to the gangsters.
The gangsters were all bitten severely by the snakes.
All of the gangsters were found dead.

Mick Jagger celebrated his birthday party with his friends.
Mick Jagger and friends ran outside in the nude.
The police arrested them for indecent exposure.
Mick Jagger was in jail for three weeks.

Arnold Schwarzenegger shook the First Lady's hand firmly.
Arnold Schwarzenegger pulled the First Lady into a dark alley.
Arnold Schwarzenegger started forcing himself upon the First Lady.
The First Lady screamed radically at Arnold Schwarzenegger.

Eddie Murphy whispered to the governor.
The governor smelled Eddie Murphy's bad breath.
The governor became sick from Eddie Murphy's breath.
Eddie Murphy saw the governor grab his stomach.

John McEnroe and a friend played a game of checkers.
John McEnroe agreed the loser would be eaten by sharks.
John McEnroe tried to push his friend into the pool of sharks.
John McEnroe's friend swore not to play with him again.

Marilyn Monroe worked at a beach as a lifeguard.
Marilyn Monroe was one of the judges at the beach acting contest.
The contest winner would do a drowning scene in a movie.
A lot of men pretended to be drowning.

VITA

PERSONAL DATA

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EDUCATION

B.A. (1981 - 1985)	Korea University Seoul, Korea
Major:	Psychology
M.S. (1986 - 1988)	Utah State University
Major:	Psychology
Ph.D. (1989 - 1992)	Utah State University
Major:	Psychology

PROFESSIONAL EXPERIENCE

1990-present	Research Assistant, Psychology Department, Utah State University
1991	Teaching Assistant for Psychology of Learning, (graduate course), Utah State University
1990	Teaching Assistant for Educational Psychology, (undergraduate course), Utah State University
1989-1990	Research Assistant, Center for Persons with Disabilities, Utah State University
1988-1989	Korean Army Officer, Daegu, Korea
1987-1988	Research Assistant, Psychology Department, Utah State University
1986-1987	Research Assistant, Center for Persons with Disabilities, Utah State University

PUBLICATIONS

- Kiewra, K.A., Mayer, R.E., Christensen, M., Kim, S., & Risch, N. (1991). Effects of repetition on recall and notetaking: Strategies for learning from lectures. Journal of Educational Psychology, 83, 120-123.
- Kiewra, K.A., DuBois, N.F., Christensen, M., Kim, S., & Lindberg, N. (1989). A more equitable account of the note-taking functions in learning from lecture and from text. Instructional Science, 18, 217-232.

Manuscripts Currently Submitted for Publication:

- Innocenti, M.S., Escobar, C., Hollinger, P., & Kim, S. A cost-effectiveness analysis of the addition of a parent involvement curriculum to a center-based intervention program. Submitted to School Psychology Review.
- Innocenti, M.S., Welge, P., Escobar, C., Goetze, L., & Kim, S. A cost-effectiveness comparison of two training models for paraprofessionals providing early intervention services. Submitted to Exceptional Children.
- Kiewra, K.A., Benton, S.L., Christensen, M., Kim S., & Lindberg, N. The effects of note-taking format and study technique on performance. Submitted to Contemporary Educational Psychology.
- Kiewra, K.A., Mayer, R.E., DuBois, N.F., Christensen, M., Kim, S., & Lindberg, N. Test-appropriate effects of type of advance organizer and repetition on learning from a videotaped science lecture. Submitted to Journal of Educational Psychology.
- Kim, S., & Kiewra, K.A. The effect of elaboration and prior knowledge on recall. Submitted to Journal of Memory and Language.
- Van Dusen, L.M., & Kim, S. Interaction of prior knowledge and text structure: Effects on comprehension and retention of texts. Submitted to Memory and Cognition.
- Van Dusen, L.M. & Kim, S. Differential effects of motivation on the comprehension and retrieval of central and peripheral information from texts with good and poor structures. Submitted to Journal of Educational Psychology.

Doctoral Dissertation:

- Kim, S. (1992). The role of prior knowledge and elaboration in text comprehension and memory: A comparison of self-generated elaboration versus text-provided elaboration.

Master's Thesis:

Kim, S. (1988). The effect of elaboration on memory: Self-generated elaboration vs. experimenter-provided elaboration.

Technical Report:

Shuster, T.A., Mortensen, L.B., Worthen, B.R., Kim, S., & Shin, E. (1990). Parent opinion concerning Year-Round Education.

PAPERS PRESENTED AT PROFESSIONAL MEETING**National Meetings:**

Kiewra, K.A., Benton, S.L., Christensen, M., Kim, S., & Lindberg, N. (1989). The effect of note-taking format and study technique on performance. American Educational Research Association, San Francisco, CA.

Kiewra, K.A., DuBois, N.F., Christensen, M., Kim, S., & Lindberg, N. (1989a). A more equitable account of the note-taking functions. American Educational Research Association, San Francisco, CA.

Kiewra, K.A., DuBois, N.F., Christensen, M., Kim, S., & Lindberg, N. (1989b). An equitable account of the note-taking functions in learning from text. American Educational Research Association, San Francisco, CA.

Kiewra, K.A., DuBois, N.F., Mayer, R.E., Christensen, M., Kim, S., Risch, N., Meyerhoffer, M., & Moss, V. (1990). The effects of repetition and organizers on note taking and achievement. American Educational Research Association, Boston, MA.

Kim, S., & Van Dusen, L.M. (1992a). The effect of text-provided elaboration on text retention. International Association for the Empirical Study of literature, Memphis, TN.

Kim, S., & Van Dusen, L.M. (1992b). The effect of elaborating narrative text while reading. American Psychological Society, San Diego, CA.

Kim, S., Van Dusen, L.M., Freudenthal, D., & Williams, D. (1992). Understanding of elaborative processing in text comprehension: Text-provided versus self-generated elaboration. Winter Text Conference, Jackson Hole, WY.

Kim, S., Van Dusen, L.M., & Shin, E. (1992). When do readers generate elaborations?: Evidence for self-generated elaboration. American Association for the Advancement of Science, Chicago, IL.

- Kim, S., Innocenti, M.S., & Goetze, L. (1991a). A Comparison of two approaches to paraprofessional training: Effect and cost-benefit. American Psychological Society, Washington, DC.
- Kim, S., Innocenti, M.S., & Goetze, L. (1991b). A Comparison of two approaches to paraprofessional training: Longitudinal Data. American Psychological Association, San Francisco, CA.
- Kim, S., & Kiewra, K.A., (1990). The effect of elaboration and prior knowledge on recall. American Psychological Association, Boston, MA.
- Van Dusen, L.M., & Kim, S. (1990a). Interaction of prior knowledge and text structure. Winter Text Conference, Jackson Hole, WY.
- Van Dusen, L.M., & Kim, S. (1990b). Comprehension of text: A function of interactive effects. American Psychological Society, Dallas, TX.
- Van Dusen, L.M., & Kim, S. (1991a). Effect of Motivation on comprehension and retention of texts. Winter Text Conference, Jackson Hole, WY.
- Van Dusen, L.M., & Kim, S. (1991b). Differential effects of motivation on the recall of central and peripheral information. American Psychological Society, Washington, DC.

Regional Meetings:

- Kiewra, K.A., Mayer, R.E., Christensen, M., Kim, S., & Risch, N. (1990). The effects of structured and unstructured repetition of videotaped instruction. Midwestern Educational Research Association, Chicago, IL.
- Risch, N., Kiewra, K.A., Christensen, M., Kim, S., & Benton, S. (1991). How the structure of graphic organizers affect notetaking. Midwestern Educational Research Association, Chicago, IL.
- Kim, S. & Van Dusen, L.M. (1992). Effect of elaboration: Interaction of text structure and prior knowledge. Western Psychological Association, Portland, OR.

University Presentation:

- Kim, S. (1991). Prior knowledge and elaboration. Paper presented at Scholar's Day (Honor Program), Utah State University.

GRANT

- Co-Principal Investigator (Lani Van Dusen, Principal Investigator) Understanding the elaboration process during text comprehension. National Science Foundation. Submitted and pending.

PROFESSIONAL AFFILIATIONS

American Psychological Association, 1990 - present
American Psychological Society, 1991 - present
Western Psychological Association, 1991 - present

AWARDS & HONORS

- | | |
|------|--------------------------------------------------------------------------------------------|
| 1992 | American Psychological Association
Dissertation Award |
| 1992 | Selected for International Student of the Year |
| 1992 | American Psychological Society
Travel Award |
| 1991 | Winner of the Edwin B. Newman Psi Chi/APA
Award for Excellence in Research |
| 1991 | American Psychological Association
Science Directorate Award |
| 1991 | Listed for Who's Who Among International Students
in American Universities and Colleges |
| 1990 | American Psychological Association
Science Directorate Award |
| 1990 | President of Korean Student Association,
Utah State University |
| 1983 | Korea University Scholarship |
| 1982 | Korea University Scholarship |