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ABSTRACT

A study examined the differential effects of previewing textual information with questions containing higher-order versus lower-order information. The 104 college students in the study read three passages, each of which was preceded by different combinations of questions about information high or low in the structural hierarchy of the text, then completed a vocabulary test and free-recall tasks on the selections. The results indicated that questions directing the subjects' attention to material at the top of the organizational structure facilitated the effective encoding of the central organizational idea within the passage segment. Indirect recall (recall of nonquizzed information) was greater for high-level questions than recall in both the low-level question condition and the no-question condition. A significant interaction also was found between subjects' vocabulary ability and question condition. The facilitative effect of high-level questions declined with increasing vocabulary ability. This interaction is consistent with the view that high-ability and low-ability people differ in their tendency to use the superordinate organizational structure of the passage and thus in their tendency to benefit from processing aids such as adjunct questions. (Author/RL)

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PRE-PASSAGE QUESTIONS: THE INFLUENCE OF STRUCTURAL IMPORTANCE

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Pre-passage Questions:
The Influence of Structural Importance

The effect of adjunct quiz questions on the retention of prose material has been studied extensively in recent years. In many studies (e.g., Boyd, 1973; Frase, 1968; Rickards, 1976; Rickards & DiVesta, 1974; Rothkopf, 1966; Sagaria & DiVesta, 1978), the position of quiz questions has been examined in relation to retention effect on both quizzed (direct) and non-quizzed (indirect) material. One of the conclusions generally drawn from this research (e.g., Anderson & Biddle, 1975) is that questions requiring the extraction of specific isolated facts from the passage will have a facilitative effect on the retention of direct information when they appear before the segment of text containing the relevant fact but that such pre-passage questions may actually retard retention of indirect information. This conclusion has been interpreted (Boyd, 1973) as showing that pre-passage questions induce a selective attention strategy which results in intensive processing and improved memory for the quizzed items and attentuated processing and poor retention of indirect material. This view has recently received support in experiments by Reynolds and his associates (Reynolds & Anderson, in press; Reynolds, Standiford, & Anderson, 1979). Using two different measures of attention, Reynolds and his associates found the superior learning of text information relevant to the adjunct questions to be associated with increased processing time for those text segments.

The experiment to be reported investigated the influence of the structural importance of the quizzed information on the selective attention

effects produced. Recent work on text structure analysis (e.g., Frederiksen, 1972, 1975; Kintsch, 1974; Meyer, 1975, 1977) and story grammars (e.g., Mandler & Johnson, 1977; Rumelhart, 1976; Thorndyke, 1977; van Dijk & Kintsch, 1976) has demonstrated that the memory representation of a prose passage corresponds in a demonstrable way to the abstract organizational structure into which a passage can be analyzed. All of these investigators have reported that the probability of recalling a passage proposition increases with its increasing height in the hierarchical structure, and some (Kintsch, Kozminsky, Streby, McKoon, & Keenan, 1975; Meyer, 1975, 1977) have demonstrated that superordinate units are less susceptible to forgetting than are subordinate units. It has also been reported (Kintsch & van Dijk, 1975; Thorndyke, 1977) that, in summarizing stories, subjects produce units most central to the organization of the passage and omit subordinate details. Meyer and her associates (Meyer, Bartlett, Woods, & Rice, Note 1) have shown that subjects' use of the top-level organizational structures found in passages is highly correlated with the amount recalled. In addition, passages tend to be recalled in chunks in accordance with structural groupings within the network (Frederiksen, 1975), and delayed verification of passage propositions is more accurate for superordinate probes than for subordinate probes (McKoon, 1977).

On the basis of these results it is reasonable to conclude that superordinate units are critically important to the memory of the passage as a whole and that through these units access to subordinate units is achieved. Furthermore, this conclusion leads to the prediction that high-level and low-level pre-passage questions will differ in their effects on indirect recall. Specifically, it was predicted that a selective search

for superordinate information would result in more indirect recall than would a selective search for subordinate information. This prediction was based on the assumption that a selective search for superordinate information will encourage the organization of the passage in memory in terms of its structural properties to a greater extent than will a selective search for subordinate information. Such a search for detail information could produce a failure to extract superordinate ideas as a sturctural base for the integration of the remainder of the topic information. Thus, more indirect recall would be expected in the high-question condition than in the no-question condition, but a superiority of the low-question condition over the no-question condition would not be predicted.

Measures of individual differences were also included in this experiment in order to increase the generality of the findings. One measure employed was that of vocabulary ability. In a review of individual difference effects in adjunct question research, Rickards and Denner (1978) concluded that more verbally skilled readers show less enhancement in performance with the use of higher level post-questions than do less skilled readers. They explained this general finding in terms of a spontaneous tendency of skilled readers to process the material effectively in accordance with its semantic organization and the meaningful relationships between information in the passage. Less skilled readers, on the other hand, need aids in order to be able to organize the material effectively. In regard to the pre-passage question manipulation of this experiment, these earlier results would suggest that the superiority of the high-question condition over the low-question condition and the no-question condition is more likely to obtain for low-vocabulary subjects than for high-vocabulary subjects.

The second individual differences measure employed was a questionnaire designed to measure the personality trait of extraversion/introversion (Eysenck & Eysenck, 1969, 1975). In one of the few studies of the relationship of extraversion to prose processing, Riding and Parker (1979) reported results suggesting that introverts have greater difficulty in distinguishing important details from insignificant details as a result of their relatively higher level of arousal at the time of study. This suggestion of a possible differential sensitivity of introverts and extraverts to the structural importance of passage information made an investigation of the interaction of question condition and extraversion of interest.

Method

Subjects

A total of 104 students enrolled in educational psychology courses at the University of Illinois participated in the experiment as part of a course requirement.

Materials

The materials read were three expository prose passages on the topics of bird migration, spiders, and color change in leaves. The spider passage was based on portions of an Audubon Society publication (Ashley, 1974). The bird migration passage was derived from a pamphlet of the Fish and Wildlife Service (USDI, 1971), and the leaf color change passage was based on portions of a National Forest Service brochure (USDA, 1967). The length of the passages in words was 611 for spiders, 724 for migration, and 722 for leaf color change. The passages were constructed so as to be highly

hierarchically organized. Figure 1 shows the hierarchical organization of one of the passages resulting from the type of top-to-bottom parsing suggested by Meyer (1975, pp. 53-56). Each passage contained information about three main topics. For the purpose of this experiment, the sentences specifying the main topics to be discussed and the sentences specifying the subtopics within each of the three main topics were considered superordinate information. All sentences containing detail information about the subtopics was designated as subordinate information. Within each passage, one of the main topics contained four subtopics, one contained three subtopics, and the other contained two subtopics. The materials employed are available upon request from the author.

Insert Figure 1 about here.

The questions employed in the study were generated by replacing segments of sentences presented in the passages with interrogatory terms. Nine high-level questions were derived for each passage by converting each sentence announcing a subtopic into a question. Nine low-level questions were formed by converting one detail sentence from each subtopic into a question. The detail sentences selected for conversion to questions were chosen on the basis of which detail sentence within each subtopic could most unambiguously be presented as a question. Each high-level question contained explicit reference to one of the main topics in the passage and required as a response one of the subtopics, while each low-level question contained explicit reference to one of the subtopics and required detailed information as a response. For example, for the subtopic cluster reading:

> One of these explanations of why birds migrate argues that a reduction in the supply of insects for food forces the birds to migrate. This reduction in the food supply is caused by the cold winter weather in the north. The first such major reduction in the supply of food for birds supposedly occurred when glaciers advanced into the northern part of North America during the ice age.

the high-level question was: "One explanation of why birds migrate argues that a reduction in the supply of what forces the birds to migrate?"; and the low-level question was: "The first major reduction in the supply of food for birds supposedly occurred when?" As Figure 1 indicates, this subtopic cluster was preceded in the passage by a main topic sentence reading: "To the question of why birds migrate, three explanations have been proposed."

Design and Procedure

Each subject received two questions, one high-level and one low-level, about each passage before reading the passage. The questions quizzed information from two of the three main topics in the passage. The pairing of questions was counterbalanced across subjects such that each possible high-level question from one passage appeared equally often in conjunction with each possible low-level question from the other two main segments of the passage. The order of the passages was randomized for each subject.

Subjects were tested either individually or in groups ranging in size from two to 25. The subjects were instructed in writing and orally by the experimenter to read each passage so as to be able to answer the two questions presented before the passage when they were presented again after reading the passages. No mention was made in the instructions that memory of the passages would be tested by any means other than the adjunct

questions. However, subjects were encouraged to read all segments of the passages thoroughly and completely even if they did not appear to be relevant to the questions. The subjects were required to record an answer to each question before proceeding to read the passage. This requirement was designed to insure that subjects attended fully to the questions.

Subjects were allowed to read the passages at their own speed, but they were encouraged not to spend a lot of time on any one of the passages. The passages were presented in booklet format. Immediately after each passage a long division arithmetic problem was presented in the booklet for subjects to work. The problem was included in order to increase the discriminability of the three passages. Following the first passage, the subjects proceeded to the second and third passages, following the same procedure as for the first passage. After completing the third passage, subjects waited until all persons in the group had finished the three passages.

A series of intervening booklet tasks was then administered. Subjects first completed one half of the Wide Range Vocabulary Test (French, Ekstrom, & Price, 1963), consisting of 24 multiple-choice items. This was followed by a nine-item biographical questionnaire requiring short answers. The questions were concerned primarily with the subject's background in biology and educational and career plans as factors that might be related to the subject's overall level of recall. Preliminary analyses indicated that the subject sample was so homogeneous in regard to these factors that further consideration of the biographical information would be as unprofitable. Following the biographical questionnaire, subjects completed a questionnaire consisting of the extraversion and lie-scale questions from the Eysenck

Personality Questionnaire (Eysenck & Eysenck, 1975). The vocabulary test was timed, but the other two tasks were unpaced.

Prior to completing the biographical and personality questionnaires, subjects were given both written and oral instructions for an unexpected free recall task. Subjects were asked to recall the three passages under the titles presented on the last pages of the booklet. The titles were presented in the order in which the passages were read, and subjects were asked to recall the passages in the order in which the titles were presented, after completing the questionnaires. Subjects were urged to recall the passages in a form as similar to the original as possible, but they were told to recall information in their own words when unable to remember the original wording. The importance of making all recall in the form of complete sentences was stressed to the subjects. Subjects were not allowed to refer back to the passages during recall. The recall task was unpaced, but no subject spent more than 45 minutes in completing the questionnaire and recall tasks.

The free-recall protocols were scored using a method similar to that employed by Rickards and his associates (Rickards & August, 1975; Rickards & DiVesta, 1974). Each test sentence was reduced to its essential proposition or propositions, and each recalled sentence was judged on the basis of whether it captured the gist of one of these propositions. A rating of 2 was used to indicate that the match between text proposition and recalled sentence was totally acceptable, and a rating of 1 was used to indicate that the match was only partial. For example, a recall of the passage sentence, "A final interesting explanation of why birds migrate is that a change in the length of day prepares birds for their migration

by altering their breeding condition," which read, "A theory of why birds migrate is that the change in the length of day changes their sexual drives," received a rating of 2, while a recall which read, "The theory of bird migration encompasses the idea of the influence of length of day," received a rating of 1. The objectivity of this scoring procedure was determined by having a graduate student as well as the experimenter score all protocols. The Pearson product moment correlation between the two raters' scores was .95. Both raters scored the protocols without knowledge of which text segments had been quizzed.

Results

Overall Indirect Recall

Separate between-subject and within-subject hierarchical multiple regression analyses were performed on the overall indirect recall scores. In the between-subject analysis, vocabulary score was entered first, followed by extraversion score and the interaction of these two measures. Vocabulary score was entered first because of its assumed more direct relationship to the cognitive task of prose recall. On the basis of this assumption, it is more important to control for the effects of vocabulary in assessing the influence of extraversion than it is to do the reverse.

In the within-subject analysis, the main factors were those of recall level (superordinate vs. subordinate) and question (high, low, and no), represented in the analysis by effects coding (Cohen & Cohen, 1975). As described above, superordinate recall was defined as the recall of main topic and subtopic sentences, and subordinate recall was defined as the recall of detail sentences (see Figure 1). On the basis of the scorers' coded analysis of each subject's recall, a determination was made

as to whether there was any indirect superordinate or subordinate recall from each of the three major segments of each passage. As discussed previously, each segment represented one of the three question conditions. Recalls rated 1 as well as those rated 2 were included in the analysis. Preliminary analyses employing only recalls rated 2 produced the same pattern of results. In the case of the segments from which the two presented questions were drawn, indirect recall consisted of information recalled from one of the subtopic clusters of that segment which was not directly quizzed and information recalled from the superordinate proposition introducing the main topic within which the quizzed subtopic was discussed. For the segment for which no question was presented, all presented information qualified to be counted as indirect recall. Thus, for each subject, the number of passages from which there was recall in each of the six conditions (2 levels of recall x 3 question conditions) was determined, and these data were submitted to the regression analysis.

Table 1 shows the order in which the variables were entered into the within-subject regression analysis. The factor of recall level was entered first in order to remove the variance of this factor before considering the factor of questions, which was of course the variable of greatest interest in the experiment. By first removing the variance due to recall level, which previously cited experiments suggested would be considerable, a conservative assessment of the relationship of question to frequency of recall was assured. The order of entry of the remaining variables followed the guidelines of Cohen and Cohen (1975, chaps. 8 & 10).

Insert Table 1 about here.

In all of the multiple regression analyses to be reported, the effects of all within-subject factors and the effects of all interactions involving within-subject factors were assessed by grouping into a set the effects-coded variables defining a factor or its interaction and testing the significance of the variance explained by the entire set. This procedure guards against large experiment-wise Type I error rates. Because of the non-independence of the within-subject measures, the conservative policy of setting the degrees of freedom equal to the number of subjects minus one was adopted for all within-subject tests of significance. In no instance did this conservative procedure suppress an effect which would have been significant using a more typical, less conservative procedure.

Table 1 also summarizes the results of the regression analyses. The significant effect of recall level was reflected in a superiority of superordinate recall over subordinate recall. The means are shown in Table 2. The significant effect of question was assessed by means of Tukey's test. Recall in the high-question condition significantly exceeded recall in both the low-question condition and the no-question condition, with a critical value of .158. Recall in the low-question condition did not differ significantly from that in the no-question condition. The means from the three question conditions are also shown in Table 2.

Insert Table 2 about here.

As shown in Table 1, the interaction of recall level and question was significant. The means from this interaction are also shown in Table 2. The pattern of significant differences between means for superordinate recall, using Tukey's test, was the same as that reported for the main

effect of question, with a critical value of .300. Subordinate recall did not vary significantly as a function of question condition.

A final significant effect in the overall analysis of indirect recall was the interaction of vocabulary and question as shown in Table 1. From the hierarchical regression analysis, a separate regression line equation for each question condition was derived. These are plotted in Figure 2. Visual inspection of the regression lines suggests that for subjects low in vocabulary ability recall in the high-question condition was greater than in the other two conditions, whereas the recall superiority of the high-question condition declined with increasing vocabulary ability to the point that recall was higher in the low-question condition for subjects with the highest vocabulary scores.

Insert Figure 2 about here.

To investigate the interaction, the subjects were divided into four groups on the basis of their vocabulary scores. One group consisted of those subjects scoring more than one standard deviation above the mean vocabulary score, another consisted of those scoring within one standard deviation above the mean, a third group contained those scoring within one standard deviation below the mean, and the fourth group contained those scoring more than one standard deviation below the mean. For each group, a one-way analysis of variance was conducted to assess the influence of question. To maintain the error probability for the set of four comparisons at .05, the significance level for each analysis was set at .0125. The effect of question did not approach significance for either of the two higher vocabulary groups, with $F(2,32) < 1$, $MS_e = 2.67$, and

$F(2,60) < 1$, $MS_e = 1.63$. For the subjects scoring within one standard deviation below the mean, the effect of question approached but did not reach significance, $F(2,74) = 2.93$, $p < .06$, $MS_e = 1.89$. The means for this group were 3.76, 3.00, and 3.34 (out of a total possible of 6), for the high, low, and no question conditions, respectively. The effect of question was significant for the group of subjects having the lowest vocabulary scores, $F(2,34) = 7.30$, $p < .003$, $MS_e = 2.06$. Recall in the high-question condition ($M = 3.89$) exceeded significantly recall in both the low-question condition ($M = 2.17$) and the no-question condition ($M = 2.50$) by Tukey's test, with a critical value of 1.18. The difference between the low-question and no-question conditions was not significant.

Indirect Superordinate Recall

A third set of analyses involved a control comparison designed to assess the relative indirect facilitative effect of a low-level question on the recall of the superordinate subtopic unit immediately above the questioned detail in the hierarchy. The prediction of a greater overall facilitative effect with high-level questions was based on the premise that high-level questions are more likely to lead to an effective encoding of the main organizational idea of the relevant topic cluster than are low-level questions; but, such a differential facilitation with high-level questions could also possibly be explained in terms of the greater number of sentences in the relevant topic cluster which contain information that partially matches that contained in the high-level, as opposed to the low-level, question. However, if the indirect facilitative effect of the question on a subtopic sentence, for example, is also dependent on the degree to which the question emphasizes the main topic idea of the passage segment

(see Figure 1), then the probability of recalling a subtopic unit partially matching a low-level question should be less than the probability of recalling a subtopic unit partially matching high-level question. In order to test this prediction, the frequency of recalls of subtopic units superordinate to a quizzed detail was calculated across the three passages for each participant. For comparison, from each topic cluster from which a high-level question was presented, one of the superordinate subtopic units not directly quizzed by the question was randomly selected for each subject to serve as a control, and the frequency of recall of these control units across the three passages was determined. These data were also submitted to multiple regression analysis. The between-subject analysis was the same as that described for the previous set of analyses. In the within-subject analysis, the main factor was that of question condition. Also included in the analysis were the interaction of vocabulary score and question condition and the interaction of extraversion score and question condition and the interaction of extraversion score and question condition.

In the regression analyses of the control comparison, the factor of question level accounted for a significant 3.88% of the variance, $\underline{F}(1,100) = 21.54$, $\underline{p} < .01$, $\underline{MS}_e = .367$. The significant effect of question level showed recall of a superordinate subtopic sentence to be greater when the adjunct question quizzed another subtopic sentence within that passage segment ($\underline{M} = 1.60$, out of a maximum possible of 3.00) than when the adjunct question quizzed a detail sentence beneath the target subtopic sentence in the hierarchy ($\underline{M} = 1.21$). The interaction of question level with each of the between-subject factors was not significant, both with $\underline{p} > .10$.

Recall from the Quizzed Subtopic Cluster

The final set of analyses compared the direct and indirect effects of high-level and low-level question on recall of information from the quizzed subtopic cluster. In one analysis, the frequency of recall of three types of superordinate subtopic sentences was compared. The three types of subtopic sentences compared were directly quizzed subtopic sentences, subtopic sentences superordinate to a directly quizzed detail, and subtopic sentences from topic clusters not quizzed by a question. The control subtopic sentence from the non-quizzed topic cluster of each passage was randomly selected for each subject. These data were also submitted to multiple-regression analysis. The between-subject analysis was the same as that described previously. In the within-subject analysis, the major factor was that of superordinate recall type. The contribution of the interaction of the within-subject factor with each of the between-subject factors to the variance explained was also assessed.

The means for the various types of recall from the quizzed subtopic cluster and from the non-quizzed control subtopic are shown in Table 3. First of all, in the analysis of superordinate recall, there was a strongly significant effect of recall type, accounting for 34.2% of the variance, $F(1,100) = 274.05$, $p < .01$, $MS_e = .384$. Recall of directly quizzed superordinate units exceeded significantly both recall of superordinate units from non-quizzed passage segments and recall of units superordinate to quizzed details, by Tukey's test with a critical value of .207. Units superordinate to quizzed details were significantly better recalled than superordinate units from non-quizzed passage segments. The proportion of

variance explained by interactions of the within-subject and between-subject factors was not significant, both p's > .25.

Insert Table 3 about here.

For the purpose of two further analyses of recall from the quizzed subtopic cluster, the subordinate units were classified into two groups. One group contained those detail sentences from which adjunct questions were derived, and the other group contained those detail sentences which were never directly quizzed by a question. Within the first group, the three types of possible subordinate recall were recall of units directly quizzed, recall of units subordinate to a directly quizzed high-level unit, and recall of subordinate control units from non-quizzed passage segments. Within the second group, the three types of possible subordinate recall were recall of units from a subtopic cluster from which another detail was directly quizzed, recall of units subordinate to a directly quizzed superordinate unit, and recall of subordinate control units from non-quizzed passage segments. In those situations in which there was more than one possible choice of item for a given classification type, the selection was made on a random basis. Multiple regression analysis was performed separately on the data of the two subordinate recall groupings. The three-level within-subject factor in each analysis was recall type.

In the analyses of the recall of details from which questions were derived, the factor of recall type was also highly significant, accounting for 36.72% of the variance, $F(1,100) = 348.63$, $p < .01$, $MS_e = .324$. Recall of directly quizzed details was significantly greater than both recall of details from non-quizzed passage segments and recall of details

subordinate to quizzed high-level units, by Tukey's test with a critical value of .190. The superiority in recall of details subordinate to quizzed high-level units over details from non-quizzed passage segments was also significant. Neither the interaction of vocabulary and recall type nor the interaction of extraversion and recall type reached significance, both p's > .25.

The percentage of variance explained by recall type, 4.01, was smaller in the analyses of recall of details not directly involved in questions, but the factor was still significant, $F(1,100) = 25.21$, $p < .01$, $MS_e = .501$. Recall of details subordinate to directly quizzed high-level units exceeded significantly details from non-quizzed passage segments, by Tukey's test with a critical value of .237, but failed to exceed significantly recall of details from subtopic clusters containing another directly quizzed detail. The superiority in recall of details from a subtopic cluster containing another directly quizzed detail over recall of details from non-quizzed passage segments also failed to reach significance. The interaction of vocabulary and recall type was not significant, and the interaction of extraversion and recall type also failed to reach significance, both p's > .25.

Discussion

The indirect recall results clearly indicate a differential effect of pre-passage question type. As was predicted, indirect recall was higher for passage segments containing information relevant to high-level questions than for segments containing information relevant to low-level questions. This result is explicable in terms of the role that superordinate passage segments play in the organization and recall of passage material.

In particular, if retrieval of passage information proceeds in a hierarchical fashion from the highest to the lowest levels of the organizational structure, then increasing the memorability of superordinate elements in a segment of a passage should facilitate the indirect recall of information from that passage segment to a greater extent than should increasing the memorability of subordinate elements in a passage segment. The mechanism whereby high-level questions increase the memorability of superordinate elements of a passage segment cannot be definitively characterized on the basis of the results of this experiment. However, one possible explanation of the increased memorability is that high-level questions result in more processing time being devoted to the superordinate elements of the passage segment relevant to the question. This increased processing time for superordinate elements would be a product of the great amount of semantic overlap between the information contained in the high-level question and the information in the superordinate elements. This assumption is consistent with the evidence cited earlier of a strong relationship between superior memory for text information relevant to adjunct questions and increased processing time for those text segments (Reynolds & Anderson, in press; Reynolds, Standiford, & Anderson, 1979).

It is important to stress here that high-level questions are assumed to have the greater facilitative effects observed partly because of the type of passage sentences which they emphasize and not solely because they emphasize a potentially larger number of sentences. As the control comparison involving indirect superordinate recall showed, the recall of a subtopic unit superordinate to a quizzed detail, and thus partially matching the low-level question, was significantly less likely than the recall of

a superordinate subtopic unit partially matching a high-level question based on another subtopic unit from the same segment. This result supports the suggestion that part of the greater facilitative effect of high-level questions is due to their emphasizing more the central organizational idea (i.e., the main topic) of the passage segment, as the basis for the subsequent retrieval of the information in the segment. That is, indirect recall of superordinate subtopics in the high-question condition is seen to benefit both from the emphasis which the subtopic units receive when they partially match the high-level question and from the emphasis which the high-level question gives to the main topic of the segment (see Figure 1).

Further support for the greater facilitation effect of high-level questions comes from the analyses of recall from the quizzed subtopic. In both analyses of subordinate recall, recall of a detail from a subtopic cluster quizzed by a high-question was greater than recall of a detail from a subtopic in the no-question control segment. At the same time, the results for the recall of quizzed subtopic information also provide some evidence of a facilitative effect of low-level questions. Recall of a subtopic unit superordinate to a quizzed detail was significantly greater than recall of a superordinate unit from the no-question control segment. However, this facilitating effect of low-level questions was very limited in scope and, as shown in the analysis of overall indirect recall, did not extend beyond the quizzed subtopic unit.

The interaction of question and vocabulary ability found in the analysis of overall indirect recall is consistent with earlier research summarized by Rickards and Denner (1978). The greater the verbal ability

of a subject, the less likely it is that processing aids such as high-level questions will facilitate performance. The reduced effect of the high-level question condition for higher-vocabulary subjects in this experiment may reflect both the greater tendency of higher-ability subjects to use spontaneously the organizational structure of the passage (Meyer, 1979; Meyer, Brandt, & Bluth, 1980) and the greater amount of excess capacity which higher-ability subjects have for effectively encoding non-quizzed information (Hunt, 1978). Conversely, the results from this interaction show the benefit which lower-ability subjects derive from high-level questions. Thus, whether the attention-focusing effects of pre-passage questions will be beneficial or harmful for lower-ability subjects apparently depends on the organizational importance of the information highlighted by the question.

The factor of extraversion did not interact significantly with any of the within-subject factors in the various analyses reported. Thus, no evidence was found to support the suggestion (Riding & Parker, 1979) that introverts may be less sensitive to the structural importance of passage information than are extraverts.

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Table 1

Summary of Regression Analyses for Overall Indirect Recall

Factor	Specified Order of Entry	Percentage Variance Explained	F	MS_e	p
Between-Subject[a]					
Vocabulary	1	9.0	10.13	.910	<.01
Extraversion	2	2.5	2.84	.885	<.10
Vocabulary x Extraversion	3	0.8	0.95	.876	>.25
Within-Subject					
Recall Level	1	5.5	76.31	.448	<.01
Question	2	2.3	32.41	.448	<.01
Recall Level x Question	3	2.7	37.39	.448	<.01
Vocabulary x Recall Level	7[b]	0.1	0.37	.448	>.25
Extraversion x Recall Level	8	0.1	0.28	.448	>.25
Vocabulary x Extraversion x Recall Level	9	0.1	0.42	.448	>.25
Vocabulary x Question	10	1.3	6.19	.448	<.05
Extraversion x Question	11	0.4	1.94	.448	<.25
Vocabulary x Extraversion x Question	12	0.1	0.42	.448	>.25

Note. The degrees of freedom for all tests were 1/103.

[a]The between-subject and the within-subject analyses were performed separately.

[b]Not shown here are the between-subject factors, which were entered in the within-subject regression as variables 4, 5, and 6 (see Cohen & Cohen, 1975, chapter 10).

Table 2

Mean Number of Overall Indirect Recalls

Recall Level	Question Condition			
	High	Low	No	Combined
Superordinate	2.38 (0.86)[a]	1.76 (1.05)	1.65 (0.93)	1.93
Subordinate	1.44 (0.98)	1.38 (0.97)	1.51 (1.07)	1.45
Combined	1.91	1.57	1.58	

Note. The maximum possible total score was 3.00.

[a]The numbers in parentheses are standard deviations.

Table 3

Mean Number of Recalls from the Quizzed Subtopic and the Non-quizzed Control Subtopic

Superordinate Recall	
Units directly quizzed	2.42 (0.71)[a]
Units superordinate to quizzed details	1.23 (0.94)
Units from non-quizzed control subtopics	1.00 (0.95)
Subordinate Recall--units from which questions were derived	
Units directly quizzed	1.93 (0.88)
Units subordinate to quizzed superordinate units	0.87 (0.81)
Units from non-quizzed control subtopics	0.51 (0.68)
Subordinate Recall--units not directly involved in questions	
Units from subtopics containing a directly quizzed detail	0.78 (0.82)
Units subordinate to quizzed superordinate units	0.99 (0.85)
Units from non-quizzed control subtopics	0.59 (0.73)

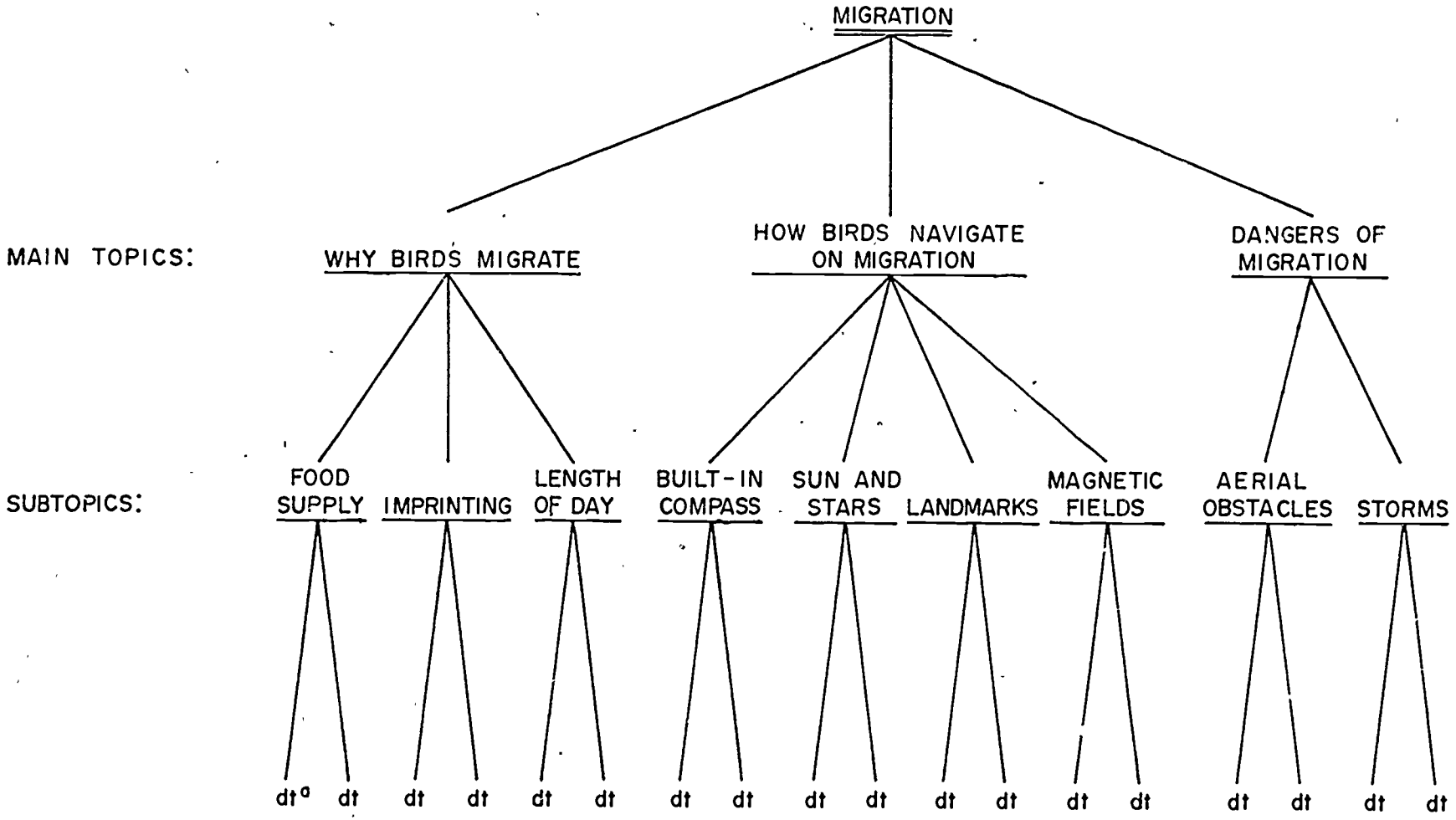
Note. The maximum total possible score was 3.00.

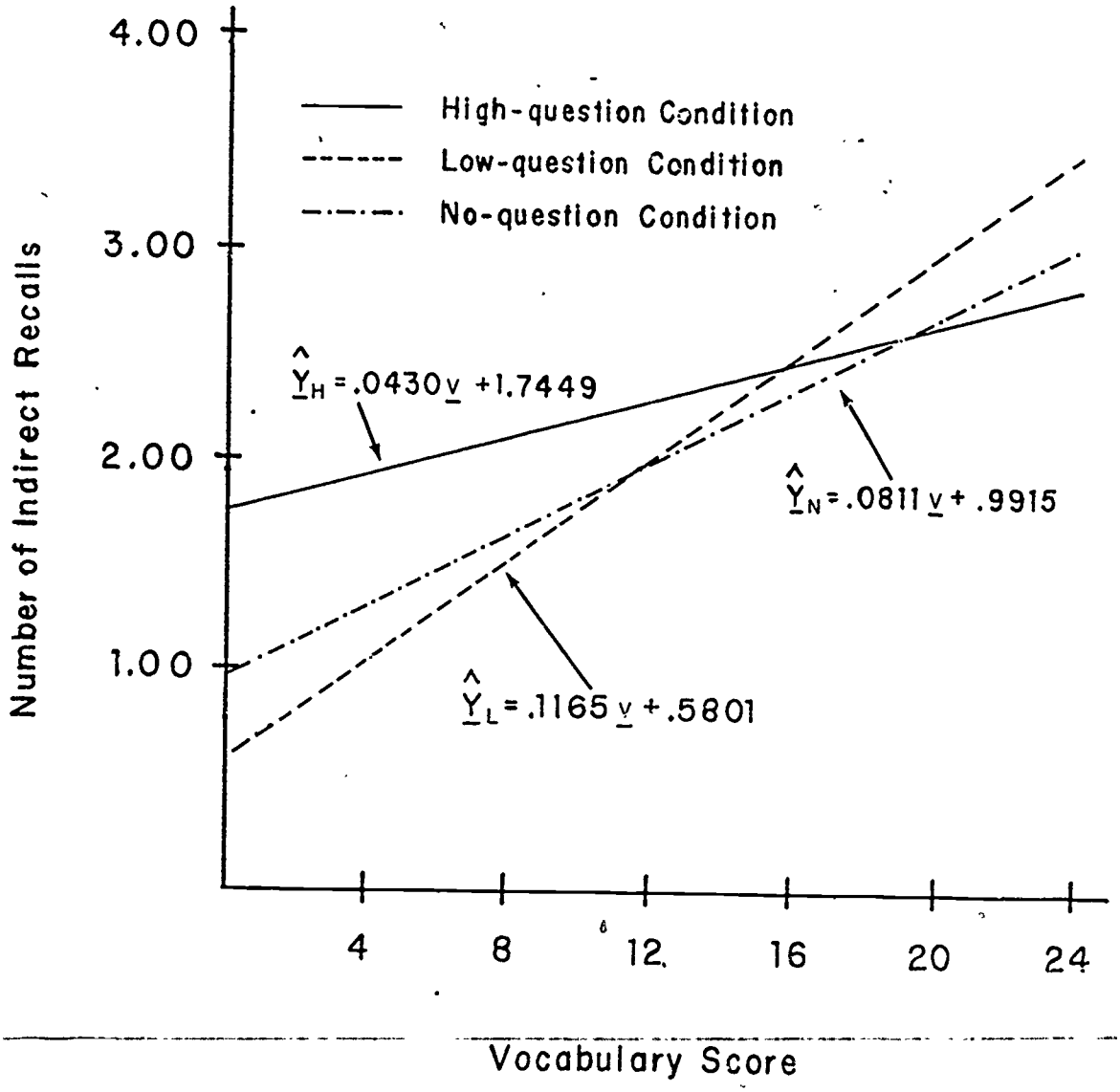
[a]The numbers in parentheses are standard deviations.

Figure Captions

Figure 1. The hierarchical representation of one of the three passages read.

Figure 2. Number of indirect recalls as a function of vocabulary score and question condition.


MIGRATION
MAIN TOPICS:
WHY BIRDS MIGRATE
HOW BIRDS NAVIGATE ON MIGRATION
DANGERS OF MIGRATION
SUBTOPICS:
FOOD SUPPLY
IMPRINTING
LENGTH OF DAY
BUILT-IN COMPASS
SUN AND STARS
LANDMARKS
MAGNETIC FIELDS
AERIAL OBSTACLES
STORMS
dt[a]
dt = detail


4.00
3.00
2.00
1.00
Number of Indirect Recalls
High-question Condition
Low-question Condition
No-question Condition
$\hat{Y}_H = .0430\underline{v} + 1.7449$
$\hat{Y}_N = .0811\underline{v} + .9915$
$\hat{Y}_L = .1165\underline{v} + .5801$
4
8
12
16
20
24
Vocabulary Score