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The Effects of Two Study Methods on Memory

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U. S. Army

Research Institute for the Behavioral and Social Sciences

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Although organizational theory and the depth of processing framework have had considerable influence on memory research, there has been little effort directed toward integrating the ideas of these two approaches. The present research focuses on this issue in an investigation of how relational (organizational approach) and item-specific (depth of processing approach) semantic processing affect recall and recognition memory. The major finding in three experiments was that optimal recall performance is associated with relational semantic
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20. Abstract (continued)

processing whereas optimal recognition performance is associated with item-specific semantic processing. Additional findings were that recall advantages following relational processing hold only for an immediate test of memory; that recognition advantages following item-specific processing are associated with slow retrieval-based recognition responses and not with fast, familiarity-based responses; and that semantic confusion errors in recognition are reduced by item-specific semantic processing. Overall, these results suggest that performance on tests involving the reconstruction of study list materials (e.g., recall) can benefit from organization of these materials during study. Performance on tests that do not require extensive constructive processes do not benefit from organizational processing during study, but may be enhanced by extensive semantic processing for individual study list items.

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The Effects of Two Study Methods on Memory

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FOREWORD

The research described in this technical report was conducted by the Instructional Technology Systems Technical Area under the research task titled "Designing Strategies for Basic Skills Development" (currently Improving Thinking, Problem-Solving, and Communication Skills for Combat Arms Operations). This task, which is part of ARI's Train the Force program area, focuses on identifying and developing learning strategies and training programs that aid soldiers in acquiring and retaining the cognitive skills and knowledge required for effective performance of military jobs.

This report describes how two methods of study, each involving processing the meaning of study materials, can differentially affect memory performance. Since processing the meaning of study materials is a fundamental aspect of any effective learning strategy, the results of this research have major implications for how learning strategies and training programs are designed for military jobs that involve significant use of mnemonic skills.

EDGAR M. JOHNSON
Technical Director

THE EFFECTS OF TWO STUDY METHODS ON MEMORY

EXECUTIVE SUMMARY

Requirement:

The requirement was to compare the effect on recall and recognition memory of two study methods, one involving semantic processing for individual words in a study list and one involving organizational processing for several words in the list.

Procedure:

Three experiments were conducted. The first experiment investigated whether awareness of a subsequent memory test interacted with item-specific and organizational semantic processing to produce differential levels of performance in recall and recognition following the two types of processing. The second experiment determined whether differential levels of performance in these two tests following the two types of processing would be observed with both immediate and delayed tests of memory. Finally, the third experiment assessed whether item-specific and organizational semantic processing led to different types of confusion errors in a test of recognition memory.

Findings:

The results consistently indicated that whereas optimal recall performance was produced by organizational processing of study list items, optimal recognition was produced by item-specific processing. This basic finding was observed under incidental and intentional learning conditions in Experiment 1, for immediate and delayed recognition, and immediate recall tests in Experiment 2, and in the immediate recognition test in Experiment 3. Moreover, item-specific processing produced far fewer semantic confusion errors in Experiment 3 than organizational processing. Overall, these results indicate that optimal performance on memory tests involving the self-generated reconstruction of original study materials (e.g., recall) may require study methods involving organizational strategies that link concepts in these materials. In contrast, optimal performance on tests involving the representation of some aspect of the original study materials (e.g., recognition) may require only that the meaning of individual concepts be thoroughly processed.

Utilization of Findings:

These findings increase our understanding of the fundamental cognitive components involved in learning and memory. This information will therefore be

of considerable interest to researchers in both the academic and military communities who are interested in basic issues in the effective acquisition and retention of skills and knowledge. More important, however, this information has direct bearing on the development of learning strategies and training programs that can enhance performance for military jobs that involve a significant memorial component.

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THE EFFECTS OF TWO STUDY METHODS ON MEMORY

INTRODUCTION

How to promote effective learning and skill retention for military job skills is one of the most difficult problems facing Army trainers. One approach to solving this problem has been the development of special training programs that teach soldiers how to learn. These programs have often transformed poor learners into motivated high achievers who quickly acquire military job skills and retain them longer. The report that follows describes research that was conducted to investigate the underlying memorial processes involved in effective learning and retention. The results show that two methods of study, each involving processing the meaning of study materials, can have different effects on memory performance. Since processing meaning is a fundamental activity for effective learning, this research has major implications for how training programs to promote better learning of military jobs should be designed.

Background Literature

Organizational theory and, more recently, the levels of processing framework have had considerable influence on current thought in memory research. It is somewhat surprising therefore that little effort has been directed at integrating the ideas of these two approaches. One reason for the lack of interest in this task seems to be that research within the organizational approach was abandoned as researchers began to focus on the novel idea of levels of processing (Battig & Bellezza, 1979). The clear relationship between increasing semantic elaboration, a notion that grew out of the levels approach, and successful memory performance led researchers to study ways to produce optimal processing for individual items rather than relational processing between list items. This trend away from the study of organizational processes is reflected in the statement from an influential paper on elaboration in episodic memory that "... it now becomes possible to entertain the hypothesis that optimal processing of individual words, qua individual words is sufficient to support good recall" (Craik & Tulving, 1975, p. 270). Another reason for the lack of research directed at integrating these two approaches was the ease with which the broadly defined notion of levels of processing and elaboration could account for organizational effects in memory; i.e., organization is simply deeper, more elaborate processing. In a series of recent studies, however, Hunt and Einstein (1981; Einstein & Hunt, 1980) have pointed out that the organizational and elaboration approaches are conceptually distinctive and, further, that organization should not be reduced to a special case of elaboration.

The organizational approach holds that relational information is critical for successful retrieval. Categorized or associatively related word lists are often used to promote encoding of this type of information because the inherent structure of these lists emphasizes processing the overlapping or common features of target items. Likewise, mnemonic strategies, such as creating a story (Bellezza, Cheesman, & Reddy, 1977) or categories (Mandler, Pearlstone, & Koopmans, 1969) for unrelated list items can also be used to promote relational processing by inducing subjects to form meaningful relations between items. This type of processing produces a unitized memory representation for the items in a study list (Mandler, 1967, 1979).

The elaboration approach, in contrast, suggests that optimal retrieval performance is produced by extensive semantic processing for the individual item (Craik & Tulving, 1975; Hyde & Jenkins, 1973; Lockhart, Craik, & Jacoby, 1976). Elaborative processing is typically induced by orienting tasks, such as rating item pleasantness or fitting the item into a sentence frame, that increase attention to the semantic features of the item. Extensive semantic elaboration is thought to produce a distinctive memory representation (Lockhart et al., 1976), where distinctiveness is defined as a function of the number of item features that do not overlap with those of other items in memory (Eysenck, 1979; Jacoby, Craik, & Begg, 1979). From this viewpoint, elaboration differs from organization in that it focuses on unique or distinctive item features rather than on shared or common features (Hunt & Einstein, 1981).

The elaboration approach does not address the issue of possible memory differences arising from differences in item-specific and relational semantic processing. A number of recent studies, however, suggest that a consideration of these differences may provide important information about retrieval processes. Bellezza and his colleagues (Bellezza, Richards, & Geiselman, 1976; Bellezza et al., 1977) have shown, for example, that once a certain amount of item-specific semantic processing for an item has occurred, additional semantic elaboration for that item has little effect on recall. On the other hand, organizing list items using an alphabetic or story mnemonic leads to further increases in performance. These findings suggest that item-specific semantic processing does not, by itself, produce optimal retrieval performance. Superior performance can be achieved, however, by item-specific processing followed by relational processing (Bellezza et al., 1976; 1977).

This additive model of semantic processing has received further support from an experiment conducted by Einstein and Hunt (1980; Exp. 2). In this experiment, subjects performed an item-specific semantic orienting task (pleasantness rating) or a relational semantic orienting task (sort items into semantic categories) on a list composed of either categorically related words or unrelated words. The highest levels of recall were produced by relational processing of unrelated lists and item-specific processing of related lists. According to the authors (Einstein & Hunt, 1980), this was due to the additive effect of information provided by list structure and information produced during processing for the orienting task. Information produced by the relational orienting task or the related study list defines the general class of information in memory from which to-be-remembered (TBR) items can be reconstructed; information produced by the unrelated study list or the item-specific orienting task aids in the retrieval of individual items within this general class (Hunt & Einstein, 1981). Both types of information are necessary for successful recall.

A second issue raised by the studies of Bellezza et al., (1977) and Einstein and Hunt (1980) is the question of whether a distinction between item-specific and relational semantic processing is necessary. It could be argued that any distinction between these two types of processing is relatively artificial since some item-specific semantic processing must also occur during relational semantic processing (Bellezza et al., 1977). Moreover, semantic elaboration can be defined in a way that encompasses both item-specific processing and relational processing. Mandler (1980), for example, has suggested that elaboration involves the formation of relationships between study list items as well as relationships between a single list item and associated items in memory. Nonetheless, if these two types of semantic processing can be shown to have different effects on different measures of memory, then a functional distinction is a valid consideration. This issue was addressed by Hunt and Einstein (1981) in an extension of their earlier work (Einstein & Hunt, 1980). Subjects again received related or unrelated study lists and were instructed to perform item-specific or relational semantic orienting tasks on these lists. The recall scores paralleled those from their earlier study in showing that optimal performance was produced by the combination of item-specific and relational processing for items. In contrast, scores for a recognition test given after recall indicated that item-specific processing produced higher levels of recognition for both related and unrelated lists. Because simple recognition relies more on distinguishing list items from extralist items than on the reconstruction of list items, item-specific semantic information may be of greater importance than relational semantic information in this task (Hunt & Einstein, 1981; Jacoby et al., 1979).

The present research was conducted to obtain additional information on whether item-specific and relational semantic information serve different purposes at retrieval. Three experiments were conducted. In the first experiment, scores for recall and recognition were examined following performance under both incidental and intentional learning conditions of a relational semantic orienting task, an item-specific semantic orienting task, and a physical orienting task. To have greater control over the amount of relational processing that could occur, the three tasks were performed on lists of unrelated words. The major question of interest in this experiment was whether the pattern of results for recall and recognition obtained by Hunt and Einstein (1981) could be replicated under both intentional and incidental learning conditions (Hunt and Einstein examined only during incidental learning) using different item-specific and relational semantic orienting tasks. Similar recall and recognition results would establish the generality of differences in the function of these two types of semantic information during retrieval.

Identical item-specific and relational semantic orienting tasks were used in Experiment 2. In this experiment, however, the tasks were performed under only the incidental learning condition. Hunt and Einstein (1981) have suggested that relational information may decay less rapidly than item-specific information. To investigate this possibility, recall and recognition tests in the second experiment were given either immediately or after a delay. In addition, recognition decision latencies for target and distractor items were examined to determine whether functional differences for the two types of information occur for both retrieval-based and familiarity-based recognition responses (c.f. Mandler, 1980). The logic of this approach rests on the assumption that a fast response occurs when a recognition decision is based on an assessment of item familiarity whereas a slow response occurs when the decision is based on the retrieval of an item's original encoding context (Atkinson & Juola, 1974; Mandler, 1980). Prior research (Bellezza et al., 1977; Hunt & Einstein, 1981) has not been clear on whether differences for item-specific and relational semantic information are restricted to retrieval processes in recognition. The present study investigates the possibility that the two types of processing also produce differences in familiarity-based recognition.

The third experiment was conducted to determine whether item-specific and relational semantic processing produce different types of recognition errors. There is some evidence that relational processing produces high false alarm rates for categorically related distractor items and that item-specific processing can reduce these rates (Einstein & Hunt, 1980). This suggests that relational information that serves only to highlight a general class of items in memory (Hunt & Einstein, 1981) may not allow targets to be distinguished from semantically related distractors. In contrast, the more precise item-specific information enhances the ability to discriminate between these items. This issue has not been examined systematically for relational processing of unrelated items. Therefore, in the third experiment recognition tests given after the performance of relational and item-specific semantic orienting tasks and a physical orienting task contained the original target items plus distractor items that were semantically or phonetically related to target items.

EXPERIMENT 1

To establish whether the differential effects of item-specific and relational semantic information observed in previous studies (Einstein & Hunt, 1980; Hunt & Einstein, 1981) generalize to other tasks and contexts, the present study employed different item-specific and relational semantic orienting tasks, and these tasks were performed under both intentional and incidental learning conditions. The item-specific orienting task was to decide whether list items had a primarily pleasant or unpleasant meaning; the relational task was to decide whether the current list item could be meaningfully related to any list item presented previously. A physical orienting task, which involved deciding whether an item contained the letter "A" or the letter "O," was also included to provide a measure of performance against which to assess the general benefit in retrieval from semantic processing.

In accordance with Hunt and Einstein (1981), it was expected that directing attention to shared features of target items would produce a qualitatively different type of information than would directing attention to their unique features. It was further assumed that these two types of information would serve different purposes at retrieval. Although retrieval processes in both recall and recognition generally benefit from semantic information (Craik & Tulving, 1975), the type of semantic information that is optimal for recognition may differ from that which is optimal for recall. Recall relies more on information that guides the search for previously presented items and serves a generative or reconstructive function; recognition requires information that respecifies the context in which an item was previously encountered and serves a discriminative function (Eysenck, 1979; Hunt & Einstein, 1981; Jacoby et al., 1979; Tulving, 1983). It was expected therefore that while both recall and recognition would be higher following the two semantic orienting tasks than following the physical orienting task, the relational orienting task would provide the greatest benefits in recall whereas the item-specific orienting task would provide the greatest benefits in recognition.

Comparing retrieval performance following the three orienting tasks under both intentional and incidental learning conditions should further establish the generality of retrieval differences for the two types of semantic information. While differences in relational and item-specific semantic processing have been demonstrated under incidental learning conditions (Einstein & Hunt, 1980; Hunt

& Einstein, 1981), it remains to be seen whether this effect will hold under intentional learning conditions. Some studies have shown that intention to learn adds little to retrieval performance following semantic processing. For example, Mandler (1967) found identical levels of recall for incidental and intentional learning groups that performed the same semantic orienting task. Other studies have shown, however, that in certain cases intention to learn can eliminate the typical recall advantage of semantic orienting tasks over physical tasks (McDaniel & Masson, 1977). It is expected, therefore, that in the present study intention to learn may provide some benefit at retrieval for the physical orienting task and therefore reduce the differences in memory performance following semantic and physical orienting tasks. The pattern of retrieval results for the two semantic tasks is nevertheless expected to be preserved under both learning conditions. It should be emphasized, however, that it is not the intention of this experiment to address the issue of differences in intentional and incidental learning or what the mechanism underlying such differences may be. Rather, the manipulation of test expectancy is designed to establish the generality of differences between relational and item-specific semantic processing when a test is expected and when it is not. If these differences are observed under various learning conditions, a stronger case can be made for a distinction in the functions of the two types of semantic information at retrieval.

Method

Design and materials. Two types of learning instructions (intentional vs. incidental), two types of retrieval (recall vs. recognition), and three orienting tasks (physical vs. item-specific, semantic vs. relational semantic) were crossed to produce a 2x2x3 mixed factorial design. Learning instructions and retrieval type were between-group factors; orienting task was a within-group factor. Subjects within each of the four groups represented by the combination of learning instructions and retrieval type (intentional recall, incidental recall, intentional recognition, incidental recognition) performed all three orienting tasks. Presentation order for the orienting tasks was counterbalanced within each group.

A 60-item study list was created using common words with six to eight letters containing either an "O" or an "A," but not both letters. These words were randomly selected from the pool of words with these characteristics that occurred 100 or more times per 1,000,000 words in the Thorndike-Lorge (1944) word count. This list was divided into three blocks of 20 words. In addition, a 15-item practice list was obtained from the same word pool and was divided into three blocks of five words. For each subject, a block of words was associated with only one orienting task; across the subjects in each group, a block of words was associated equally often with each orienting task. There were two random orders for the study list.

The 60 target items and an equal number of unrelated distractor items were randomly arranged in a recognition test booklet with the restriction that the first and the last three words in any block of words in the study list did not occur in the first or last five positions of the test booklet. The 60 distractor items for the recognition test booklet were high-frequency words containing either an "O" or an "A." These items were chosen from the same word pool as the target items. A second recognition test booklet was created using a different random order for target and distractor items.

Procedure. Subjects were tested individually and were informed at the beginning of the session that the purpose of the experiment was to study how people comprehend words. The subjects were then instructed in the performance of the three orienting tasks. For the physical orienting task, they were asked to determine whether list words appearing on a video monitor screen contained the letter "A" or the letter "O." For the item-specific semantic orienting task they were asked to determine whether each study word had a pleasant or unpleasant meaning. For the relational semantic orienting task, they were instructed to determine whether the current list word appearing on the video screen could be related in a meaningful way to any previously presented word or words. Responses for each of these orienting tasks were made by pushing one of two black buttons on a response console following the appearance of a + on the video screen. The two black buttons were labeled with the decision alternatives for the current orienting task (O or A, Pleasant or Unpleasant, Related or Unrelated). Subjects were asked to make this response with the index or middle finger of their nondominant hand.

Following these instructions, the subjects in the two intentional learning conditions were told the type of retrieval test they could expect following the performance of the three orienting tasks. Those in the recall condition were told to expect a recall test for the list items and those in the recognition condition were told to expect a recognition test. Subjects in the incidental learning conditions were given no information concerning their retrieval test at this time.

Before the presentation of the words in each block of the practice and study lists, the instructions for the orienting task for that block were displayed on the video screen for two seconds. A warning signal (asterisk) appeared prior to the presentation of each word in a block. The warning signal appeared in the same location as the words and was replaced with a blank screen after 500 milliseconds. The signal indicated the occurrence of a new word and warned the subject to focus attention on the video screen. Five hundred milliseconds after signal offset, the word appeared on the screen and remained in sight for 500 milliseconds. Four seconds after word offset, the orienting task signal (+) appeared and remained on the screen for 500 milliseconds. An 8-second interval intervened between word offset and the warning signal for the next word.

To acquaint subjects with the procedure, they were first required to perform the three orienting tasks on the practice list. After the presentation of this list, subjects in the intentional recall and recognition conditions performed a 5-minute distractor task consisting of circling specified digits in a table of three-digit numbers and were then given 10 minutes to complete their respective recall or recognition test. Those in the incidental learning conditions did not receive a test at this time. These subjects proceeded to the next procedure in the session after an interval approximately equal to that required for the performance of the distractor task and retrieval test in the two intentional conditions.

The presentation of the three blocks of words in the study list followed the presentation and retrieval of the practice list. After presentation of the study list all subjects performed the 5-minute distractor task. Subjects in the intentional recall condition were given 15 minutes to recall the words presented in the study list. Those in the intentional recognition condition were given an equal amount of time to perform a YES/NO recognition judgment for the items in the recognition test booklet. Subjects in the incidental recall and recognition conditions were given an equal amount of time to complete an unexpected recall or recognition test.

Subjects. Seventy-two students from an introductory psychology course at George Washington University received course credit for participating in this experiment. Eighteen subjects were randomly assigned to each of the four conditions.

Results and Discussion

Separate analyses were performed for the recall and recognition data. Mean recall proportions and recognition hit rates[1] for each orienting task in the intentional and incidental learning conditions can be found in Table 1. Unless otherwise indicated, all effects reported as reliable in this data and in the data of all subsequent experiments reached a level of at least $p < .05$.

Recall. A 2 (learning instructions) x 3 (orienting task) mixed factorial ANOVA for recall proportions revealed main effects of learning instructions, $F(1,34) = 4.56$, $MSe = .025$ and orienting task, $F(2,68) = 55.27$, $MSe = .013$. The interaction between intention to learn and orienting task was not significant, $F(2,68) < 1$. Thus, knowledge of the retrieval test produced higher recall scores, yet differences in performance associated with the three orienting tasks were the same whether or not a test was expected. Comparisons of orienting task means (Tukey a, Winer, 1971) collapsed across learning instructions indicated that both semantic orienting tasks produced better recall than the physical orienting task ($d_T = .06$). This result agrees with previous research (e.g., Craik & Tulving, 1975; Hyde & Jenkins, 1973) in showing that semantic processing produces better recall performance than physical processing. Relational semantic processing, however, produced higher recall than item-specific semantic processing. This suggests that semantic processing involving the formation of relationships between list items may be more useful in recall than processing the unique semantic features of individual items.

Recognition. A 2 (learning instructions) x 3 (orienting task) mixed factorial ANOVA for the recognition data revealed that, in contrast to recall, there was no effect of learning instructions, $F(1,34) < 1$, $MSe = .032$. Recognition performance was not increased by knowledge of the subsequent test. There was a substantial effect of orienting task, $F(2,68) = 130.48$, $MSe = .017$, however, showing that the three tasks produced differences in recognition. Finally, the absence of an instruction by task interaction, $F(2,68) = 1.58$, indicated that similar orienting task differences were present under both learning conditions.

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[1]Due to the within-subject design of this experiment, recognition scores following each task for distractor items could not be compared. Therefore, only recognition hit rates were analyzed.

Table 1

Mean Recall and Recognition Hit Rates as a Function of Learning Instructions and Orienting Task

		Orienting Task		
Test	Instructions	Physical	Item-Specific	Relational
Recall	Incidental	.05	.29	.33
	Intentional	.15	.32	.40
Recognition	Incidental	.42	.95	.85
	Intentional	.51	.95	.84

Comparisons of the orienting task means (Tukey a, Winer, 1971) collapsed across learning instructions indicated that, in agreement with the recall results, both the item-specific and relational semantic orienting tasks produced higher recognition than the physical orienting task (d_T = .07). In contrast to recall, however, item-specific processing led to much better recognition than relational processing. Focusing on the unique semantic features of each list item apparently produced better recognition than focusing on the common features of several items.

Two findings emerge from the analysis of the retrieval results in this experiment. First, intentional recognition instructions induce processing operations that add little to the information produced by the orienting tasks or, alternately, the additional information that is produced is of little use in the recognition test. Intentional recall instructions, on the other hand, seem to induce encoding processes beyond those of the orienting tasks. The encoding processes that are responsible for the effect of intention to learn are not known. Some researchers have claimed that intention to learn does not induce additional organization of list items, but may involve additional item-specific processing (Neely & Balota, 1981) or rehearsal (McDaniel & Masson, 1977). In accordance with this claim, it is unlikely that knowledge of the recall test led to additional organizational or relational processing for list items in the present experiment. Organizational processing, if present, should provide greater retrieval benefits in recall when combined with the item-specific orienting task than when combined with the relational task (c.f. Hunt & Einstein, 1981). This finding was not observed. In fact, differences between the means for intentional and incidental conditions were somewhat greater following the relational (.07) orienting task than following the item-specific task (.03). Perhaps the benefit in memory from knowledge of the recall test was due to additional rehearsal of the information produced by the orienting tasks.

The second, more important, finding is that under both intentional and incidental learning conditions recall is better following relational semantic processing, whereas recognition is better following item-specific processing. These results are consistent with those of Hunt & Einstein (1981; Einstein & Hunt, 1980) and, likewise, suggest that the information produced by item-specific processing supports different retrieval processes than the information produced by relational processing. Recall is better following encoding operations that focus on the semantic features shared by list items. These operations may integrate several study list items into a unitized memory representation (Mandler & Bock, 1974; Hunt & Einstein, 1981) thereby producing information that can guide reconstructive processes for these items. In contrast to recall, recognition is better following encoding operations that focus on the semantic features of the individual item. Processing individual item semantic features may lead to a more detailed or distinctive memory representation for items in the study list (Hunt & Einstein, 1981), thereby producing information that is useful in retrieving the original encoding context for these items.

This experiment provides support for the notion of functional differences at retrieval for item-specific and relational semantic information. However, there were two problems with the experiment that weaken this argument. First, an examination of the means for the intentional and incidental recall groups suggests that differences in overall recall performance following the two semantic tasks may be due largely to differences in the intentional learning condition. Second, because orienting task was a within-subjects factor with all tasks performed in one session, real differences between these tasks may have been minimized by carryover of processing from one task to another. Moreover, due to this design, it was not possible to compare recognition scores for extralist distractor items for each orienting task. In the second experiment these problems were eliminated and several additional issues concerning functional differences between item-specific and relational information were examined.

EXPERIMENT 2

In this experiment, subjects performed either the item-specific semantic orienting task or the relational semantic orienting task, and afterwards, were given an immediate or delayed recall or recognition test. They were unaware that this test would be given. A number of questions were addressed in this experiment. First was whether the recall results observed in Experiment 1 could be replicated under incidental learning conditions with orienting task as a between-subjects factor. If recall is again higher following relational semantic processing than item-specific semantic processing, then this effect can clearly be attributed to differences in the information produced by the two semantic orienting tasks and not to the combined effects of the task and the expectancy of a recall test.

A second question was whether differences between item-specific and relational processing would be present on delayed recall and recognition tests. There is currently little empirical evidence upon which to base a prediction of the effect of these two types of semantic processing on delayed retrieval. McDaniel and Masson (1977, Exp. 2) have reported, however, that the level of delayed recall for related list items is associated with the amount of clustering for list items. On the basis of this finding, it might be expected that the relational semantic task would produce better delayed recall performance than the item-specific task. However, because categorically related word lists were used in this study the results may not generalize to the unrelated word lists used in the present study. In the case of categorical relationships, the associations between list items are well established in semantic memory and are likely to be quite durable; the relationships formed between unrelated items, however, are novel and may be highly idiosyncratic. Consequently, these relationships are less well established in semantic memory, and unless rehearsed, are probably quite transient. If so, relational semantic processing may lead to enhanced recall for an immediate test, but not for a delayed test. Moreover, if recognition is less dependent upon the presence of interitem relationships, relational processing should have little effect on performance for either immediate or delayed recognition.

Finally, it has been assumed that functional differences for item-specific and relational information are restricted to retrieval processes that occur during recall and recognition. According to Mandler (1979, 1980), however, there may be two bases for recognition responses. These responses can be made using information that leads to the retrieval of list context or, alternately they can be context-free, using familiarity or occurrence information. An interesting question is whether the differences observed in recognition following item-specific and relational semantic processing are due solely to differences in retrieval-based recognition or whether these two tasks produce differences in familiarity-based recognition as well.

To determine whether the recognition results following item-specific and relational semantic processing were similar for familiarity-based and retrieval-based recognition decisions, recognition hit and correct rejection rates for the two semantic processing tasks were analyzed as a function of decision latency. Several researchers (Atkinson & Juola, 1974; Mandler, 1980; Mandler & Boek, 1974) have suggested that fast recognition responses are based on an assessment of item familiarity and that slow responses are based on retrieval processes that may involve reconstructing initial encoding context. Item familiarity is a function of perceptual processes that occur during presentation and is generally unaffected by manipulations of semantic processing; retrieval processes, in contrast, are highly dependent upon semantic analysis (Jacoby & Dallas, 1981; Mandler, 1980). Thus, if item-specific and relational semantic processing affect primarily retrieval processes in recognition, a difference may be observed for slow, retrieval-based responses. There should be little difference between these tasks, however, for fast, familiarity-based recognition responses.

Method

Design and materials. The design was a 2x2x2 factorial with retrieval interval (immediate vs. delayed), type of memory test (recall vs. recognition), and type of orienting task (item-specific semantic vs. relational semantic) as between-subject factors. This design produced eight groups representing all combinations of the levels within each factor.

Two 30-item study lists were constructed from the 60-item study list used in Experiment 1. The first five items in the study list were practice items, the remaining items were target items. There were two random orders of each list. Two test lists for the recognition condition were constructed by combining the 25 target items in each study list with a set of 25 items chosen from the distractors used in Experiment 1. Two random orders for each test list were created with the restriction that an item appearing in the first or last five positions of the study list did not appear in the first or last five positions of a test list.

Procedure. Subjects were tested individually and, as in the previous experiment, were told that the purpose of the experiment was to study the way people comprehend words. They were then instructed in the performance of their respective orienting task. The instructions for these tasks were identical to those given to subjects in Experiment 1, except they were read to subjects rather than presented on the video monitor screen. The timing characteristics for the presentation of items in the study list were identical to those in Experiment 1. However, the signal indicating that an orienting task decision response should be made did not appear and subjects were told to make this response whenever they felt ready.

The five practice words were presented first to familiarize subjects with their orienting task, and the presentation of the study list followed the presentation of the practice list. After the study list had been presented, subjects performed a 5-minute distractor task identical to the one performed in Experiment 1. Subjects in the immediate recall condition completed an unexpected self-paced recall test and rated their confidence that the items recalled were actually on the study list. Subjects in the delayed recall condition returned 24 hours later for an identical retrieval test. All recall subjects were instructed to enter each item they recalled on a sheet of paper provided by the experimenter. They were further instructed to place beside each recalled item a number from confidence rating scale that appeared at the top of the sheet of paper. This scale ranged from 1 (very confident) to 5 (very unsure).

The subjects in the immediate recognition condition completed an unexpected, self-paced, YES/NO recognition test; those in the delayed recognition condition returned 24 hours later to complete an identical recognition test. Items in the recognition test were presented one at a time in the center of the video monitor screen for a duration of 1 second and recognition latencies were measured from item onset. Subjects were instructed to indicate whether they had seen test items previously by hitting a button marked Y or N on their response console. They were further instructed to make this response as rapidly as possible. It was emphasized, however, that accuracy was more important than speed. The subjects were given a sheet of paper containing the confidence rating scale and 50 blank spaces for entering the number from the scale corresponding to the rating for each recognition response. They were instructed to rate their confidence in each response by selecting the appropriate number from the rating scale and entering it in the correct blank. They were further instructed to rate their confidence only after they had first made their recognition response. Five seconds after word offset a series of asterisks (*****) appeared in the center of the video screen. This signal indicated that the next test word was available for presentation. The subjects were instructed that when this signal appeared, they could hit the "READY" button on their response console and 500 milliseconds later the next test word would appear in its place.

Subjects. Ninety-six students from introductory level psychology courses at George Washington University participated in the experiment. Those who had participated in Experiment 1 were excluded from this experiment. The subjects were paid $5.00 per hour for their participation. Twelve subjects were randomly assigned to each of the eight groups.

Results and Discussion

Separate analyses were conducted for the recall and the recognition data. Mean recall proportions for each orienting task and retrieval interval are presented in Table 2. Mean hit rates (total hits/25), and correct rejection rates (total correct rejections/25), for these conditions are presented in Table 3. Analyses were also performed on hit and correct rejection rates for fast and slow recognition decisions and these data are presented in Table 4.

Table 2

Mean Recall Hit Rates as a Function of Retrieval Interval and Orienting Task

	Orienting Task	
Interval	Item-Specific	Relational
Immediate	.40	.48
Delay	.25	.21

Recall. A 2 (retrieval interval) x 2 (orienting task) between-subjects ANOVA produced a main effect of interval, $F(1,44) = 77.31$, $MSe = .007$, showing that recall was higher for the immediate test than for the delayed test. The main effect of orienting task was not significant, $F(1,44) < 1$. There was, however, an interval by task interaction, $F(1,44) = 66.56$. An analysis of the simple effects of orienting task at each interval showed that relational semantic processing produced better recall than item-specific semantic processing on the immediate test, $F(1,44) = 5.61$, $MSe = .007$, and that performance following the two tasks did not differ on the delayed test, $F(1,44) = 2.17$.

The recall results for the immediate test are similar to those of Experiment 1 despite the fact that in the present experiment subjects were unaware that this test would be given. Thus, the pattern of results obtained in the earlier experiment is not due to the combination of test expectancy and relational processing. Rather, the information produced by relational processing at encoding is apparently necessary for optimal recall. However, relational information did not provide any recall advantage after a delay between study and test, perhaps because unrelated words may lead to the formation of novel associations between list items that can enhance immediate recall. It appears, however, that the novel associations formed between unrelated items are transient and, if not rehearsed, become inaccessible over time. These results differ from earlier findings that greater organization is related to successful delayed recall (McDaniel & Masson, 1977, Exp. 2). In this earlier study, however, words were organized by category memberships that are likely to remain accessible in memory even after a delay.

Recognition. A 2 (retrieval interval) x 2 (orienting task) between-subjects ANOVA for recognition hit rates produced results that were similar to the recognition results in Experiment 1. There were main effects of interval, $F(1,44) = 9.02$, $MSe = .011$, and of orienting task, $F(1,44) = 6.55$, and the interaction between these two factors was not significant, $F(1,44) = 1.80$. Recognition performance was better on the immediate test than on the delayed test, and, for both tests, recognition was higher following the item-specific semantic orienting task than following the relational orienting task. These results demonstrate that for both immediate delayed tests item-specific processing produces better recognition for study list items than relational processing. Thus, the information produced by relational semantic processing is not as useful in recognition as that produced by item-specific processing.

Table 3

Mean Recognition Hit and Correct Rejection Rates as a Function of Retrieval Interval and Orienting Task

		Orienting Task	
Interval	Item Type	Item-Specific	Relational
Immediate	Target	.94	.90
	Distractor	.9[illegible]	.89
Delay	Target	.89	.77
	Distractor	.75	.78

A 2 (retrieval interval) x 2 (orienting task) ANOVA performed on correct rejection rates[2] produced a main effect of interval, $F(1,44) = 20.25$,

[2]Correct rejection rates were used in this analysis in order to provide an acceptable number of data points for the later analysis of recognition latency. The number of false alarms was too low to satisfv this requirement. It should be pointed out, however, that the false alarm rate mirrors the correct rejection rate and that the results of the analysis for these data are entirely consistent with those for the correct rejection rates.

MSe = .013, showing that the ability to reject new distractor items was better in the immediate test than in the delayed test. However, neither the main effect of orienting task, $F(1,44) < 1$, nor the interaction between interval and task, $F(1,44) = 1.27$, was significant. Thus, the benefit observed for hit rates following item-specific semantic processing is not present for correct rejection rates. Apparently, the type of semantic processing performed for target items makes little difference in the ability to recognize unrelated distractor items.

Recognition as a Function of Decision Latency. Outliers were eliminated from the recognition decision latencies by computing the overall mean for all test items for each subject and removing any score that was ± 2 SD away from the mean. This procedure resulted in the elimination of only 7% of the latency scores. To determine whether differences between item-specific and relational processing were present for both familiarity-based and retrieval-based recognition responses, the remaining decision latencies for each subject were divided into "fast" and "slow" categories, respectively, using a procedure described by Mandler & Boek (1974). Specifically, the median recognition latency was

Table 4

Mean Recognition Hit and Correct Rejection Rates as a Function of Speed of Response, Retrieval Interval, and Orienting Task

		Orienting Task	
Interval	Speed	Item-Specific	Relational
		Targets	
Immediate	Fast	.96	.96
	Slow	.94	.87
Delay	Fast	.90	.88
	Slow	.85	.70
		Distractors	
Immediate	Fast	.97	.95
	Slow	.91	.87
Delay	Fast	.76	.81
	Slow	.74	.77

determined for each subject. Recognition responses with latencies below the median latency were assigned to the "fast/familiarity" category and responses with latencies above the median were assigned to the "slow/retrieval" category. Hit and correct rejection rates were then computed for the responses assigned to each category. Recognition scores associated with outliers were not included; however, the elimination of these data did not change the direction of any differences between overall retrieval interval and orienting task means.

A 2 (retrieval interval) x 2 (orienting task) x 2 (speed) mixed factorial ANOVA for hit rates produced a main effect of retrieval interval, $F(1,44) = 11.36$, $MSe = .022$, a main effect of orienting task, $F(1,44) = 4.20$, and no interaction between these two factors, $F(1,44) < 1$. This finding parallels the effects of retrieval interval and orienting task on hit rates observed in the earlier analysis. There was also a main effect of speed, $F(1,44) = 14.68$, $MSe = .014$. The absence of an interaction between this factor and retrieval interval, $F(1,44) = 1.48$, indicated that recognition performance was better for fast responses than for slow responses for both immediate and delayed tests. As expected, there was a significant interaction between orienting task and speed, $F(1,44) = 4.14$, and the three-way interaction between these two factors and retrieval interval was not significant, $F(1,44) < 1$. An analysis of the simple effects of orienting task for each level of speed showed that, as predicted, there was no difference in recognition performance following the two semantic orienting tasks for fast responses, $F(1,46) < 1$, $MSe = .0141$. However, item-specific processing greatly increased recognition performance for slow responses, $F(1,46) = 5.61$, $MSe = .0259$. Differences between these two types of semantic processing are apparently confined to retrieval-based recognition.

The analysis for familiarity-based and retrieval-based correct rejections paralleled the results of the overall analysis of these scores. There was again a main effect of retrieval interval, $F(1,44) = 24.09$, $MSe = .025$, showing that correct rejection rates were higher for the immediate test than for the delayed test. In addition, a main effect of speed, $F(1,44) = 5.63$, $MSe = .012$, indicated that there were more correct rejections associated with fast responses than with slow responses. No other effects were significant. Together, the results of these analyses of recognition scores as a function of decision latency show that recognition differences following relational and item-specific processing are confined to slow, retrieval-based responses for target items.

To summarize the recognition results, item-specific semantic processing produced higher hit rates for both immediate and delayed recognition than relational processing. On the other hand, item-specific processing for study list items produced no particular advantage in recognizing extralist distractor items; correct rejection rates were similar following both types of processing. Finally, differences in recognition following the two types of semantic processing were confined to slow responses to target items. These differences did not appear for fast responses to target items or for fast or slow responses to distractor items.

Although relational semantic processing played a major role in recall performance, item-specific processing was more important than relational processing in recognition. Hit rates for target items were higher following item-specific processing. Moreover, this was true for both immediate and delayed recognition tests. It appears that relational information produces a unitized representation in memory from which items can be generated or reconstructed; item-specific information provides the more detailed information that is necessary to retrieve individual items within this general class (Hunt & Einstein, 1981). Detailed, item-specific information for target items is apparently more useful in recognition than relational information about the class of knowledge of which these items are a part.

This interpretation does not hold, however, for distractor item recognition. It was expected that the detailed memory representation produced by item-specific processing of target items would also provide benefits in the recognition of distractor items. This was not the case; correct rejection rates following item-specific processing were similar to those following relational processing. According to Hunt & Einstein (1981, p. 513), "if a recognition decision can be made on the basis of general information, relational processing should produce recognition equivalent to that of individual item processing." Therefore, a possible explanation for the present finding may be that relational information is as useful as item-specific information in recognizing distractor items that are unrelated to target items.

Finally, the finding that differences in recognition following item-specific and relational processing were present only for slow responses to target items and not for fast responses suggests that the locus of these differences is in retrieval-based recognition and not in familiarity-based recognition. Fast recognition decision latencies reflect the use of familiarity information; slow responses reflect the operation of retrieval processes (Atkinson & Juola, 1974; Mandler, 1980; Mandler & Boek, 1974). It is therefore reasonable to assume that the presence of item-specific or relational semantic information makes little difference when a recognition response can be made on the basis of familiarity information, but that these two types of information are differentially effective when retrieval processes are involved in this response.

Overall, the results of this experiment are consistent with those of Experiment 1 in showing that the information produced by relational and item-specific semantic processing at encoding may serve different purposes at retrieval. The associations between items produced by relational processing yield a unitized representation of the study list that delineates the general class of information in memory from which study list items can be generated; the more detailed information produced by item-specific processing enhances the retrieval of items within the list. Relational information therefore produces optimal recall of study list items, whereas item-specific information produces optimal recognition of these items. However, the general information produced by relational processing may be as useful as item-specific information in recognizing unrelated extralist items.

EXPERIMENT 3

An unexpected finding in Experiment 2 was that although the presence of item-specific information had a substantial effect on the recognition of study list items, it had little effect on the recognition of unrelated extralist items. The explanation given for this finding was that item-specific processing produced more detailed semantic information for individual study list items but that the ability to recognize unrelated extralist items may not be dependent upon greater detail for these items. Indeed, recognition of unrelated extralist items may be accomplished equally well using the unitized list information produced by relational processing. Two reasons that relational information may be of equal value in the recognition of extralist items come to mind. First, it is unlikely that unrelated distractors would be included in the general class of information produced by relational processing of target items. Exclusion from this class may be sufficient to reject the item at recognition. Alternately, the semantic features of unrelated distractor items may be so different from those of the study list items that there is little chance of confusion. Consequently, detailed item information is unnecessary.

It is not clear how one would go about determining which of these two alternatives is the more likely explanation. A first step in this direction, however, is to determine whether relational and item-specific processing are differentially useful in the recognition of distractor items that share semantic features with study list items. In the present experiment therefore, distractors used in the recognition test were semantically related to target items. It is expected that relational processing will not provide the detailed semantic information required to distinguish between target items and semantically related distractor items; item-specific processing, however, should provide this information. Thus, in comparison to item-specific processing relational processing should produce more false recognition errors for semantically related distractors.

Distractors that were similar in sound to target items were also included in the recognition test, and a third orienting task that involved deciding whether study list items had one or two syllables was added to the design. This task requires primarily physical processing and does not induce the degree of semantic processing required by either the relational orienting task or the item-specific task. The phonetic distractors and physical orienting task were included to allow a comparison between the types of errors produced by physical and semantic orienting tasks. Research has shown that physical tasks such as this lead to high levels of recognition errors for both phonetic and semantic distractors (Coltheart, 1977; Elias & Perfetti, 1973). This suggests that physical processing for an item produces a memory representation that is relatively impoverished with respect to semantic information. Similar results are expected in the present experiment. On the other hand, the semantic processing involved in both the item-specific and the relational orienting tasks should provide enough semantic information about target words to allow the rejection of like-sounding distractor items.

The problems inherent in creating a recognition test in which each target is paired with one semantically related distractor and one phonetically related distractor have been noted by Coltheart (1977). Specifically, control items must be included that prevent subjects from locating target items by noticing that these items are the only ones that are related in some way to two other items. Moreover, control items must also reduce the effect of any selection bias that is unrelated to the encoding task. For example, subjects with an inherent bias toward selecting phonetically related words would tend to have an inflated level of phonetic errors that is not due to the encoding task. To eliminate these problems, Coltheart (1977, Exp. 2) created three sets of two control items for each distractor item. The following example illustrates three sets of test items produced using this method when KITTEN is the target (T).

KITTEN (T) CAT (S) MITTEN (P) MAT (Cp) GLOVE (Cs)
KITTEN (T) CAT (S) MITTEN (P) MAT (Cp) RUG (Cs)
KITTEN (T) CAT (S) MITTEN (P) LOVE (Cp) GLOVE (Cs)

Test items were thus composed of: (a) one control item (Cs) that was semantically related to the phonetic distractor (P) [e.g., MITTEN (P) GLOVE (Cs)] and one (Cp) that was phonetically related to the semantic distractor (S) [e.g., CAT (S) MAT (C)]; (b) one control item that was phonetically related to the (Cp) [e.g., CAT (S) MAT (Cp)] and one (Cs) that was semantically related to this phonetic control item (Cp) [e.g., MAT (Cp) RUG (Cs)]; (c) one control item (Cs) that was semantically related to the phonetic distractor (P) [e.g., MITTEN (P) GLOVE (Cs)] and one (Cp) that was phonetically related to this semantic control item (Cs) [e.g., GLOVE (Cs) LOVE (Cp)]. It is clearly impossible to tell which item in these sets is the target based solely on its relationship with other items. Moreover, any inherent bias toward selecting items based on phonetic or semantic relationships should produce no greater level of errors for the actual related distractor items than for the controls. An identical process was used to create the control items in the present experiment.

Method

Design and materials. The design was a 3 x 4 mixed factorial with type of orienting task (physical vs. item-specific vs. relational) as a between-subject factor and type of distractor (phonetic vs. semantic vs. semantic control (Cs) vs. phonetic control (Cp)) as a within-subject factor. There were therefore three groups, and the subjects within each group received all four types of distractor items on their recognition test.

Study list items were drawn from the pool of one- and two-syllable stimulus words listed in Shapiro and Palermo's (1968) Atlas of Normative Free Association Data. Two 30-item lists were constructed by randomly selecting 15 one-syllable and 15 two-syllable words from this pool. Through an oversight on the author's part one additional one-syllable word and one less two-syllable word were included in List 1. There were two random orders of each study list and in each list the first six items were designated practice items.

The semantically related distractor for each study list item was the primary response given to this word in the Atlas of Normative Free Association Data (Shapiro & Palermo, 1968). Due to this criteria, there were 12 instances in List 1 and 9 instances in List 2 where the number of syllables for a semantically related distractor did not match its target. None of these distractors, however, had more than two syllables. Whenever possible, control items that were semantically related to distractor items or to other controls were chosen from the free association atlas. When this was not possible the author generated a likely associate. Phonetically related distractors for study list items were selected from a rhyming dictionary (Stein, 1983). There was only one case, in List 1, where the number of syllables in a phonetically related distractor did not match the study list word and the number of syllables in this item did not exceed two. Whenever possible, control items that were phonetically related to distractor items or to other control items were selected from the rhyming dictionary.

Three different sets of control items were constructed for the semantically and phonetically related distractor items for a study list item using the method described previously. There were therefore three five-item recognition test sets (T, S, P, Cs, Cp) for each of the 24 words in study Lists 1 and 2. Each set was randomly assigned to one of three recognition test booklets for a study list. There were two random orders of the test sets in each of these three booklets with the restriction that no target item in the first or last three positions in the study list appeared in a recognition set in the first or last three positions of the recognition test booklet. An equal number of subjects within each group received each of the 12 combinations of study list and test list (2 study lists x 3 test lists x 2 random orders). The random order assigned for a test list always matched the order assigned for the study list.

Procedure. Subjects were tested in groups of two. In all respects except for the performance of the syllable count orienting task, the procedure for study list presentation was identical to that for Experiment 2. In the syllable count orienting task, subjects were instructed to read each word appearing in the video monitor screen and to decide whether this word had one or two syllables. Upon making their decision they were to press one of two buttons on their response console marked with the appropriate response categories (O-one; T-two).

After the presentation of the study list, subjects were given a 5-minute distractor task identical to the one used in Experiments 1 and 2. They were then given a self-paced recognition test. For this test, subjects were instructed to consider each of the five words in a set of items in the recognition test booklet and to make a YES/NO recognition decision and confidence rating for each item in the set. The subjects recorded their recognition responses by placing a Y or an N in one of two blank lines underneath each word. Confidence ratings from a scale given at the top of each page in the recognition booklet were placed in the second blank line underneath the word. The subjects were further instructed to finish making their recognition decisions and confidence ratings for the five items in each set before continuing on to the next set of items in the booklet.

Subjects. Seventy-two students from introductory level psychology courses at Boise State University received course credit for their participation in the experiment. Twenty-four subjects were randomly assigned to each of the three orienting task groups.

Results and Discussion

The mean hit rates by orienting task and mean false alarm rates by orienting task and distractor type are presented in Table 5.

A one-way ANOVA for hit rates indicated that the three orienting tasks produced different levels of recognition performance, $F(2,69) = 19.97$, $MSe = .014$. Post hoc comparisons of orienting task means (Tukey a, Winer, 1971) showed that the item-specific orienting task produced better recognition than both the physical and the relational tasks and these latter two did not differ ($d_T = .08$). These results resemble the recognition results of Experiments 1 and 2 in that item-specific processing again provided greater benefits in recognition than relational processing. However, unlike the results of Experiment 1, recognition was not better following relational semantic processing than following physical processing. Possible reasons that these results varied across these

Table 5

Mean Hit Rates and Mean False Alarm Rates by Distractor Type as a Function of Orienting Task

	Orienting Task		
	Physical	Item-Specific	Relational
Hits	.75	.94	.81
FAS	.27	.04	.18
FACS	.14	.01	.07
FAP	.18	.01	.07
FACP	.13	.02	.06

two experiments could be that counting syllables for words provides a better basis for recognition than searching for letters (Exp. 1) or that the inclusion of related distractor items increases the difficulty of selecting the correct target item following the relational orienting task.

A one-way ANOVA for false alarm rates collapsed across the four distractor types produced a large effect of orienting task, $\underline{F}(2,69) = 21.31$, $\underline{MSe} = .007$. Post hoc comparisons (Tukey a) of the three means showed that overall false alarm rates were higher following the physical orienting task than following either the item-specific or relational semantic orienting tasks ($d_T = .06$). These comparisons also showed that false alarm rates following the relational task were higher than those following the item-specific task. Thus, overall false alarm rates in the present experiment reflect the superiority of item-specific processing over relational processing. Moreover, contrary to the hit rate data, the false alarm rates provide evidence for the superiority of relational semantic processing over physical processing.

To compare differences in the type of confusion errors associated with the three orienting tasks, the false alarm data were submitted to a 3 (orienting task) x 4 (distractor type) ANOVA. This analysis produced a main effect of orienting task, $\underline{F}(2,69) = 21.31$, $\underline{MSe} = .028$ and a main effect of distractor type, $\underline{F}(3,207) = 37.13$, $\underline{MSe} = .004$. These main effects were qualified, however, by a significant orienting task by distractor type interaction, $\underline{F}(6,207) = 5.06$. An analysis of the simple effects of this interaction indicated that there were large differences between the distractor type means for the physical orienting task, $\underline{F}(3,207) = 24.14$, $\underline{MSe} = .004$, and the relational orienting task, $\underline{F}(3,207) = 17.57$. The differences for the item-specific task, however, were not significant, $\underline{F}(3,207) = 1.26$. Planned comparisons indicated that false alarm rates for semantic distractors were higher than those for their control items (S vs.

Cs) for the physical orienting task, $F(1,207) = 52.27$, $MSe = .004$, and for the relational orienting task, $F(1,207) = 31.20$, but not for the item-specific orienting task, $F(1,207) = 2.87$. In contrast, differences between false alarm rates for the phonetic distractors and their controls (P vs. Cp) were significant for the physical orienting task, $F(1,207) = 6.90$, but not for the relational task, $F(1,207) < 1$, or for the item-specific task, $F(1,207) < 1$. Thus, the physical orienting task produced confusion errors for both semantic and phonetic distractors, the relational semantic orienting task produced errors for primarily semantic distractors and the item-specific orienting task produced few errors for either semantic or phonetic distractors.

The finding that the physical orienting task was the only task associated with phonetic confusion errors suggests the memory representation produced by this task contains little semantic detail. Specifically, there does not seem to be enough semantic information encoded for list items during this task to adequately distinguish these items from like-sounding distractors. In contrast, the degree of semantic information encoded during both the relational semantic orienting task and the item-specific semantic task was sufficient to reduce the incidence of phonetic confusion errors. In comparison to item-specific semantic processing, however, relational semantic processing produced higher levels of confusion errors for semantically related distractor items. This suggests that when distractor items share semantic features with target items, the information produced by relational processing does not provide a sufficient basis for discriminating between these items. Apparently, the unitized list information that is produced by relational processing contains only minimal semantic detail for individual study list items. This level of detail does not support the finer distinctions between semantic attributes that are required when target and distractor items are similar in meaning. The more detailed semantic information produced by item-specific processing uniquely specifies each study list item and increases the ability to distinguish these items from the set of related distractor items.

GENERAL DISCUSSION

The results of the three experiments in this study are straightforward. The best recall performance was associated with relational semantic processing. This effect occurred under both intentional and incidental learning instructions in Experiment 1 and was observed for an immediate, but not a delayed, recall test in Experiment 2. In contrast, the best recognition performance was associated with item-specific semantic processing. Higher hit rates followed item-specific processing under intentional and incidental learning conditions in Experiment 1, for immediate and delayed recognition tests in Experiment 2, and for an unexpected, immediate test in Experiment 3. Moreover, although item-specific processing provided no greater advantage than relational processing in the recognition of unrelated distractor items in Experiment 2, item-specific processing did increase the recognition of semantically related distractor items in Experiment 3. Finally, an analysis of recognition performance for fast and slow responses in Experiment 2 showed that differences for item-specific and relational processing were confined to slow recognition responses and did not occur for fast responses. Overall, these results support the idea that there are functional differences in the type of retrieval information produced by these two types of semantic processing. Relational processing produces information that is optimally suited to retrieval processes in recall; item-specific processing produces information that is optimally suited to retrieval processes in recognition.

During retrieval, information present in the retrieval environment interacts with information present in the memory representation for a prior event (Tulving, 1983). For both recall and recognition, greater overlap between the information encoded during study and the information encoded during retrieval will lead to better performance (Flexer & Tulving, 1978; Lockhart et al., 1976). In a free recall test, however, there is typically little information present in the retrieval environment that overlaps with the information in the encoded memory representation. Retrieval in recall thus becomes a problem of self-guided reconstruction of TBR items (Jacoby et al., 1979). In a recognition test, on the other hand, considerable information in the form of the TBR item itself is present at retrieval and item reconstruction is less important. It may be necessary, however, to reconstruct contextual information for TBR items in order to distinguish their encoded memory representations from the representations of other items in memory (Jacoby et al., 1979). It is therefore reasonable to assume that the differences observed for recall and recognition in the present study are related to the different retrieval requirements for these tests and to the issue of whether the information encoded during item-specific and relational semantic processing supports these different requirements.

The information produced by item-specific and relational processing may be described best by a feature-sampling account of encoding (Begg, 1978; Jacoby et al., 1979; Tversky, 1973). This account is compatible with both the levels of processing and the organizational approaches to memory and therefore seems especially appropriate in the present situation. According to this account, word knowledge consists of a set of "features" (Begg, 1978; Tversky, 1973). For example, knowledge about the word "table" might include the semantic features "is furniture," "has legs," "provides support," etc. Performance of semantic orienting tasks, such as the item-specific and relational tasks used here, focuses attention on the specific subset of semantic features that satisfies task requirements. These features largely determine the nature of the encoded memory representation. Attention to two different sets of features for the same item will thus produce qualitatively different memory representations. It then follows that item-specific and relational processing may produce two qualitatively different semantic representations for list items.

In the present study, relational processing led to higher recall on all except a delayed recall test. Relational processing focuses attention on the semantic features that are common to many list items and thereby encourages the formation of relationships between these items. Encoding these relationships may have created a more "unified" memory representation (Mandler, 1967, 1979). This unified representation could support retrieval processes in recall in a number of ways; i.e., by increasing the accessibility of the individual items within the representation (Tulving, 1983), by delineating the general area in memory from which list items could be reconstructed (Hunt & Einstein, 1981), or by providing a retrieval scheme or plan to guide reconstruction (Battig & Bellezza, 1979; Bellezza et al., 1977).

As performance on the delayed recall test showed, however, relational processing for unrelated words produced only short-lived benefits in performance. This finding differs from studies showing higher delayed recall for categorized word lists (McDaniel & Masson, 1977, Exp. 2). A possible explanation may be that, unlike the relationships between items in a categorized list, the relationships formed between unrelated items are unfamiliar and are not well-established in semantic memory. Unless rehearsed, these relationships may become inaccessible. Some evidence for this assumption comes from studies by Bellezza et al. (1976) and Epstein, Phillips, & Johnson (1975). In the former study, a story mnemonic led to better delayed recall than instructions to remember. However, subjects performed both of these orienting tasks within a single study list and were told explicitly not to think about any of the words during the delay. It is likely therefore that some rehearsal for the list items occurred both during and after list presentation for both the story mnemonic and remember conditions. Likewise, in the latter study, delayed cued recall was higher following relational processing of unrelated words. In this case, the delayed test followed an immediate test, once again providing the opportunity for rehearsal. These studies suggest that the recall advantage following relational processing may be preserved for a delayed test if the encoded relationships are either well-established in semantic memory or, if not well-established, are well-rehearsed following their formation. Direct evidence bearing on this issue clearly requires further experimentation.

Turning now to the discussion of the recognition data, the results consistently showed that, in contrast to recall, recognition performance was higher following item-specific processing than following relational processing. Since recognition is less dependent upon self-guided reconstruction of list items, relational processing may be relatively unimportant in this test. Item-specific processing, however, seems to be very important. Whereas relational processing focuses attention on the common features of list items, item-specific processing focuses attention on features that are unique to these items. Thus, item-specific processing may be characterized more by encoding unique semantic information about each list item than by encoding semantic relations between these items. This type of processing may therefore result in a highly detailed or distinctive memory representation for each list item rather than a unitized representation for all list items. These detailed representations will tend to "stand out" from other items in memory thereby supporting the retrieval of contextual information and the discrimination of list items from extralist items encoded in memory.

Further evidence that item-specific information may lead to a detailed or distinctive memory representation comes from the finding that this type of information is more effective in the recognition of distractors that are semantically related to study list items than in the recognition of unrelated distractors. Since semantically related distractors share semantic features with target items, distinguishing between the memory representations for these items will be a difficult task. More specifically, the retrieval information provided by these distractors will have an increased resemblance to the information in the encoded memory representation for a semantically similar target item. Relational processing for target items does not produce a detailed or distinctive memory representation and therefore provides little basis for distinguishing between the semantically similar targets and distractors. However, if the target item representation is made more precise or detailed by item-specific information, there will be less chance that this representation will overlap with the representation for the related distractor, and recognition accuracy will not suffer.

In recent years, distinctiveness has become a leading candidate to explain the beneficial effect of semantic elaboration on memory. A number of researchers have noted, however, that the advantage of a more distinctive representation is relative to the requirements of the particular retrieval test (Begg, 1978; Eysenck, 1979; Jacoby et al., 1979). The present results are compatible with this view. The greater distinctiveness resulting from item-specific processing was less important in recall than the formation of associations between list items (c.f. Einstein & Hunt, 1980; Hunt & Einstein, 1981; Jacoby et al., 1979), and although increased distinctiveness for study list items was important in the recognition of semantically related distractor items, it was much less important in the recognition of unrelated items. Apparently, when the features of targets and distractors are dissimilar, even a less distinctive memory representation is sufficient to distinguish between these items in recognition.

This account of functional differences in the retrieval information produced by item-specific and relational processing builds upon earlier research by Hunt and Einstein (1981; Einstein & Hunt, 1980). The present results go beyond this research, however, in showing that differences between item-specific and relational information occur for slow recognition responses but not for fast responses. According to a number of researchers (Atkinson & Juola, 1974; Mandler, 1980), recognition latency varies as a function of whether a decision can be made on the basis of an immediate assessment of item familiarity or whether the decision must wait for slower retrieval processes. The present findings suggest that when recognition responses are made quickly on the basis of familiarity information, functional differences between item-specific and relational semantic processing are minimal. On the other hand, when slower retrieval processes are required, these differences are quite striking. The present results do not address the issue of how item-specific and relational semantic orienting tasks affect item familiarity. However, one possibility that is consistent with Mandler's (1979; 1980) dual process theory of recognition is that both types of processing produce similar degrees of integration for item perceptual features. When perceptually based familiarity information can be used for recognition, responses are fast and show no evidence of functional differences between item-specific and relational semantic processing. When familiarity information cannot be used, recognition is based on slower retrieval processes and greater accuracy is associated with the more distinctive memory representations produced by item-specific semantic processing. On this view, the present results suggest that it may be useful to distinguish among three types of mnemonic information: perceptually based familiarity information, item-specific semantic information, and relational semantic information.

In summary, the present results, together with the results of several earlier studies (Bellezza et al., 1976, 1977; Einstein & Hunt, 1980; Hunt & Einstein, 1981), add to a growing body of evidence that differences in retrieval following item-specific and relational processing are related to functional differences in the type of retrieval information produced by these two types of semantic processing. Item-specific information increases the distinctiveness of individual events encoded in memory; relational information increases the organization or unitization of these events. Both types of semantic information provide benefits in retrieval, especially when compared with the information produced by physical processing. However, these benefits may vary with the characteristics of the memory test. Self-guided reconstruction of list items may rely more on the unitized memory representation produced by relational semantic processing. Reconstruction of original encoding context and discrimination between items may rely more on the distinctive memory representation for each list item produced by item-specific semantic processing. However, functional differences for these two types of semantic information may be of little importance when familiarity information can be used for the memory test.

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