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The effect of semantic encoding on unconscious retrieval processes

Toth, Jeffrey Paul, Ph.D.

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U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

THE EFFECT OF SEMANTIC ENCODING ON UNCONSCIOUS RETRIEVAL PROCESSES

by

Jeffrey Paul Toth

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Approved by

R. Reed Hunt
Dissertation Adviser

APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of the Graduate School at The University of North Carolina at Greensboro.

Dissertation Adviser R. Reed Hunt

Committee Members Fred D. Morrison

M. Mandel

[illegible]

Herbert Wells

[illegible]

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The purpose of the present research was to investigate the conditions under which unconscious retrieval processes would show sensitivity to semantic encoding operations. In three experiments, subjects studied word-lists either semantically or non-semantically. Experiment 1 used categorized lists and tested for retention using word-fragment completion. Experiments 2 and 3 used unrelated words, presented visually and aurally at study, and tested for recognition memory using a response signal ("deadline") procedure in an attempt prevent the use of conscious retrieval strategies. In both experiments, target words were presented visually at test and target-signal delays were 500 ms and 1500 ms. In Experiment 2 subjects were directed to respond positively ("yes") to all previously presented words. In Experiment 3 subjects were directed to respond negatively to words previously presented in the visual modality.

The results of Experiment 1 showed that encoding operations directed toward the categorical nature of the word-lists facilitated performance in fragment completion more than a pleasantness rating task and a non-semantic letter-scanning task. Categorical encoding also resulted in performance facilitation on non-presented category exemplars. On a subsequent free recall task, pleasantness rating resulted in the highest level of performance.

Experiment 2 showed that retrieval times under 1000 ms were associated with a significant modality effect which was eliminated by 2000 ms. However, the effect of orienting task was reliable at both points in the recognition process.

Experiment 3 showed that semantic encoding resulted in a higher level of false recognitions than non-semantic encoding when retrieval time was restricted. By 2000 ms, the ability to reject previously presented words was equivalent for the two study orientations.

The present results suggest that unconscious retrieval processes are affected by prior conceptual operations. On memory tests which do not make reference to a prior study experience, the effect is dependent on contextual similarity between encoding and retrieval conditions. On memory tests which do make reference to a prior event, unconscious processes are influenced by both prior perceptual and conceptual operations. The results are discussed in terms of current theoretical approaches to the nature of conscious and unconscious processes supporting memory performance.

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CHAPTER I

INTRODUCTION

The distinction between implicit and explicit remembering has become a central issue in memory research (Richardson-Klavehn & Bjork, 1988; Schacter, 1987). Explicit memory refers to the conscious recollection of a prior experience. Tests such as free recall and recognition are called explicit because they include instructions for the subject to consciously bring to mind an event in their past. Implicit memory, on the other hand, refers to situations in which a persons' current behavior is influenced by a past event, but the person is not aware of that event nor does she intend to "remember" it. Instructions on implicit memory tests do not refer to the past; subjects are engaged in a perceptual or problem-solving task and retention is measured (inferred) from the facilitation in performance attributable to a specific prior experience. The development of experimental tasks which do not require conscious recollection has allowed researchers to consider the role of unconscious processes in memory.

Table 1 shows some of the characteristics that are believed to distinguish these two forms of memory. Of most theoretical importance are the three characteristics listed

Table 1. A summary of the characteristics assumed to distinguish implicit and explicit memory.

Form of Memory:	Implicit	Explicit
Measure (operationally defined):	* Indirect	* Direct
Tests (e.g.):	* Stem Completion * Word Identification	* Free Recall * Recognition
Descriptions:	* Memory without awareness * Memory as a tool	* Memory with awareness * Memory as an object
Type of Process:	* Unconscious (automatic)	* Conscious (controlled)
Mode of Retrieval:	* Unintentional	* Intentional
Representation (or Process) Mediating Performance:	* Perceptual	* Conceptual

at the bottom. First, it is thought that implicit memory relies on unconscious processes whereas explicit memory relies on conscious processes. Second, the retrieval of information acquired in the past is thought to be unintentional during the operation of implicit memory, but explicit memory appears to require a deliberate, intentional act. Finally, the type of representation mediating performance is thought to be perceptual in the case of implicit memory, and conceptual in explicit memory.

Perhaps the most important reason for the distinction between implicit and explicit memory is their capacity to be dissociated as a function of experimental manipulations. Dissociation refers to the situation in which a particular variable produces an effect on one type of memory test (e.g., free recall) but no effect, or an opposite effect, on another type (e.g., perceptual identification). Research to date has shown that implicit and explicit memory can be dissociated in at least four ways. (1) Explicit memory is severely impaired in amnesia; implicit memory is often equivalent to that of normal populations (Graf, Squire, & Mandler, 1984). (2) Explicit memory appears to vary with the amount of semantic elaboration performed at encoding; implicit memory appears insensitive to semantic processing (Graf & Mandler, 1984; Jacoby, 1983a, 1983b; Jacoby & Dallas, 1981). (3) Study-test changes in surface information (e.g., modality of presentation) have little effect on explicit memory; implicit memory is severely attenuated by such changes (Graf, Shimamura, & Squire, 1985; Jacoby & Dallas, 1981; Roediger & Blaxton, 1987a). (4) Explicit memory for an event declines with the passage of time; implicit memory remains relatively intact across comparable time intervals (Sloman, Hayman, Ohta, Law, & Tulving, 1988; Tulving, Schacter, & Stark, 1982).

Currently, there are two major theoretical approaches to explaining these effects, the multiple memory systems view, of which there are a number of variations (Cohen, 1984; Johnson, 1983; Tulving, 1983, 1985; Tulving & Schacter, 1990), and the processing view (Roediger & Blaxton, 1987b; Roediger, Weldon, & Challis, 1989; see also Jacoby, 1983a). The memory systems view is a structuralist approach and basically proposes that different memory tasks access different underlying systems. The processing view is a more functional approach and suggests that memory be understood in terms of data-driven and conceptually-driven processes.

Although these two competing approaches explain dissociations very differently, it is interesting to note that they share two fundamental assumptions. The first is that priming is perceptual. In memory systems terminology (Tulving & Schacter, 1990), priming is mediated by the perceptual representation system (PRS), a "presemantic" system which does not store conceptual information. In the processing approach (Roediger, 1990), priming is due to the transfer of data-driven processes. A second, more tacit, assumption is that specific tests tap specific systems or processes. For example, recognition is said to tap episodic memory; perceptual identification is said to primarily require data-driven processes.

Problems with the Distinction between Implicit and Explicit Memory

As noted in recent reviews (Richardson-Klavehn & Bjork, 1988; Schacter, 1987) no one theoretical approach can sufficiently account for the dissociations identified above. Current difficulties in understanding the nature of implicit memory and its relationship to explicit memory may stem from two related issues. The first concerns the variety of retention measures used to study these forms of memory. A partial list of measures referred to as implicit would include word-fragment completion (Tulving, Schacter, & Stark, 1982), word-stem completion (Graf & Schacter, 1985; Schacter & Graf, 1986), the reading of altered text (Kolers, 1976; Masson & Sala, 1978), perceptual identification (Jacoby, 1983a, 1983b; Jacoby & Dallas, 1981), lexical decision (Smith, MacLeod, Bain, & Hoppe, 1989), and category production (Graf, Shimamura, & Squire, 1985). What relates these measures is the fact that task instructions do not make reference to past events (note 1). Nevertheless, there are theoretical as well as empirical reasons for believing that each of these measures involves different component processes (see e.g., Hunt & Toth, 1990; Levy & Kirsner, 1989; Roediger & Srinivas, & Weldon, 1989; Witherspoon & Moscovitch, 1989). At present, it is unclear whether similarities in instructions or in component processes account for the dissociations between these measures and explicit memory.

A related issue which may underlie current theoretical difficulties concerns the nature of psychological processes that can potentially fall under the rubric of "implicit memory." Presumably, the main reason for interest in implicit measures is the notion that they assess unconscious processes. But the conditions for demonstrating the influence of unconscious processes are not entirely clear. Schacter (1987) states that "implicit memory is revealed when previous experiences facilitate performance on a task that does not require conscious or intentional recollection of those experiences" (p. 501). This definition appears to treat awareness and intention as a single process, or as two processes which invariably occur together.

The use of the terms "implicit" and "explicit" have been used to refer to both test instructions and hypothetical forms of memory. This has led some researchers to use the terms "direct" and "indirect" which can be operationally defined in terms of task instructions and measurement criteria (note 2). As noted by Richardson-Klavehn and Bjork (1988), when the terms implicit and explicit are used as descriptions of both task instructions and forms of memory, unwarranted assumptions are made concerning the roles of intentionality and awareness in memory. As will become apparent, the confounding of these two psychological phenomena is one of the main reasons for questioning the validity of the implicit/explicit distinction. Indeed, the present experiments, as well as others reviewed below (General Discussion), provide strong evidence that unconscious influences of memory can occur in the presence of awareness and intention. Additionally, evidence is marshalled that so-called "implicit measures of memory" often recruit consciously-controlled processes. If correct, these observations suggest that the terms implicit and explicit do not identify mutually exclusive forms of memory; rather, they can be viewed as very general and, in a sense, overlapping terms referring to a number of psychological processes which interact to produce performance.

The research presented here is based on three assumptions that differ substantially from those underlying the theoretical positions outlined above. First, performance facilitation resulting from a specific prior experience (cf. "priming") is assumed to be very sensitive to context and meaning (i.e., to prior conceptual processes). The argument for this assumption is, essentially, that current theoretical approaches have not taken into account the crucial role played by retrieval environments in mediating performance on indirect measures. Contrary to these approaches, performance on both direct and indirect measures is assumed to involve the recruitment of both perceptual and conceptual representations (or processes). This assumption can be viewed as the main impetus for the present experiments; the rationale underlying it is presented in more detail below. The second assumption underlying the present approach is that all memory tests, whether "implicit" or "explicit," involve a mixture of processes, both conscious and unconscious in nature. This assumption suggests that the presumed correspondence between "form of memory" (implicit/ explicit) and type of psychological processes (unconscious/ conscious) is inaccurate. The third assumption is that unconscious influences of memory can occur, indeed typically occur, in the presence of awareness and intention (cf. Table 1). The results of the experiments presented here are consistent with each of these assumptions and suggest that the separation of implicit and explicit memory as depicted in Table 1 misrepresents the nature of memory.

The Role of Context in Mediating Memory

Two of the most important ideas for understanding memory performance on direct tests are the processes of organization and elaboration. Organization is recognized as one of the dominant principles of memory; retrieval of specific items is facilitated by accessing the integrated whole of which these items are a part (Puff, 1979; Tulving & Donaldson, 1972). If an encoded feature is common to an otherwise unrelated set of items, accessing that feature will facilitate retrieval of the set. Alternatively, research within the levels-of-processing framework (Craik & Lockhart, 1972) emphasized the notion of elaboration (Craik & Tulving, 1975); memory will benefit to the extent that the to-be-remembered item is related to other information stored in memory. Similar to organization, elaborative processing is assumed to faciliatate memory by increasing the number and effectiveness of potential retrieval cues. Unlike organization, however, elaboration involves the encoding of features not shared by other encoded items (Lockhart, Craik, & Jacoby, 1976). Thus, elaboration serves to make particular items distinctive in the context of the episode in which they were originally embedded (Jacoby & Craik, 1979).

Organization and elaboration have been highly successful in accounting for a variety of memory phenomena as assessed by direct measures (see Einstein & Hunt, 1980;

Hunt & Einstein, 1981). However, contemporary research using indirect measures represents a significant break in this tradition. The reason for this break appears to be based on the fact that organization and elaboration are psychological processes performed on the meanings of events. Performance on indirect measures appears relatively insensitive to manipulations of meaning. In comparison to non-semantic processing, semantic elaboration produces no subsequent benefit in performance on indirect measures (Graf & Mandler, 1984; Jacoby & Dallas, 1981). Additionally, performance on indirect tests has been found to be highly dependent on the preservation of specific perceptual details from study to test (Graf, Shimamura, & Squire, 1985; Jacoby & Dallas, 1981; Jacoby & Hayman, 1987; Roediger & Blaxton, 1987a). These findings have led to the assumption that unconscious retrieval processes respond only to perceptual information whereas conscious processes reflect conceptual (meaning-based) information.

There are studies, however, that have reported effects of conceptual encoding operations on indirect measures (Blaxton, 1989; Gardiner, 1989; Hirshman, Snodgrass, Mindes, & Feenan, 1990; Toth & Hunt, 1990). These studies resist integration into current theoretical systems because they appear to show that, under some circumstances, unconscious retrieval processes can be affected by encoding operations directed toward the meaning of study material. What could account for these anomalous findings?

One explanation concerns the nature of retrieval environments in which indirect memory performance is assessed. As discussed by Jacoby and Craik (1979), elaborative encoding may only be effective if the original study context is recovered at test. Elaboration serves to increase the distinctiveness of a particular item, but distinctiveness is "context-relative"; it can only be assessed in terms of the information available in the original encoding episode. The effective context in which memory occurs is a function of the retrieval environment, the cues given in a task, and, most importantly, the task instructions. On direct tests, retrieval cues (including instructions) directly reference the target episode; thus, the original context can be intentionally recreated by the subject. On indirect tests, the target episode is not directly referenced; it can therefore be assumed that subjects do not attempt to recover the original study context. Thus, semantic elaboration may often appear irrelevant to performance on indirect measures because the retrieval environment shares little relationship with the context in which study items were originally processed. This suggests that to observe the effects of semantic operations on indirect tests, a processing context similar to that available at encoding must be created in the retrieval environment.

The typical procedure in an "implicit" memory experiment is to present subjects with a unrelated set of words which are differentially processed according to the variable of interest. This study phase is then followed by presentation of an indirect retention test. Test lists are composed of a subset of the input words randomly mixed with additional unrelated words. Jacoby (1983b) and others have suggested that, if a word were to be tested in the context in which it was studied, performance on indirect tests may come to rely on conceptual processes. In fact, Jacoby (1983b; Allen & Jacoby, 1990) demonstrated that performance in word identification is enhanced when the test list contains 90%, as opposed to 10%, of the previously studied words.

However, amidst the large research literature using indirect measures, only a handful of experiments have attempted to explicate such contextual factors. Mandler, Graf, and Kraft (1986) embedded target words in categorized lists at encoding, but memory for these targets was assessed in the usual set of unrelated words and no effects of semantic orientation were found. The few experiments which have reinstated the encoding context at retrieval all show effects of prior conceptual processing (Franks, Plybon, & Auble, 1982; Hannigan, Shelton, Franks, & Bransford, 1980; Kasserman, Yearwood, & Franks, 1987; Toth & Hunt, 1990; Winnick & Daniel, 1970). Each of these studies used perceptual measures of retention which are associated with operation of "implicit" memory; however, only Toth and Hunt (1990) used indirect instructions. It would therefore seem that the role of retrieval contexts as a factor mediating performance on indirect measures has been relatively ignored.

The present approach contends that, by exclusively using unrelated word lists and encoding tasks that bear little similarity to retrieval tasks, contemporary studies of implicit memory underestimate the extent to which unconscious retrieval processes are sensitive to prior conceptual processes. It is hypothesized that reinstating aspects of the encoding context at retrieval can provide an environment in which prior semantic processing becomes evident. This hypothesis is congruent with the notion of transfer appropriate processing (Morris, Bransford, & Franks, 1977) but extends the notion of transfer beyond perceptual similarity to include conceptual/meaningful operations (see Adams et al., 1988; Lockhart et al., 1988; Toth & Hunt, 1990).

A Unified Theory of Implicit and Explicit Memory

The present approach is guided by the notion that performance on direct and indirect measures can be explained by a common set of theoretical principles. However, a unified theory of memory is thwarted by assumptions that the processes underlying performance on direct and indirect tests are fundamentally different; that is, that "implicit" and "explicit" memory are mutually exclusive categories defined by the dichotomies of psychological process, intent, and type of representation mediating performance (see Table 1). These assumptions are encouraged by the dissociations found between direct and indirect measures. The result has been the development of theoretical systems which propose that performance on direct and indirect measures is mediated by different processes (e.g., data-driven and conceptually driven: Roediger & Blaxton, 1987b) or memory systems (Tulving & Schacter, 1990). Dissociations represent important data which must be explained by any satisfactory theory of memory. However, dissociations between memory tests do not necessarily mean that the processes underlying performance on the two tests are fundamentally different; rather, they may simply indicate that the type of information required on the two tests differs (Levy & Kirsner, 1989; Shoben & Ross, 1976).

The assumption of an absolute difference between memory tests is analogous to assumptions concerning encoding operations made during the development of the levels-of-processing model. Underlying the levels-of-processing framework was the assumption that "deep," semantic processes support better retention than "shallow," non-semantic processes (Craik & Lockhart, 1972). However, as demonstrated by Stein (1978) and others (e.g., Hunt & Mitchell, 1978; 1982), nonsemantic processing can be crucial to explicit memory performance if the test requires access to nonsemantic features. The present work hypothesizes that an analogous situation exists in the study of implicit memory; current approaches assume that perceptual encoding processes are sufficient to maximize performance on indirect measures. This may be an artifact, produced by the consistent use of unrelated word lists and incompatible tasks. Semantic processes are crucial to performance on indirect tests; however, these processes will only be apparent in retrieval environments which are contextually similar to the original episode in which those processes were used.

The experiments reported here were primarily designed to investigate the effects of prior conceptual operations on unconscious retrieval processes. Finding conceptual effects would not only broaden the hypothesized scope of unconscious processes in memory; it also has the potential of uniting conscious and unconscious processes under a single set of theoretical principles. In contrast to conceptualizing memory performance in terms of one type of psychological process or one form of representation, all episodes of remembering may involve conscious and unconscious processes, and the interaction of perceptual and conceptual representations. If so, the phenomena associated with "implicit" memory could be described by established psychological principles such as organization, elaboration, and distinctiveness.

One method for studying unconscious retrieval is to use indirect retention measures. This method relies on the popular assumption that retention measures are pure with regard to the psychological processes they evoke. The problem with this assumption is that there are reasons to believe that indirect measures do not always assess "implicit" memory. There are many opportunities for a subject to use intentional strategies on indirect measures and these strategies can easily go undetected. Nevertheless, Experiment 1 investigated the effects of semantic and non-semantic study orientation on fragment completion; this measure was chosen because it has been used extensively to assess "implicit" memory. An alternative method for studying unconscious processes in memory is to assume that all retention measures involve both conscious and unconscious components. If this assumption is correct, it should be possible to isolate the unconscious processes contributing to performance on a direct test. This strategy was used in Experiments 2 and 3 which also manipulated orienting task, but assessed performance in recognition memory using a response signal procedure (Reed, 1973, 1976) in an attempt to separate conscious from unconscious retrieval processes.

CHAPTER II

EXPERIMENT 1

An influential study in the delineation of implicit memory was published by Winnick and Daniel in 1970. This research is usually cited by contemporary researchers because of their Experiment 2 which demonstrated that tachistoscopic thresholds (a measure used to study implicit memory) are sensitive to the form in which a word is presented at encoding. That is, if a word is to be visually identified, visual presentation of that word at encoding provides for more positive transfer at test than does presentation of the word's referent (i.e., a picture) or the word's definition. This is an important finding, given current attempts to understand the nature of implicit memory. However, whereas Winnick and Daniel's Experiment 2 produced results consistent with current accounts of implicit memory, their Experiment 1 produced a finding which is not as easily incorporated into those accounts. That experiment demonstrated that words <u>not</u> presented at encoding, but drawn from the same "set" as the presented words (i.e., the States of the Union), may be identified more readily than matched control words. This finding clashes with current theoretical approaches which uniformly identify "priming" effects with perceptual processes (Roediger, 1990). Winnick and Daniel's (1970) study suggests that unconscious retrieval processes can be affected by the conceptual information conveyed in the retrieval environment.

The present experiment can be viewed as an extension of Winnick and Daniel (1970, Experiment 1) in the context of current methodological approaches to implicit memory. The goal was to demonstrate an effect of semantic processing on an indirect measure, and to demonstrate "memory" for information not physically present in the encoding environment. Orienting task (semantic versus nonsemantic) was manipulated at encoding and categorized lists were used to provide a conceptual structure which could be re-presented at test. Memory was tested using fragment-completion (e.g., C-A-P-G-E as a cue for CHAMPAGNE), a retention measure which has been extensively studied. It was hypothesized that performance on the indirect measure of fragment completion would show sensitivity to encoding operations when the retrieval environment was contextually similar to the encoding environment.

Demonstrating memory for information not physically present at encoding may appear paradoxical. However, it has been known for some time that experiencing a familiar event or concept implicitly "activates" associatively related concepts (Cofer, 1967; Cramer, 1964, 1966). Implicitly activated associates have been shown to lead to false recognitions (Underwood, 1965) and recall intrusions (Deese, 1959). Recent work by Nelson and colleagues has been directed toward uncovering variables (e.g., associative set-size) which affect "memory" for a word's associates (Nelson, Bajo, McEnvoy, & Schreiber, 1989) and the conditions under which implicit activation may have positive or negative consequences for memory performance (Nelson, McEnvoy, & Schreiber, 1990). All of these studies suggest that implicitly activated associates form part of the original or "target" episode.

In terms of direct retention measures, implicitly activated information may be viewed as interfering with accurate retrieval. However, indirect measures do not require awareness of the prior event; from the subjects perspective, "correct performance" is defined in terms of the task at hand. This focus blurs the distinction between presented and non-presented information; both become valid sources of information if they facilitate performance. To the extent that implicitly activated information can affect performance on an indirect retention measure, "memory" has been demonstrated. Showing that such effects are modulated by specific forms of study processing would constitute another source of evidence that unconscious retrieval processes are sensitive to previous conceptual operations.

Study materials consisted of 4 exemplars from each of 4 taxonomic categories. At test, fragments of these 16 ("Old") items were presented along with 32 unstudied items. Sixteen of the unstudied items consisted of 4 ("New") exemplars taken from each of 4 categories not represented in the original study list. The remaining unstudied items were drawn from the same taxonomic categories represented in the study list (4 exemplars from each category: "Exemplar"). These items were included to assess whether implicit activation is affected by study orientation (see Cofer, 1967; Cramer, 1964, 1966). Thus, New items provided a baseline measure of performance, Old items a measure of "repetition priming", and Exemplar items a measure of "indirect priming" due to implicit activation.

At encoding, different groups of subjects performed one of three orienting tasks: (1) Category-classification (CC), in which the subject named the category from which the exemplar was drawn; (2) Pleasantness rating (PR), in which the subject rated the idiosyncratic pleasantness of the meaning of each word; (3) Letter-scanning (LS), in which the subject identified and recorded lower-case letters in the target word (as descibed below, target words were presented in mixed-case).

The Category-classification and Pleasantness rating tasks were designed to encourage semantic processing of the study words. Based on previous research (Einstein & Hunt, 1980; Hunt & Einstein, 1981), the nature of that processing is assumed to differ as a function of specific semantic orientation. Category classification is a variation of the sorting procedure used by Hunt and colleagues and is assumed to evoke relational processing of words from a single category. In line with the implicit activation literature cited above, this procedure was also expected to result in the activation of non-presented category members. The Pleasantness rating task requires that the presented word be considered in relation to other knowledge not necessarily related to categorical membership. This task was thus assumed to result in a more distinct or item-specific encoding than the category-classification task. The Letter-scanning task was a typical non-semantic orienting task designed to encourage relatively superficial processing of the study words. A number of studies to date have demonstrated that such non-semantic orientation produces performance equivalent to that of semantic orientation on indirect measures (e.g., Jacoby & Dallas, 1981). However, as noted in the introduction, these studies have invariably used unrelated stimulus materials.

A particularly tricky issue in implicit memory research concerns whether subjects truly retrieve information unintentionally at the time of test (see Schacter, 1987; Schacter, Bowers, & Booker, 1989). Because the study material can potentially be accessed intentionally, it is possible that subjects may adopt conscious retrieval strategies. The usual approach to this problem is to either (1) present the indirect test as one of several filler tasks (e.g., Gardiner, 1989; Graf, Squire, & Mandler, 1984) or (2) provide explicit instructions that subjects should (a) attempt to complete all test items (e.g., Gardiner, 1988; Gardiner, Dawson, & Sutton, 1989), and/or (b) respond "with the first word that comes to mind" (e.g., Schwartz, 1989). Based on previous research (Graf & Mandler, 1984; Roediger, Srinivas, & Weldon, 1989; Schacter & Graf, 1986) it would appear that these methods succeed in eliminating conscious retrieval strategies; differential effects of study variables are found when identical test cues are provided and only the nature of the test instructions (direct or indirect) differ. In the present study, both methods described above were used. In addition, subjects were allowed only one attempt to "solve" a particular test item within a limited response interval (10 seconds). The combination of these instructional constraints was expected to reduce the amount of strategic, reconstructive processes involved in the retrieval process.

However, the problem of ensuring an "implicit" retrieval mode was particularly acute in the present experiment because of the semantic effects predicted. Such effects are typically taken as prima facie evidence for explicit remembering (see Roediger et al., 1989). Experiment 1 attempted to counter this objection by also assessing explicit memory. Previous research (Einstein & Hunt, 1980; Hunt & Einstein, 1981) has shown that distinctive processing of related items produces higher levels of explicit memory (free recall) than relational processing. Thus, if category-classification produces greater fragment completion performance than pleasantness rating, and if this order of performance is reversed in free recall, we would have converging evidence that subjects adopted an implicit retrieval mode.

To summarize, the present experiment attempted to demonstrate that performance on fragment completion can show sensitivity to encoding operations when the retrieval environment is contextually similar to the encoding environment. Context can be conceptualized in a number of ways. Typically, the role of context in mediating memory performance is studied by manipulating the cues paired with study and test items (as, for example, in A-B, C-A designs). In these studies, context is conceptualized in terms of individual test items. However, context can also be viewed in terms of an entire task. For example, in Jacoby (1983a) the role of context was studied by manipulating the composition of test lists. That is, different groups of subjects were tested using lists containing different ratios of studied ("old") and non-studied ("new") items. Allen and Jacoby (1990) have shown that the enhancement in memory performance associated with reinstating study context is not the result of intentional retrieval strategies. Thus, the role of context in these studies can be conceptualized in terms of the overall processing demands made at study and test.

Experiment 1 attempted to show the importance of reinstating processing demands by using categorized lists and orienting tasks which emphasized different aspects of study items. Unlike the experiments described above (Jacoby, 1983a; Allen & Jacoby, 1990), the ratio of old and new items was the same for all groups. Thus, contextual reinstatement was in terms of processing demands - that is, the extent to which the processes engaged at study were also required at retrieval. It was hypothesized that an orienting task which emphasized categorical information (i.e., Category-classification) would result in more positive transfer to a categorically structured test, in comparison to orienting tasks which did not emphasize this type of information.

Method

Design, equipment, and subjects

The experiment was designed as a 3 x 3 mixed factorial with orienting task (Category-classification, Pleasantness rating, Letter-scanning) as a between-subjects variable and test-item status (Old, Exemplar, New) as a within-subjects variable. The performance measures were accuracy and completion time. Completion times can be used as a measure of study facilitation and thus may reveal the effects of elaborative processing in the absence of effects on accuracy. All stimuli were presented on a monochrome CRT (Amdek video-300). When response time was measured, subjects responded verbally; this triggered a Coulbourn voice switch (model S28-24) connected to a Tecmar Labtender in an IBM-XT. Seventy-two undergraduates, enrolled in introductory psychology classes, participated for course credit.

Materials

Eight exemplars from each of 8 categories were drawn from the Battig and Montague (1969) norms of free associations to category superordinates. The 8 categories were separated into two groups (A and B) and exemplars within a category were separated into two sets (1 and 2). Based on the rank order of exemplar production (Battig & Montague, 1969), sets contained an equal number of high- and low-production exemplars. This arrangement allowed lists to be constructed (A1, A2, B1, and B2) and rotated through conditions such that all items served an equal number of times in each role (old, exemplar, and new).

Study lists contained 16 items; 4 exemplars from each of 4 categories. Test lists contained 48 word fragments corresponding to critical items; 16 old, 16 nonstudied exemplars, and 16 items from nonstudied categories. With few exceptions, fragments contained the first letter of the word and were created by removing every other letter, with the restriction that the resulting fragment had only one completion. Thus, on average, fragments contained an equal number of letters and blanks.

The stimuli for all groups were constructed such that the letters to be provided in the subsequent fragment completion test were the same as those in upper-case in the study word (e.g., the study word for the test fragment T-U-P-T was TrUmPeT). As discussed above, the Letter-scanning task is a non-semantic orienting task designed to provide relatively superficial processing of the study words. Compared to a semantic orientation, such tasks typically produce poor performance on direct retention measures but equivalent performance on indirect measures. However, given the categorized structure of the study and test lists, we expected the letter task to produce relatively poor performance, even on the indirect measure. Thus, the Letter-scanning task was designed to provide as much useful information as possible without evoking semantic processing. The use of upper-case letters emphasized the stimulus pattern that would later have to be completed. The complete set of critical stimulus materials is presented in Appendix 1.

Both study and test lists were randomized with the exception that all categories represented (for the study list) and all test conditions appeared once before any was repeated. Because of the nature of the Letter-scanning task (see below), words were presented at study in mixed-case (e.g., "eXaMpLe") for all groups.

<u>Procedure</u>

For all subjects, the sequence of events was identical except for the orienting task. The sequence was as follows: (1) timed generation of surnames given a first name; (2) timed generation of cities given a state; (3) presentation of study list with appropriate orienting task; (4) free recall of states (USA); (5) fragment completion test; (6) free recall of study list. Tasks 1, 2, and 4 were filler tasks designed to disguise the indirect retention measure. In addition, tasks 1 and 2 were designed to provide subjects with practice on the reaction time task. All orienting tasks, to be described below, were incidental with respect to memory; no mention was made of the ensuing retention tests. The entire procedure lasted approximately 40 minutes.

Category-classification (CC). Subjects were informed that the task involved speed and accuracy in classifying category exemplars; their task was to name the category from which the item was drawn. They were also told about the form in which words were to be presented (i.e., mixed-case). An index card with labels of the four study categories was affixed under the computer screen for reference during the task. A trial began with the presentation of a set of arrows indicating the future location of the "test" item. Following a variable interval (500 to 1500 msec), a category exemplar in mixed-case was presented. As soon as the voice key had been triggered by the subjects response the item disappeared. A set of arrows for the next stimulus presentation appeared following a 1000 msec interval. To ensure relational processing, subjects were instructed to continue watching the CRT following list presentation for feedback on their performance; all study items were then presented on the CRT in upper-case letters with an appropriate category label and average reaction times per category.

Pleasantness rating (PR). Presentation of study items was the same as in the category-classification task except for the following. (1) The message "PLEASANTNESS?" appeared under the item after a delay of 1000 msec. Subjects were instructed to judge the pleasantness of the meaning of each word and were provided with a five-point scale (1 = unpleasant, 3 = neutral, 5 = pleasant). Judgements were entered on the computer keyboard. (2) Items remained on the screen until the subject had entered a rating. (3) Items were not re-presented at the end of the list.

Letter-scanning (LS). Presentation of study items was the same as in the pleasantness rating task except instead of the message "PLEASANTNESS?", the message "LETTERS?" appeared followed by the message "DIFFICULTY?" after a delay of 500 msec. Subjects were informed that the task involved judging the difficulty of reading words presented in mixed-case. They were instructed to (1) type in all the letters which were in lower-case to the prompt "LETTERS?" and (b) judge the relative difficulty of reading the word using a five point scale which was provided (1 = easy, 5 = difficult).

Each trial on the fragment completion test consisted of the presentation of a single fragment. Subjects were told that the task involved completing words with missing letters. No mention was made of the pior study experience. Subjects were allowed 10 seconds in which to produce a completion. A trial began with the presentation of a set of arrows indicating the future location of the test item. One second later, a fragment was presented. The computer screen was cleared immediately after a response was given or at the end of the 10 second trial. All responses were recorded by the experimenter. As soon as the voice key had been triggered by the subjects response the item disappeared. A set of arrows for the next stimulus presentation appeared following a 1000 msec interval.

Results

Unless specified, the terms "significant" and "reliable" are based on an alpha level of .05.

Fragment completion

Accuracy. The percentage of correct completions as a function of orienting task (CC, PR, LS) and test-item (Old, Exemplar, New) are presented in Table 2. Table 2 also contains facilitation scores (cf. "priming") for the Old and Exemplar conditions; this score can be viewed as measuring the effects of the prior study experience and is computed for each subject by subtracting performance on New items from that on Old and Exemplar items. A separate analysis of variance (ANOVA) was performaned on both measures (i.e., overall performance and facilitation).

Analysis of overall performance showed a main effect of test-item, $F(2,138)=110.9$, $MSe=.018$, $p < .0001$. The Least Significant Difference (LSD) for comparisons among means was .044. Thus, old items (.68) were completed significantly more often than Exemplar items (.44) which, in turn, were completed more often than New items (.37). Collapsing across orienting tasks, this effect suggests that the study manipulation was successful; in relation to New items both Old and Exemplar items showed significant facilitation. The main effect of orienting task did not reach significance, $F=1.41$. T-tests (LSD) revealed a difference only between CC (.52) and LS (.47); in separate comparisons, performance

Table 2. Mean percentage of correct completions and facilitation scores as a function of orienting task and test item in Experiment 1.

Orienting Task		Test Item: Old	Test Item: Exemplar	Test Item: New
	CC	.74	.48	.34
	Facilitation	.40	.13	
	PR	.70	.43	.38
	Facilitation	.31	.04	
	LS	.61	.42	.37
	Facilitation	.24	.05	

Note: Facilitation ("priming") scores were computed for each subject by subtracting performance on New items from that on Old and Exemplar items. CC = Category-classification; PR = Pleasantness rating; LS = Letter-scanning.

following PR (.50) did not differ statistically from the other two groups. The interaction between test-item and orienting task was marginally significant $F(4,138)=2.30$, $MSe=.018$, $p < .07$. Post-hoc comparisons (Newman-Keuls) revealed a number of reliable differences (alpha = .05). First, completion performance on Old items following the non-semantic task LS (.61) was less than that following both of the semantic tasks: PR (.70) and CC (.74). Second, performance on Old items was greater than that on Exemplar items for all three study groups. Third, only the CC group completed Exemplar items at a level reliably greater than that with New items. Finally, performance on New items was not significantly different among the three study conditions. This null finding shows that baseline performance was statistically equivalent among the three groups and therefore justifies the analysis of facilitation scores presented next.

Analysis of facilitation scores revealed a main effect of test-item, $F(1,69)=102.02$, $MSe=.02$, $p < .0001$. As expected, facilitation was larger for items actually presented at study (i.e., Old items, .32) than for items only semantically related to presented items (i.e., Exemplar items, .08). The main effect of orienting task was also significant, $F(2,69)=3.74$, $MSe=.048$, $p < .03$. T-tests (LSD) showed facilitation following CC (.26) to be significantly greater than both PR (.18) and LS (.15), which did not differ from each other. The interaction between test-item and orienting task was not reliable (F=1.14). Post-hoc comparisons (Newman-Keuls) were generally similar to the main effect results reported above: for Old items, CC (.40) produced greater facilitation than both PR (.31) and LS (.24), p's $< .05$; the difference between the latter two groups was not reliable. Similarly, facilitation in completing Exemplar items was most apparent following CC (.13); this level of performance exceeded that in both the PR (.04), $p < .10$, and LS (.05), $p < .06$, conditions.

Completion time. The mean times (ms) required to complete test fragments as a function of orienting task and test item are presented in Table 3. An ANOVA revealed only an effect of test item, $F(2,138)=27.88$, MSe=778331, $p < .0001$. T-tests (LSD) showed all means to be reliably different: Old items (2350) were completed significantly faster than Exemplar items (3100) which, in turn, were completed faster than New items (3420).

Table 3. Mean completion times (ms) as a function of orienting task and test item in Experiment 1.

Orienting Task		Test Item	
	Old	Exemplar	New
CC	2287	3028	3161
PR	2232	2956	3496
LS	2533	3317	3603

Note: CC = Category-classification; PR = Pleasantness rating; LS = Letter-scanning.

Free Recall

Two analyses were performed on the free-recall results; one on the simple proportion recalled and a second on an adjusted score which corrected for recall intrusions. The use of categorized lists and incidental memory instructions at encoding was expected to result in a high percentage of guesses on the final recall test. Thus, similar to corrected recognition scores (i.e., hits minus false alarms), adjusted recall scores were calculated to provide a more accurate depiction of recall memory.

An ANOVA of the simple proportions yielded a significant effect of study orientation, $F(2,69)=62.0$, $MSe=.0205$, $p < .0001$. As can be seen in Table 4, recall following LT was much lower than that following CC and PR; however, the difference between the latter two groups was not reliable. Because of the high level of recall intrusions (17% of the total number of items output), a second analysis was performed on on an adjusted recall score which subtracted intrusions from target items recalled. This analysis was also was significant, $F(2,69)=43.03$, $MSe=.028$, $P < .0001$. T-tests showed all group means to be significantly different (see Table 4).

Table 4. Mean percentage of items recalled and adjusted percentage of items recalled as a function of orienting task in Experiment 1.

Orienting Task	Recall Measure: Unadjusted	Recall Measure: Adjusted
CC	.62	.49
PR	.67	.61
LS	.25	.18

Note: Adjusted recall was computed for each subject by subtracting recall intrusions from target items recalled. CC = Category-classification; PR = Pleasantness rating; LS = Letter-scanning.

Disscussion

The results of Experiment 1 were generally consistent with predictions. On fragment-completion, Category-classification (CC) produced the highest level of performance followed by Pleasantness rating (PR) and, finally, the non-semantic Letter-scanning (LS) task. Assuming that the analysis of facilitation scores provides the most accurate depiction of the data, completion of Old items did not differ statistically for the PR and LS groups; both, however, facilitated performance less than CC. Performance on Exemplar items also followed this general trend; completion of non-studied category members exceeded baseline only in the CC group. It was not the case, however, that category-classification resulted in superior performance on all retention measures; on the direct measure of free recall, pleasantness ratings produced the most accurate performance.

Fragment completion has been described as an implicit measure of memory because subjects are not instructed to "remember" items from the previous study experience, but only to complete test items with "the first word that comes to mind." In addition, a variety of studies have shown performance on this measure to be equivalent following semantic and non-semantic processing (Graf & Mandler, 1984; Jacoby & Dallas, 1981). Unlike previous studies, the present experiment used categorized words at both study and test and found a clear advantage for semantically processed words. The strongest implication of the present set of data is that unconscious retrieval processes are highly sensitive to, and affected by, previous conceptual operations; the influence of these operations, however, is dependent upon reinstatement of the relevant study context. As discussed above, previous failures to demonstrate an effect of semantic processing on indirect measures of memory may largely reflect a lack of contextual overlap between study and test (Jacoby, 1983a; Toth & Hunt, 1990).

Of course, the strong conclusion presented above would be suspect if subjects attempted to intentionally recall study items during the fragment completion test. A number of points, both methodological and empirical, argue against this interpretation. First, "study" processing was incidental with respect to memory and the fragment completion test was presented as one of a number of unrelated tasks. Subjects were instructed to complete all items with the first word that came to mind and could not go back to previously unsolved items. Other researchers (e.g., Graf & Mandler, 1984; Roediger, Srinivas, & Weldon, 1989; Schacter & Graf, 1986) have provided evidence that these indirect testing methods eliminate conscious retrieval strategies. In addition to these methods, the present experiment restricted the amount of time each test stimulus was present, further reducing the usefulness of conscious, reconstructive strategies. Important here is the fact that, although subjects were allowed 10 seconds to complete any test item, the average completion time for Old items was just over 2 seconds.

Additional evidence that retrieval in fragment-completion was unintentional is provided by the dissociation between that measure and free recall. Completion performance following Category-classification was superior to that following Pleasantness rating and Letter-scanning. Yet on the direct measure of free recall, PR produced performance superior to that of CC (cf. Einstein & Hunt, 1980; Hunt & Einstein, 1981). If completion performance was based on intentional retrieval, the pleasantness rating group would have shown the highest level of completions.

The present set of results therefore suggest that unconscious retrieval processes are indeed sensitive to previous conceptual operations. Given the theoretical analysis outlined in the introduction, these results should not be surprising. The form of processing engaged by category-classification would be most effective in a retrieval environment characterized by the presence of categorical information. All groups were presented at study with a perceptual stimulus pattern that was specific to a subsequent test item. However, unlike PR and LS, Category-classification presumably engaged conceptual operations more specific to those required on the fragment test.

In this regard, it can be speculated that PR acted similar to other semantic orienting tasks used in studies of implicit memory - tasks which have not produced higher performance relative to non-semantic orientation (Graf & Mandler, 1984; Jacoby & Dallas, 1981). Although a form of semantic processing, pleasantness ratings require study items to be considered in relation to knowledge other than category membership. In the absence of test demands that re-engage this form of processing, no effect of semantic orientation would be expected. It would appear to be the categorically structured nature of the test list that allowed the effect to emerge in the CC group (cf Winnick & Daniel, 1970).

Finding an effect of semantic processing on an indirect measure raises interesting theoretical questions, one of which concerns the issue of test awareness and its relation to intentionality (see Schacter et al., 1989). Although awareness of a prior episode is often taken to imply intentionality at retrieval, the two concepts are theoretically distinct. It is quite possible to be aware of the relationship between a current and past episode and yet not consciously attempt (i.e., intend) to retrieve information from that episode. Nevertheless, awareness of the past would appear to make intentional retrieval a more likely possibility.

Although rarely assessed, it appears that a substantial number of subjects in studies of implicit memory become aware that previously presented items are re-presented at test (see, e.g., Bowers & Schacter, 1990; Richardson-Klahven & Bjork, 1988; Schacter, 1987). In the present experiment, informal interviews following the fragment completion test suggested that the majority of subjects were aware that some test items had been presented earlier. However, even when questioned directly, no subject reported attempting to recall study items. The most frequent comment was that the temporal constraints of the test and the degraded nature of the stimulus made recall an ineffective strategy. Most subjects reported that the solution word simply "popped into mind", after which they assessed whether or not it had been presented earlier.

Nevertheless, the presence of test awareness raises the possibility that retrieval was not entirely unintentional, but rather involved "involuntary explicit memory" (Schacter, 1987). According to Schacter (1987; see also, Richardson-Klavehn & Bjork, 1988), involuntary explicit memory occurs "when a test cue leads to an unintentional but fully conscious and explicit `reminding' of the occurence of a prior episode" (p.510). In the present experiment, it seems unlikely that test cues per se (i.e., word-fragments) reminded subjects of the prior study experience. Test solutions, however, probably had this effect. Furthermore, the high rate of completion performance following category-classification suggests that subjects in this condition were in a better position to become aware of the relationship between study and test. The question, of course, is whether knowledge of this relationship was used to initiate intentional retrieval. Although the dissociation between orienting task (CC vs. PR) and retention measure (fragment completion vs. free recall) is consistent with the claim that retrieval was unintentional, the dissociation was rather weak. Stronger conclusions could be drawn if even the possibility of consciously-controlled retrieval was eliminated. The second experiment was designed to achieve this goal.

CHAPTER 3

EXPERIMENT 2

The predominant method of assessing unconscious retrieval processes has involved the use of indirect retention measures such as fragment completion or perceptual identification. The assumption underlying this method is that task instructions or other procedural details (see above) are sufficient to preclude the use of intentional retrieval strategies. This assumption may be invalid for a number of reasons. As discussed above, it is very likely that subjects become aware of the nature of indirect measures once they have been presented with a number of study items. Awareness need not imply intentionality, but the conditions under which subjects intentionally retrieve information from past episodes are little understood. Indirect memory instructions provide no control over the processes actually engaged (note 3).

A more important reason for questioning whether indirect retention measures provide the best index of unconscious retrieval is that no test of memory may be process pure. All retention measures may involve both conscious (intentional) and unconscious (unintentional) processes operating interactively. This assumption is consistent with the position that conscious strategies can enhance performance on indirect measures (see Richard-Klavehn & Bjork, 1988, esp. pp. 527-528); and with the view that "implicit" retrieval may support performance on direct measures (Chiarello & Hoyer, 1988; Graf, Squire, & Mandler, 1984; Jacoby & Hollingshead, 1990; Shimamura, 1986). Such observations suggest that specific retrieval processes cannot be identified with individual retention measures. What is required is a method that separates intentional from unintentional retrieval within a single task.

One strategy for separating the two forms of memory involves manipulating the time available for stimulus processing. This strategy relies on the distinction between automatic and controlled processing (LaBerge & Samuels, 1974; Posner & Snyder, 1975; Shiffrin & Schneider, 1977) and assumes that unintentional retrieval shares important characteristics with processes described as automatic. Compared with consciously-controlled processes, automatic processes are described as faster, requiring less effort, and occurring without intent or awareness. If unintentional retrieval is an automatic process, it may be possible to preclude the influence of conscious, reconstructive retrieval strategies by employing a retention measure that requires a fast response.

One paradigm which meets this criterion is the response signal ("deadline") procedure. Following a study experience, subjects are presented with individual test items followed by a signal to respond. By varying the delay between presentation of the test item and presentation of the response signal, the experimenter can control the amount of time available for stimulus processing.

Response signal procedures have been used previously to explore various aspects of memory. Developed by Reed (1973, 1976), the procedure has been used to reveal the time course of retrieval. By using a variety of response signal delays (e.g., 100, 300, 600 ms, etc.), the procedure can provide data concerning the speed with which information becomes available and has been used to assess the effects of semantic priming on bias and discrimination of target items (Dosher, McElree, Hood, & Rosedale, 1989), the differential availability of item and associative information (Gronlund & Ratcliff, 1989), and the relationship between memory and inference following text processing (McKoon & Ratcliff, 1989).

Experiment 2 used the response signal procedure to assess the mnemonic effects of semantic and non-semantic processing at different times in the recognition process. Recognition was chosen for two reasons. First, it is easily integrated with the response signal procedure. More importantly, a variety of theoreticians have described recognition as involving a number of component processes, both conscious and unconscious in nature. Dual process theories (Gillund & Shiffrin, 1984; Jacoby & Dallas, 1981; Mandler, 1980) propose that recognition decisions can be based on two independent sources of information, recollection and familiarity. Recollection is a consciously-controlled (intentional) "search" process that requires the recall or reconstruction of a relevant prior experience. Alternatively, familiarity can be viewed as an unintentional, automatic influence of memory. If recollection requires more time than the assessment of familiarity, then an early response signal during the recognition process may isolate familiarity-based responding.

Roediger and colleagues (Roediger & Blaxton, 1987b; Roediger, Weldon, & Challis, 1989; see also, Jacoby, 1983b) have suggested that recognition be understood as a mixture of data-driven and conceptually-driven processes. Part of the rationale for this suggestion is that, while operationally a direct ("explicit") measure of memory, recognition often responds similarly to manipulations which influence performance on indirect measures. Although the critical variables have not been identified, under some conditions recognition may show sensitivity to study-test changes in surface information such as modality (Hashtroudi, Ferguson, Rappold, & Chrosniak, 1988; Jacoby & Dallas, 1981). Such sensitivity is a defining characteristic of data-driven processing - a form of processing associated with implicit memory (Roediger & Blaxton, 1987).

Although the response signal procedure can restrict the amount of time a stimulus is available, it is unclear at what point intentional retrieval would be precluded. However, by manipulating the modality in which information is presented, it may be possible to separate the data-driven component from the conceptually-driven component in recognition. Modality effects are typically found on indirect retention measures; a modality effect can therefore act as a "marker," indicating the point in time at which retrieval is predominantly unintentional. The question of interest is whether prior semantic processing will facilitate performance more than non-semantic processing at this point in the recognition process.

To summarize, Experiment 2 manipulated orienting task and study-test modality in a response signal procedure to assess the effects of semantic input processing on unintentional retrieval. At input, subjects were presented with a list of words, half visual, half auditory. Input words were processed either semantically (pleasantness rating) or non-semantically (rhyme judgment). Recognition memory was assessed by presenting old and new items followed by a signal to respond; the signal occurred either 500 or 1500 ms after the test item was presented. All test items were presented visually.

Jacoby, Woloshyn, and Kelly (1989) have used manipulations of attention to study unconscious influences of memory. In those studies, dividing attention reduced subjects' ability to consciously recollect a prior study experience, thus allowing effects on unintentional retrieval to emerge. The present experiment can be viewed as employing an analogous strategy. A short (500ms) delay was expected to prevent conscious, reconstructive retrieval processes; a long (1500ms) delay, to allow such processes to operate. Modality was manipulated to provide an independent index of unintentional retrieval. It was predicted that responding at the short delay would be marked by substantial modality effects which would be attenuated at the long delay. In line with the results of Experiment 1, an effect of semantic processing was expected to occur at both points in time.

Method

Design and subjects

The experiment was designed as a 2 x 2 x 3 mixed-factorial. Orienting task (pleasantness rating, rhyme judgment) and response signal delay (500ms, 1500ms) were manipulated between subjects. The relationship between test words and prior study experience was manipulated within subjects; all test words were presented visually and included words previously read (visual), heard (auditory), and words that had not been presented (new). Twenty-four subjects participated in return for credit in introductory psychology courses. Subjects were tested individually.

Materials and equipment

A total of 96 nouns, from 4 to 7 letters in length and ranging in frequency from 1 to 442 occurrences per million (Kucera & Francis, 1967), were used as critical stimulus materials. Forty-eight of those words were separated into two sets of 24 for use at study. The remaining 48 words were used as distractors on the recognition test. Distractor (new) words were not rotated with study words, as the main comparisons of interest involved the effect of study modality (visual vs. auditory) on recognition performance. Average frequencies (Kucera & Francis, 1967) of the two study sets and the distractor set were 72.3, 72.3, and 70.5, respectively. In addition to the critical words, eight medium-frequency (53-72 occurrences per million) words were used as primacy and recency buffers at study. The complete set of critical stimuli are provided in Appendix 2.

Except for the auditory study list (see below), all stimuli were presented on a monochrome CRT (Amdek video-300). When reaction time was measured, subjects responded by pressing a key on a tone generator; this triggered a Coulbourn voice switch (model S28-24) connected to a Tecmar Labtender in an IBM-XT.

Procedure

The experiment was conducted in three phases; study, response training, and test. In the study phase, subjects were informed that word-judgments were being collected for normative purposes; thus, the study phase was incidental with respect to memory. Subjects were told that they would be presented with a list of words, half of which would be presented on the computer screen and half of which would be read by the experimenter. Subjects in the pleasantness rating condition were told that their task was to rate the pleasantness of each word using a five-point scale which was attached below the computer screen (1 = unpleasant, 3 = neutral, 5 = pleasant). Subjects were told to think about the meaning of each word and to rate the pleasantness of that meaning on the response sheet provided. Subjects in the rhyme judgment condition were told that their task involved rating how difficult it is to produce rhymes for the presented words, using a five-point scale (1 = very easy, 5 = very difficult). Subjects were told that, to make their judgment, they could either come up with rhymes silently or make an intuitive judgment based on the sound of the word. Study lists were presented in an alternating fashion (visual, auditory, visual, auditory, etc.) using a different random order for each subject. Four primacy (2 visual and 2 auditory) and four recency (2 visual and 2 auditory) items were also presented. Visual words were presented in the center of the CRT and remained on the screen for one second. Subjects were allowed as much time as they needed to make their rating; once a response had been made, the next word was provided.

The second phase of the experiment was designed to give subjects practice with the response signal procedure. Following McKoon & Ratcliff (1989), a lexical descision task was used because it requires no study experience and allows for quick training. The sequence of events for this task was as follows. A set of arrows indicating the future location of a test string appeared in the center of the CRT. One second later a test string (word or non-word) appeared between the arrows. After 500 or 1500 ms (depending on the delay condition), a row of 24 asterisks appear 2 lines under the string. Subjects were instructed to respond within 400 ms after the asterisks appeared; "yes" responses (words) were made with the right hand, "no" responses (non-words) with the left hand. Immediately after a response was made the screen was cleared and the response time was displayed at the top of the screen. If the response time was faster than 50 ms the message "Too fast... Wait for the stars" was displayed. If the response time was slower than 400 ms, the message "Too slow... Try to respond faster" was displayed. If the response time was within this range (50-400), the message "Good!!!" was displayed.

Following the training phase, subjects were informed that their memory for words presented in phase 1 would be tested. They were told that test words would be presented in the same format as letter strings in the preceeding task and that their responses should occur within 400 ms after the asterisks appeared. They were told to respond "yes" if the word was presented in phase 1 and "no" if it was not. The testing procedure was identical to that used in phase 2 with the exception of the test stimuli. The test list was random with the exception that visual, auditory, and new items were equally distributed throughout.

Results

Responses were included for analysis if they occurred within 50 to 500 ms after the response signal appeared. Timing errors due to subjects or equipment occurred on 189 (8%) of the 2304 test trials. Data were analyzed in terms of both accuracy and response time (within the 50-500 ms range).

Accuracy

The percentage of items correctly recognized (hits and correct rejections) as a function of orienting task (pleasantness rating, rhyme judgment), response signal delay (500, 1500 ms), and study item (visual, auditory, new) are presented in Table 5. Table 5 also contains corrected recognition scores (hits - false alarms) for visual and auditory items.

Table 5. Mean percentage of correct recognitions and corrected recognition scores as a function of orienting task, delay, and study item in Experiment 2.

		Orienting task			
		Semantic		Non-semantic	
	Delay:	500	1500	500	1500
Study Item	Visual	.86	.94	.74	.77
	Corrected	.67	.84	.51	.53
	Auditory	.68	.90	.58	.77
	Corrected	.49	.80	.35	.53
	New	.81	.91	.76	.75

Note: Semantic orientation was pleasantness rating. Non-semantic orientation was rhyme judgment. Corrected recognition scores were calculated for each subject by subtracting false alarms from hits.

An overall analysis of correct recognitions (hits and correct rejections) revealed main effects of orienting task, F(1,20)=15.2, MSe=.048, p < .002, delay, F(1,20)=11.0, MSe=.048, p < .004, and study item, F(2,40)=4.8, MSe=.012, p < .02. Superior performance was found for pleasantness rating as opposed to rhyme judgment (.85 vs. .73), and for the 1500 ms delay as opposed to the 500 ms delay (.84 vs. .74). The main effect of study item was a function of the low hit rate for auditory study items (.73) in comparison to visual study items (.83) and correct rejection of new words (.81). The interaction between delay and study item was also significant, F(2,40)=3.8, MSe=.012, p < .03. As with the main effect of study item, this interaction was almost entirely due to performance on auditory study items; recognition increased from .63 at the 500 ms delay to .84 at the 1500 ms delay. Comparable increases across delay (500 to 1500) were much smaller for both visual study items (.80 to .86) and new items (.79 to .83).

The most important aspects of the data involved recognition of studied words (visual and auditory) as a function of orienting task and delay. For these items, separate analyses were performed on both the unadjusted recognition scores and the corrected scores (hits - false alarms). Given that both analyses produced the same pattern of results, only the analysis on corrected scores is reported. Pleasantness ratings produced more accurate performance than rhyme jugdments (.70 vs. .48), $F(1,20)=15.8$, $MSe=.038$, $p < .0007$; performance following the 1500 ms delay was better than that following the 500 ms delay (.67 vs. .50), $F(1,20)=9.0$, $MSe=.038$, $p < .007$; and visual study produced higher performance than auditory study (.64 vs. .54), $F(1,20)=22.2$, $MSe=.0048$, $p < .0001$. More important, the interaction between delay and study modality was highly reliable, $F(1,20)=13.8$, $MSe=.0048$, $p < .002$. Whereas visual study items were more accurately recognized than auditory study items at the 500 ms delay (.59 vs. .42), this difference was nearly eliminated at the 1500 ms delay (.68 vs. .66). This interaction strongly suggests that different psychological processes mediated performance at the two delays.

The three-way interaction was not reliable ($F=.11$), indicating that an effect of orienting task was present at both the 500 and 1500 ms delays. Post-hoc comparisons (Newman-Keuls) showed that, within modality, orienting task had a significant influence on performance at the 500 ms delay ($p < .01$, for both the visual and auditory items). A final set of comparisons showed that performance on visual items following non-semantic orientation did not increase across delay (.51 vs. .53); semantic orientation, however, resulted in a significant increase in performance for visual items (.67 vs. .84).

Response time

Only response times occurring within the 50-500 ms range were accepted for analysis. Table 6 presents mean response times, conditionalized on correct recognition (hits and correct rejections), for each of the experimental conditions. In an analysis these data, only the effect of orienting task approached significance, $F(1,20)=2.99$, $MSe=10254.9$, $p < .10$; responses following semantic orientation (246 ms) were slightly faster than those following non-semantic orientation (270 ms). Post-hoc comparisons (Newman-Keuls) showed that responses to visual study items at the 1500 ms delay were faster following semantic (227) than non-semantic orientation (277), $p < .01$; however, although in the same direction, a similar comparison for auditory study items was not reliable.

One other aspect of the response time data may be worth emphasizing. As noted by Gronlund and Ratcliff (1989), response signal experiments typically show decreasing latencies as a function of delay. As can be seen in Table 6, this pattern occurred following semantic orientation but not following non-semantic orientation. Reed (1976) has suggested that latency be viewed as reflecting relative preparedness to respond and that differences between conditions might indicate different processing demands. Although not overwhelming, the pattern of response time data suggests that the processing demands at test were not equivalent following semantic and non-semantic study.

Table 6. Mean response time, conditionalized on correct recognition, as a function of orienting task, delay, and test item in Experiment 2.

		Orienting task			
		Semantic		Non-semantic	
	Delay:	500	1500	500	1500
Study Item	Visual	255	227	264	277
	Auditory	267	244	277	270
	New	245	237	262	268

Note: Semantic orientation was pleasantness rating. Non-semantic orientation was rhyme judgment. Only response times occurring within 50 to 500 ms following response signal were included.

Discussion

Experiment 2 manipulated the time available for word recognition in an attempt to separate intentional from unintentional retrieval processes. Using a response signal procedure, it was hypothesized that short target-signal delays would prevent the use of conscious, reconstructive retrieval strategies whereas long delays would allow such strategies to operate. The results of the experiment strongly suggest that the manipulation was successful.

Study modality was manipulated in order to provide a marker for the operation of unintentional retrieval processes. For both orienting tasks a large modality effect was found at the 500 ms delay, but the effect was virtually eliminated at the 1500 ms delay. This interaction indicates that different psychological processes mediated performance at the two delays. Although modality effects are sometimes obtained in recognition memory (Hastroudi et al., 1988; Jacoby & Dallas, 1981), like free recall, recognition performance is usually equivalent following visual and auditory study (Kirner, Milech, & Standen, 1983; Roediger & Blaxton, 1987a). Indirect measures, on the other hand, invariably show modality effects (Graf, Shimamura, & Squire, 1985; Jacoby & Dallas, 1981; Kirsner et al., 1983; Kirsner & Smith, 1974; Roediger & Blaxton, 1987b). Indeed, sensitivity to study-test changes in surface information has been taken as a criterial difference between implicit and explicit memory (Roediger & Blaxton, 1987b; Schacter, 1987). Thus, the interaction between modality and delay is consistent with the assumption that intentional retrieval processes were considerably attenuated at the short delay.

Nevertheless, a large effect of orienting task was found at both points in the retrieval episode. Semantic study produced better performance than non-semantic study irrespective of total processing time at recognition. An effect of orienting task was expected at the long delay (Craik & Tulving, 1975) and suggests that performance in this condition was a function of intentional retrieval processes. Similar effects have been found using fast-response recognition paradigms (see Gillund & Shiffrin, 1984); however, the current experiment demonstrates that this effect can be obtained simultaneously with a large effect of modality, and therefore represents a novel and challenging finding. Consistent with the results from Experiment 1, this pattern of data suggests that unintentional retrieval processes can be influenced by previous conceptual operations.

Dual-process models of recognition (Gillund & Shiffrin, 1984; Jacoby & Dallas, 1981; Mandler, 1980) propose that recognition decisions can be based on either familiarity or recollection. In these models, familiarity is treated as a more automatic basis for responding than is recollection. Familiarity-based responding is generally faster than recollective-based responding and does not require the intentional retrieval of contextual details associated with a study experience. The pattern of results obtained in the present experiment is in accord with this theoretical decription. However, the assumption that stimulus familiarity is a function of the perceptual similarity between initial experience and subsequent exposure (Jacoby & Dallas, 1981; Mandler, 1980) was not supported. The present results suggest that familiarity-based responding is not a function of perceptual similarity alone; the conceptual operations performed at study also appear to influence this aspect of the recognition process.

A related point can be made concerning Roediger's approach to recognition (Roediger & Blaxton, 1987b; Roediger, Weldon, & Challis, 1989). Based on parallels and dissociations between recognition and indirect measures of memory, Roediger has suggested that recognition be understood as a composite of data-driven and conceptually-driven components. Presumably, the data-driven component of recognition accounts for the effect of surface-level manipulations, whereas the conceptually-driven component accounts for semantic effects. Although at some level this characterization appears correct, the present set of results questions whether the two components can be separated experimentally. Requiring a fast recognition decision produced a large modality effect, thus indicating the presence of data-driven processing. But conceptually-driven processes were equally apparent and at a very early stage in retrieval. At the very least, these results suggests that data-driven and conceptually-driven processing are highly interactive (see Hunt & Toth, 1990; Toth & Hunt, 1990).

As discussed above, the effect of target-signal delay can be viewed as influencing a subject's basis for responding; at the short delay, responding was presumably automatic and unintentional - based on a word's familiarity; at the long delay, responding was a function of consciously-controlled processes. Certain aspects of the data, however, suggest that it may be inappropriate to associate processing times with particular bases for responding. The amount or type of input processing may also influence what information or processes are relied upon and this influence may sometimes be independent of response time.

For both orienting tasks, performance on auditory study items improved with increases in target-signal delay. This can be interpreted as reflecting the use of conscious retrieval strategies; given sufficient processing time, recognition is based on a study words' referent, not its perceptual pattern. Visual items, on the other hand, revealed a different pattern of performance. Following semantic processing, performance on visual study items increased across the delay conditions; however, virtually no increase was observed for non-semantically processed items.

Taken together, these results suggest that, following semantic study and given sufficient processing time, subjects can improve their performance by consciously recollecting a word's prior presentation. However, if the item to be remembered is not elaboratively processed (as is the case with non-semantic study), subjects may rely predominantly on familiarity-based responding, regardless of the processing time available.

Although not conclusive, the response time data are consistent with this interpretation. Following semantic orientation, responding was faster at the 1500, as compared to the 500 ms, delay. This suggests a difference in readiness to respond (Reed, 1976) and implies that the increased delay allowed additional (analytic/contextually detailed) information to become available. No similar pattern was observed following non-semantic orientation, suggesting that readiness to respond was the same at both delays. This would be expected if responding was based only on familiarity.

Of course, the interpretations offered above would require modification if responding at the short delay was based on intentional, conscious recollection. Because recognition is typically viewed as a direct, explicit measure of memory, it could be argued that the response signal procedure simply alters the way intentional retrieval processes are expressed. According to this argument, the effect of orienting task at both delays would be attributed to intentional retrieval processes. The effect of restricting response time would simply be to increase the relative contribution of perceptual (or data-driven) processes or representations. Experiment 3 was designed to provide further evidence that performance at the short delay was a function of automatic (and thus, unintentional) retrieval processes.

CHAPTER IV

EXPERIMENT 3

Experiment 2 used a response signal procedure in an attempt to separate intentional from unintentional retrieval processes. The interaction between delay and modality suggests that the procedure was successful. However, it is possible that some level of conscious control was operating at the short delay. Recently, Jacoby (e.g., Jacoby et al., 1989; Jacoby & Whitehouse, 1989) has developed a method by which unconscious influences of memory can be unambiguously identified. This "exclusion" methodology, described below, offers a converging operation on the response signal procedure and can be used to provide conclusive evidence that unintentional retrieval is sensitive to previous conceptual operations.

One of the difficulties in making conclusions about the effects of unconscious processes is that conscious processes can usually produce similar effects. For example, thinking about a word in one situation may increase the probability that the word automatically comes to mind in a similar situation. If there was no intent to remember the original episode, this would be an unconscious influence of memory. However, the word could also be brought to mind by consciously recollecting the original episode. The psychological processes involved may be very different in the two cases; however, the effect (retrieving the word) is the same. Thus, without conclusive evidence that one set of processes were prevented from occurring, it can always be argued that so-called unconscious influences were actually produced by consciously-controlled processing that went undetected by the experimenter. Such is the case with the experiments reported above. Performance was influenced by previous meaningful processing; however, because effects of this sort have been shown to occur (in fact, have occurred most often) in the presence of conscious, intentional retrieval strategies, it can be argued that such strategies were present but undetected. (Of course, this explanation does not account for the dissociation obtained in Experiment 1, nor the modality effects found in Experiment 2).

One way around this interpretive problem is to set unconscious influences in opposition to conscious ones (e.g., Jacoby & Whitehouse, 1989). If unconscious processes can be made to produce an effect opposite to that which would occur if processing was consciously-controlled, unconscious influences can be isolated. This was the strategy used by Jacoby et al. (1989) to study the effects of unintentional retrieval on subjective judgments. In those experiments, subjects were asked to make fame judgments to a list of names, some of which were non-famous names they had read earlier in the experiment. Subjects were told that all of the names read earlier were non-famous. Nevertheless, in comparison to a set of new names, more of the old names were judged as famous. This can be clearly interpreted as an unconscious influence of memory because if subjects could consciously recollect a names prior occurrence, they could be sure it was not famous. Thus, assumming that one of the functions of consciousness is to resist the influence of the past, placing conscious and unconscious processes in opposition can be useful for assessing their separate contributions to performance.

Experiment 2 provided evidence that unintentional retrieval is differentially affected following semantic and non-semantic study. This conclusion was predicated on the assumption that forcing subjects to respond very quickly to test words prevented the use of intentional retrieval strategies. However, it is possible that subjects consciously recollected the words' prior occurrence, thus producing the effect of orienting task. In order to distinguish between these interpretations, Experiment 3 employed the "opposition logic" described above.

In the first phase of the experiment, different groups of subjects processed a visually presented list of words either semantically or non-semantically. In this phase, no mention was made of the subsequent memory test. Next they were presented with a list of words aurally and told to remember them for a test of recognition memory. The test list contained the visually and aurally presented words and a set of new words not previously presented. Prior to the test, subjects were told that words from the first phase (and new words) would be included on the test list; however, they were instructed to respond positively (i.e., say "yes") only to those words they were told to remember (those presented aurally).

As in Experiment 2, the test list was presented using the response signal procedure; half of the subjects were given a signal to respond 500 ms after the test word appeared, while the other half were given a response signal following a delay of 1500 ms. If responding at the 500 ms delay is based on conscious recollection then subjects should be able to respond negatively to words presented in the first phase of the experiment; false alarm rates for old visual words should be no greater than that found for new words. Alternatively, if responding at the short delay is based on familiarity, and familiarity is an automatic, unintentional form of retrieval, then the false alarm rate for old visual items should be higher than that for new items. Furthermore, if semantic study produces a higher false alarm rate than non-semantic study, a strong case can be made that unintentional retrieval is influenced by how meaningfully an item was originally processed.

Method

Design and subjects

The experiment was designed as a 2 x 2 x 3 mixed-factorial. Orienting task (pleasantness rating, letter judgment) and response signal delay (500ms, 1500ms) were manipulated between subjects, whereas study item (visual, auditory, no study (new)) was manipulated within subjects. Visual items were presented in the first phase of the experiment under incidental memory instructions and were processed either semantically (pleasantness rating) or non-semantically (letter judgment). The letter judgment task was used instead of the rhyme judgment task (Experiment 2) to reduce the possibility of interference with the aurally presented words in Phase 2. The auditory words were presented under intentional memory instructions. For any individual subject, new words were first encountered at the time of test. All test words were presented visually. Thirty-two subjects participated in return for credit in introductory psychology courses. Subjects were tested individually.

Materials and equipment

A total of 120 nouns, from 4 to 8 letters in length and ranging in frequency from 1 to 442 occurrences per million (Kucera & Francis, 1967), were used as critical stimulus materials. Sixty of those words were separated into two sets of 30 for use at study (visual) and as new words on the test of recognition. These two sets were rotated through conditions such that each set was used an equal number of times as Phase 1 study words and as new test words. Average frequncies of the two sets were 93.2 and 93.5. The remaining 60 words were used as the aurally presented list in Phase 2. Average frequency for these 60 words was 43.6. Words from the aurally presented list were not rotated with study words, as the main interest was in false alarm rates as a function of orienting task (semantic vs. non-semantic) in comparison to words not previously presented (i.e., new words). In addition to the critical words, eight medium-frequency (53-72 occurrences per million) words were used as primacy and recency buffers in Phase 1. The complete set of critical stimuli are provided in Appendix 3.

Except for the auditory study list (see below), all stimuli were presented on a monochrome CRT (Amdek video-300). When reaction time was measured, subjects responded by pressing a key on a tone generator; this triggered a Coulbourn voice switch (model S28-24) connected to a Tecmar Labtender in an IBM-XT.

Procedure

The experiment was conducted in four phases; incidental study, intentional study, response training, and test. The incidental study phase was identical to that in Experiment 2 with the exception of the letter judgment task. For this condition, the concept of bi-gram frequency was explained and subjects were told that their task involved scanning each word in order to identify which pair of adjacent letters they believed appeared most infrequently in the English language. All words in Phase 1 were presented visually, in the center of the CRT, and remained on the screen for one second. Subjects were allowed as much time as they needed to make their rating; once a response had been made, the next word was provided. A different randomly ordered list was used for each subject. In addition, four primacy and four recency items were also presented.

In the second phase of the experiment the auditory word list was presented under intentional memory instructions; subjects were told to expect a recognition memory test at the end of the experiment. The list was read by the experimenter at a rate of approximately one word every three seconds. Subjects repeated each word aloud.

Phase 3 (training) was described as an intervening task between study and test and was procedurally identical to the training phase in Experiment 2. Following the training phase, subjects were informed that their memory would be tested for the aurally presented words. They were told that the test list contained words from the first phase and words not presented in any part of the experiment, but they were to respond positively ("yes") only to words presented in Phase 2; all other words should be rejected ("no"). In addition, subjects were told that the test words would be presented in the same format as letter strings in the preceeding task and that their responses should occur within 400 ms after the asterisks appeared. The testing procedure was identical to that used in phase 2 with the exception of the test stimuli. The test list was random with the exception that visual, auditory, and new items were equally distributed throughout.

Results and Discussion

Responses were included for analysis if they occurred within 50 to 500 ms after the response signal appeared. Timing errors due to subjects or equipment occurred on 258 (7%) of the 3840 test trials. Data were analyzed in terms of both accuracy and response time (within the 50-500 ms range).

Analysis of the response time data, conditionalized on correct recognition decisions (i.e., "yes" for auditory words, "no" for visual and new words), revealed that responses were faster at the long, as opposed to short delay (231 vs. 262 ms), $F(1,28)=9.27$, $MSe=7596.1$, $p < .006$. As noted above, response signal experiments typically show a decrease in response latency as a function of delay. The only other reliable effect was that of study item, $F(2,56)=3.56$, $MSe=585.5$, $p < .04$. Unstudied (new) words (238 ms) were responded to faster than Phase 2 (auditory) words (249) which, in turn, were responded to faster than

Phase 1 (visual) words (254).

In line with the hypotheses under investigation, accuracy data were scored in terms of the probability of calling a word "old"; this amounts to correct recognition of aurally presented words and false alarms for visual and new items. These probabilities are presented in Table 7 as a function of orienting task, delay, and study item. Three analyses were performed on different aspects of these data, each of which is described below.

The assumption that response delay affected retrieval mode can be assessed by comparing false alarm rates for those items which subjects were instructed to reject: visual words from Phase 1 and new words. An analysis of these items showed that false alarm rates were much higher at the short, as opposed to long, delay (.34 vs. .18), $F(1,28)=19.8$, $MSe=.044$, $p < .0004$, and higher for old (Phase 1) words in comparison to new words (.32 vs. 20), $F(1,28)=.17.0$, $MSe=.027$, $p < .0006$. The interaction between these two factors was also reliable, $F(1,28)=4.43$, $MSe=.027$, $p < .05$; the difference between old and new words was greater at the short delay (.43 vs. .25) than at the long delay (.20 vs. .15). These results show that restricting response time decreased subjects' ability to consciously recollect (and thus reject) old items, whereas the longer reponse time allowed such recollection to occur.

Table 7. Mean percentage of "old" responses as a function of orienting task, delay, and study item in Experiment 3.

		Orienting task			
		Semantic		Non-semantic	
	Delay:	500	1500	500	1500
Study Item	Visual	.56	.20	.30	.21
	New	.27	.18	.22	.11
	Auditory	.62	.55	.63	.76

Note: Semantic orientation was a pleasantness rating task. Non-semantic orientation was letter judgment task. Visual items were presented in Phase 1 under incidental study instructions. Auditory items were presented in Phase 2 under intentional study instructions. Values represent correct recognitions for auditory items and false alarm rates for visual and new items.

A second analysis included only data from items presented in Phase 1: visually presented words processed either semantically or non-semantically. This analysis showed that false alarm rates were higher following the 500 ms, as opposed to 1500 ms, delay (.43 vs. .20), $F(1,28)=26.13$, $MSe=.016$, $p < .0001$. As with the first analysis, the higher false alarm rate at the short delay is consistent with the assumption that restricting retrieval time interferes with conscious recollection, leaving familiarity-based responding relatively unopposed. The main effect of orienting task was also significant, $F(1,28)=8.79$, $MSe=.016$, $p < .007$; pleasantness ratings resulted in a higher false alarm rate than letter judgments (.38 vs. .25). More important, the interaction between delay and orienting task was reliable, $F(1,28)=9.30$, $MSe=.016$, $p < .006$. The interaction shows that false alarm rates at the short delay were much higher following semantic (.56) than non-semantic processing (.30); at the long delay, however, false alarm rates did not differ (.20 vs. .21).

A final analysis of the percentage of words called "old" was performed on the entire data set; this measure corresponds to false alarms for visual (Phase 1) and new words, and correct recognitions for auditory (Phase 2) words. The analysis revealed a main effect of delay, $F(1,28)=12.8$, $MSe=.054$, $p < .002$, and study item, $F(2,56)=106.5$, $MSe=.016$, $p < .0001$. The main effect of delay reflects the larger percentage of "old" responses at the short delay (.43 vs. .34) and, in line with the assumptions concerning retrieval mode, suggests that responding became more conservative at the longer delay (see below). The main effect of study item shows that, as expected, auditory words elicited many more "old" responses than either visual or new words (.64, .32, and .20, respectively). The interaction between delay and study item was also reliable, $F(2,56)=8.22$, $MSe=.016$, $p < .002$. This interaction can be understood as reflecting an increase in recollective-based responding and was mainly a function of the large decrease in "old" responses for visual words across response signal delay (from .43 at 500ms to .20 at 1500ms). Although not as great, new items also showed a decrease in the number of "old" responses (from .25 to .15); however, correct "old" responses for aurally presented words changed little from the short (.63) to the long delay (.65).

Orienting task interacted with both delay, $F(1,28)=7.24$, $MSe=.054$, $p < .02$, and study item, $F(2,56)=8.31$, $MSe=.016$, $p < .002$. The interaction between orienting task and delay shows that, at the short delay, more "old" responses were made following semantic than non-semantic processing (.48 vs. .31) but the reverse was found at the long delay (.31 vs. .36). The interaction between orienting task and study item occurred primarily because of the low level of correct responses to auditory words following semantic (.58) as opposed to non-semantic input processing (.70).

Both of these interactions can be understood by assuming that (a) intentional retrieval is substantially prevented at the short delay, and (b) as suggested in the discussion of Experiment 2, responding following non-semantic study is based predominantly on familiarity, regardless of retrieval time. If given enough time, subjects in the pleasantness rating condition could consciously recollect a word's prior presentation; however, non-semantic processing results in a much lower level of recollection (e.g., Craik & Tulving, 1975). Because of this difference in conscious recollection, subjects in the semantic study condition may have been more sensitive to the possibility of falsely recognizing a visually presented item. This would result in relatively conservative responding at the long delay, but only following semantic input processing.

The above interpretation is supported by a comparison recognition performance on auditory items following semantic and non-semantic study at the two delays (see Table 7). Although the three-way interaction was only marginally significant, $F(2,56)=3.03$, $MSe=.016$, $p < .06$, post-hoc tests (Newman-Keuls) showed that correct recognition of auditory items at the short delay did not differ as a function of orienting task whereas at the long delay non-semantic processing resulted in significantly more hits than semantic processing (.76 vs. .55), $p < .05$. It would appear that, for auditory items, responding at the short delay was based on similar retrieval processes following both study orientations. However, at the long delay, semantic input processing resulted in a stricter criterion for accepting an auditory item as old; that is, responding was more conservative. Assuming that subjects in the non-semantic condition could recollect little about the original (Phase 1) study episode, a conservative response criteria would not be expected. In line with the results and analysis of Experiment 2, this interpretation would be consistent with the suggestion that non-semantic processing is predominantly based on familiarity, regardless of the amount of time available for retrieval.

A difference in retrieval processes following semantic and non-semantic processing may also help explain why false alarm rates for Phase 1 words were equivalent at the long delay. This result was a bit surprising; based on previous research (Craik & Tulving, 1975) and the results of Experiment 2, it was expected that the high level of recollection following semantic processing would allow Phase 1 words to be more successfully rejected than following non-semantic processing. The lack of a difference in these conditions suggests an asymmetry between the use of memory to select for items (as in Experiment 2) and the use of memory to select against items. However, such an asymmetry may be understandable in the context of a dual-process theory of recognition (Jacoby & Dallas, 1981; Mandler, 1980), especially with the added notion that familiarity can be a function of prior conceptual operations. Although recollection was superior following semantic, as opposed to non-semantic, input processing, this condition also produced larger gains in familiarity. That is, for the semantic group, high levels of recollection were required to override the increased familiarity associated with prior presentation. For the non-semantic group, both recollection and familiarity were relatively impoverished. The net result of these opposing processes produced equivalent false alarm rates.

To summarize the main results, in comparison to new words, restricting response times resulted in a higher rate of false recognitions for words previously presented (old words). Moreover, false recognitions at the short delay were much higher following semantic, as opposed to non-semantic, study. These result substantiate the claim that unintentional retrieval is sensitive to prior meaningful processing. Requiring fast responses prevented conscious recollection; recognition decisions had to be made more automatically, based on an words' relative familiarity. Familiarity-based reponding, however, was not simply a function of perceptual similarity but also reflected prior conceptual operations performed at input.

CHAPTER V

GENERAL DISCUSSION

The major goal of the experiments reported here was to demonstrate that unconscious retrieval processes can be influenced by conceptual/semantic encoding operations. This goal was largely achieved. In Experiment 1, an effect of encoding operations was obtained using fragment completion, an indirect retention measure which has been used extensively to study implicit memory. An effect of encoding operations was also found in Experiments 2 and 3, both of which employed a response signal procedure to separate conscious from unconscious retrieval processes in recognition. These results represent novel findings and are particularly relevant to three issues in contemporary memory theory: (1) the distinction between implicit and explicit memory, (2) the nature of unconscious retrieval processes, and (3) automatic processes in recognition memory. Each of these issues, and the relevance of the present experiments to current theoretical approaches, is addressed below.

<u>The Distinction between Implicit and Explicit Memory</u>

As noted earlier, the terms "implicit" and "explicit" have been used to refer to both retention measures and hypothetical forms of memory. The potential negative consequences of confusing these two uses has led some researchers to propose the operationally defined terms "direct" and "indirect" to identify retention measures (Johnson & Hasher, 1987; Richardson-Klavehn & Bjork, 1988). The point of this section is to argue that the theoretical distinction between implicit and explicit memory is inappropriate, most notably because it confounds intentionality with awareness. Instead, a more apt distinction is that between automatic and consciously-controlled retrieval. As can be seen in the brief historical survey provided below, the terms implicit and explicit have served a useful function in identifying two general forms in which performance can be influenced by prior experience. However, the hypothetical forms of memory which these terms are meant to identify, and the related methodological approach of task dissociations, are not well suited to further explicate the variety of ways in which memory functions.

The theoretical rationale for a distinction such as that between implicit and explicit memory is predicated on the assumption that the factors governing retrieval are different in the two cases. There is no doubt that some experimental manipulations differentially affect performance following direct and indirect instructions. However, the relationship between direct and indirect measures is not as straightforward as the dissociations might suggest. Parallel effects among direct and indirect measures (Graf & Mandler, 1984; Hunt & Toth, 1990; Jacoby & Dallas, 1981; Schacter & Graf, 1986a), dissociations between indirect measures (Hunt & Toth, 1990; Roediger, Weldon, & Challis, 1989; Witherspoon & Moscovitch, 1989), and the influence of conceptual operations on indirect measures (Experiment 1 of the present work; Gardiner, 1988; Gardiner, Dawson, & Sutton, 1989; Hirshman et al., 1990; Toth & Hunt, 1990) have also been found. In addition, conceptual representations have been implicated in mediating re-reading times (an indirect measure of memory) for transformed text (Graf & Levy, 1984; Masson & Sala, 1978; Tardif & Craik, 1989). This complex pattern of findings highlights the need for a closer examination of the distinction between implicit and explicit memory.

The theoretical separation of implicit and explicit memory relies on two related assumptions. First, that unconscious influences of memory occur only in the absence of awareness and intention. Second, that retention measures can be identified with specific retrieval processes: that is, indirect tests measure unconscious, unintentional processes whereas direct tests measure conscious, intentional processes. Both of these assumptions are questionable (note 4).

The contemporary interest in unconscious retrieval processes can be traced to the discovery that amnesic subjects often show memory performance equivalent to that of normals when an indirect retention measure is used (for reviews, see Schacter, 1987; Shimamura, 1986). Subsequent research showed that, within normal populations, similar dissociations can be found between direct and indirect measures as a function of certain experimental manipulations; for example, study-test changes in modality (Jacoby & Dallas, 1981) and elaborateness-of-processing (Graf & Mandler, 1984). These original demonstrations touched off a wave of experiments intended to explicate differences between direct and indirect measures as a function of encoding variables (e.g., self-generation, repetition, intentional vs. incidental study, imagery, delay between study and test, test order, study-test changes in surface form, etc.).

Presumably, the ultimate goal of these experiments was to understand the nature of unconscious processes in retrieval. This is an important goal. However, dissociations notwithstanding, there is no a priori reason to believe that indirect measures engage the same processes in normals and amnesics. Theoretically, correct performance on indirect measures does not require awareness of, or intent to retrieve, a prior episode. But there is little doubt that performance on these measures can be improved through the use of conscious, intentional retrieval strategies. With amnesic subjects, there is reason to assume that such strategies are not, in fact cannot be, engaged (e.g., Johnson, 1990). This is not the case with normal populations. Current work on implicit memory is conducted almost entirely with a set of retention measures that do not control for the possibility of "contamination" from consciously-controlled (i.e., intentional) processes (note 5). However, the problem facing memory researchers is not simply one of correspondence between instructions (direct/indirect) and retrieval mode (explicit/implicit); rather, the notion that implicit and explicit memory are mutually exclusive categories may itself be suspect.

Although often occurring together, awareness need not imply intentionality. Unconscious influences of memory can occur even though an individual is aware of the effects of prior experience. Recent work by Jacoby and colleagues has shown that the subjective experience of a reduction in background noise when hearing previously presented sentences (Jacoby, Allan, Collins, & Larwill, 1988) occurs even when subjects are aware of the effect and told to avoid it. Similarly, Experiment 3 of the present work demonstrated that even in the face of direct instructions to disregard a particular class of events (i.e., the visual list), unintentional retrieval processes may still control responding. This finding is similar to the effects found in Stroop tests, in which color words interfere with naming the color of the words even though subjects are aware of the nature of the interference and do not intend to process the words semantically (note 6). Thus, in contrast to the assumption underlying the implicit/ explicit distinction, awareness and intention need not be perfectly correlated, nor does their presence rule out the possibility of unconscious influences.

Nevertheless, the popular search for task dissociations attests to the prevalence of the assumption that retention tests are process-pure (i.e., that tests can be identified with specific forms of memory). Task dissociations can only delineate differences in the nature of psychological processes if this assumption holds. However, if tasks engage a number of component processes as the studies cited above would suggest, a dissociation can only indicate that the tasks do not share some subset of those processes. Thus, the search for task dissociations can tell us something about tasks, but very little about psychological processes.

As noted earlier, a number of researchers have argued that conscious strategies can improve performance on indirect measure (see Richardson-Klavehn & Bjork, 1988). Note that this argument does not necessarily imply that subjects intentionally retrieve information from a prior episode; rather, various forms of task-specific, consciously-controlled processing, could improve performance. Experiment 1 found that an encoding task which drew attention to the categorical nature of the stimuli (category-classification) produced higher fragment completion performance than one which emphasized individual items (pleasantness-rating). Performance was reversed on free recall, suggesting that subjects did not attempt to intentionally retrieve study words on the fragment completion test. Nevertheless, given the categorically structured nature of the fragment test, it seems highly likely that performance was improved through consciously-controlled strategies. It has also been proposed that unconscious retrieval processes support performance on direct tests (e.g., Jacoby & Hollingshead, 1990; Johnston, Dark, & Jacoby, 1985). This position is consistent with the results of Experiments 2 and 3. Recognition, a direct, "explicit" measure of memory, was shown to have a substantial automatic component that can be characterized as both unconscious and unintentional.

Taken together, these observations suggest that the assumptions and methodology underlying the implicit/explicit distinction are not well founded. An alternative set of assumptions are that (a) all retention measures engage both conscious and unconscious components, and (b) drawing on a distinction made in the attention literature (see LaBerge & Samuels, 1974; Posner & Snyder, 1975; Shiffrin & Schneider, 1977), retrieval involves both automatic and consciously-controlled processes. Explaining performance in terms of automatic and consciously-controlled retrieval processes does not assume such a rigid correspondence between awareness and intention. Automatic influences of memory would be expected to occur in the presence of awareness and intention (Bargh, 1990). Furthermore, these assumptions encourage research designed to separate conscious from unconscious processes within a single task.

If we assume that conscious and unconscious processes are engaged in all task environments, the question facing memory researchers is how to separate these two aspects of performance. Experiment 2 attempted to separate conscious from unconscious retrieval processes by manipulating the time available for making recognition decisions. Like manipulations of attention (Jacoby et al., 1989), fast recognition decisions were assumed to prevent the use of reconstructive retrieval strategies, thus leaving automatic influences of memory unopposed. The finding of a large modality effect at the short delay supports this interpretation.

However, the position that retention tests are not process-pure applies to the response signal procedure as well as indirect measures. It is doubtful that responses at the short delay were purely automatic or unintentional. However, by placing conscious and unconscious processes in opposition (Experiment 3), independent evidence was found that consciously-controlled retrieval processes were considerably attenuated at the short delay. Although more quantitative techniques are required, this methodology allows clear conclusions to be drawn concerning the nature of unconscious processes within a task.

The Nature of Unconscious Retrieval Processes

Taken together, the results of the three experiments reported here are consistent with the following conclusions. (1) Unconscious retrieval processes are sensitive to prior conceptual operations. (2) Unconscious retrieval processes influence performance on direct, as well as indirect, measures of memory. (3) On tasks which do not make reference to a prior experience (i.e., indirect measures), effects of prior conceptual operations depend on the reinstatement of contextual details present at study. (4) Unconscious retrieval processes are generally faster than conscious retrieval processes; however, if the target event was only superficially (e.g., non-semantically) processed, responding may be based on familiarity regardless of retrieval time. The fourth point is more of a hypothesis than a conclusion. Regardless, it is consistent with the results of Experiments 2 and 3 and appears to account for certain accuracy and response-latency differences between semantic and non-semantic conditions. This issue was discussed above (Experiments 2 and 3, Discussion) and will not be addressed here. The second point is addressed in the following section on recognition memory. The first and third points, and their relation to other empirical work, are discussed below.

The major assumption underlying the present project was that unconscious retrieval processes are influenced by previous conceptual operations; however, such influences require a retrieval environment that reinstates aspects of the original encoding context. The effect of prior conceptual operations may only become apparent if the original study context is recovered at test (Jacoby & Craik, 1979). On a direct measure of memory, retrieval cues (including instructions) specify a target episode; thus, the original study context can be intentionally recreated by the subject. With indirect measures, no past episode, and therefore no specific context, is referenced. In order to observe the effects of previous conceptual processing, the prior (i.e., target) context must be (re)created in the test environment.

According to this position, previous failures to obtain semantic encoding effects on indirect measures (e.g., Graf & Mandler, 1984; Jacoby & Dallas, 1981; Jacoby, 1983a, 1983b) are explained by the discrepancy between the items presented and the task demands required at encoding and test. Typically, unrelated word lists are used and, in terms of processing demands, the retrieval tasks bear little similarity to the encoding tasks. Experiment 1 attempted to remove this discrepancy through the use of categorized word lists. It was hypothesized that semantic categories would provide a study context which could by recreated at test by presentation of category exemplars. Task performance could then benefit from previous processing that drew attention to categorical membership. In line with this analysis, the semantic orienting task of category-classification produced higher completion performance than pleasantness-rating and the non-semantic letter scanning task. The goal of this section is to determine if this theoretical framework can be extended to other studies which have found conceptual effects on indirect measures.

The generation effect refers to superior memory performance on self-generated material in comparison to similar matreial that is externally provided (Slamecka & Graf, 1978). Generation effects are typically found on direct measures of memory; however, like investigations of semantic processing, a number of studies have found that the usual mnemonic benefit of self-generated material does not obtain with indirect measures (e.g., Jacoby, 1983b; Schwartz, 1989). Generation requires the subject to provide information not present in the stimulus, often in accordance with a predefined semantic context (e.g., antonym, synonym, sentence fragment); generation can therefore be considered a conceptual operation. Thus, three recent studies which have obtained generation effects on indirect measures are relevant to the present project.

Gardiner (1988; see also Gardiner, 1989; Gardiner et al., 1990) found an effect of generation on the indirect measure of fragment-completion, but only with test fragments that were identical to those used for generating words at study. A similar finding was obtained by Toth and Hunt (1990, Experiment 1) on a word-identification task. In contrast to read words, generated words were more often identified when test stimuli were presented as fragments; when complete words were used, reading and generation produced equivalent levels of identification. Toth and Hunt (1990, Experiments 2 and 3) also found that identification of complete words can benefit more from generation than reading if a previously studied context cue is presented prior to an identification trial (note 7). Blaxton (1989) also found an effect of generation, using general knowledge questions (e.g., "what metal makes up 10% of yellow gold?") as the indirect ("implicit") measure of memory. Like the majority of studies on generation, Blaxton had subjects generate target items in the presence of semantically related cues (e.g., "TIN - C-----").

All of these studies are consistent with the hypothesis that unconscious retrieval processes engage prior conceptual operations if there is contextual overlap between the encoding and retrieval environments. What differentiates these studies from others which have failed to find generation effects (e.g., Jacoby, 1983b) is the specificity of perceptual information and/or the processing demands made at study and test. For example, in Jacoby (1983b), words at study were never presented visually and were generated in the presence of semantic context cues; test words, however, were presented visually and without semantic context. In contrast, test conditions in the three studies demonstrating generation effects were contextually similar to those at encoding. What differentiates these three studies from each other is whether the contextual similarity was perceptual (Gardiner, 1989; Toth & Hunt, 1990, Experiment 1) or conceptual (Blaxton, 1989; Toth & Hunt, Experiments 2 and 3) in nature. The more interesting case would appear to be that of perceptual similarity; there, no conceptual operations are initiated prior to presentation of the test item. Nevertheless, like the use of semantic context cues, a previously experienced perceptual pattern can result in the automatic transfer of prior conceptual operations used in the generation process (note 8).

The finding of "implicit memory for new associations" (Graf & Schacter, 1985) can also be interpreted within this framework. Research in this area has shown that word-stems are more often completed with previously studied, as opposed to non-studied, words, but only when tested in the presence of the identical context cue used at study. Interestingly, this effect appears to be dependent on elaborative processing of the cue-target pair (Schacter & Graf, 1986) and is modality specific (Schacter & Graf, 1989). Also, the effect has been demonstrated with amnesic subjects who show little conscious recollection of the study material (Graf & Schacter, 1985; but see Shimamura & Squire, 1989). All of these findings are consistent with the assumption that unintentional retrieval can be influenced by prior conceptual operations if the retrieval environment reinstates aspects of the encoding context in which those operations were originally performed.

One difference between the studies reviewed above and Experiment 1 of the present project is whether contextual specificity was a characteristic of individual test-items or of the complete retrieval task. Studies of the generation effect and of new associations have all used unrelated word lists and manipulated context locally (i.e., for individual items). In contrast, Experiment 1 attempted to induce a more test-wide or global processing context by using semantically related (i.e., categorized) stimuli. Other experiments which can be viewed as manipulating test-wide context were performed by Jacoby (1983a). Performance facilitation in word ("perceptual") identification was enhanced when the test list contained 90%, as opposed to 10%, of previously studied words (see also, Allen & Jacoby, 1990). In another experiment, which investigated facilitation effects over a five-day period (Jacoby, 1983a), identification performance was larger if the test list contained only items studied on the fifth day, than if they were mixed with old items from previous days. Both of these effects require explanations that go beyond perceptual repetition. Like the effect of semantic processing found in Experiment 1 of the present study, enhanced performance appears to be mediated by contextual reinstatement. Note, however, that in Experiment 1 the list context (i.e., number of items and categories) was equivalent for all subjects; contextual reinstatement was more in terms of processing requirements between study and test.

In this regard, three other studies are relevant. Oliphant (1983) found that, unlike words presented in a study list, words presented as part of a preexperimental questionanaire or as instructions did not facilitate performance in a subsequent lexical decision task. A similar pattern of results was reported by MacLeod (1989) using fragment completion; although target words embedded in a meaningful passage produced facilitation relative to non-presented words, they did so much less than words presented as part of a to-be-learned list. MacLeod (1989) concluded that "...context plays a critical role in priming: As a word moves from being contextually bound in meaningful discourse to being isolated in a list, its probability of priming increases" (p. 398).

That context plays a critical role in mediating the effects of prior experience ("priming") is in accord with the present framework. However, MacLeod's conclusion focuses on contextual factors at encoding without considering the importance of contextual factors at retrieval. That words isolated on a study list show the highest level of "priming" would be expected on an indirect retention measure which itself contains little meaningful structure. The present approach suggests that if the context associated with meaningful text were available at retrieval, even "contextually bound" words would show performance facilitation.

This interpretation was confirmed in a study by Levy and Kirsner (1989; see also Kasserman et al., 1987; Franks et al., 1982) which suggests a broader interpretation of the effects of prior experience. They manipulated the surface characteristics of meaningful passages and word-lists in order to study word- and text-level transfer on indirect measures of memory. Replicating Oliphant (1983), they found that words embedded in natural text did not facilitate performance on a subsequent measure of perceptual identification; words presented in isolation, however, did facilitate identification performance, the magnitude of which varied with the similarity of surface characteristics from study to test. More importantly, when the complete passages were re-presented at test and the indirect measure was rereading time, performance (reading time) was significantly facilitated and varied with surface-level similarity. Thus, whether a prior experience influences subsequent performance depends critically on the context in which that performance is assessed; transfer is most apparent when the context reinstates aspects of the original processing episode. Similar points can be made concerning spontaneous transfer in problem solving (Adams et al., 1988; Lockhart et al., 1988).

Cognitive psychologists have emphasized the importance of understanding memory in terms of an interaction between encoding and retrieval (Morris, Bransford, & Franks, 1977; Tulving, 1983). However, relatively few studies have attempted to explicate the role of contextual or organizational factors in indirect retrieval environments. This is a curious state of affairs. Outside of the psychological laboratory, retrieval rarely occurs in the absence of a meaningfully structured (i.e., organized) context. Given a form of memory that is extremely sensitive to contextual factors, yet often occurs with little intentional control over their nature, an emphasis on the structure of retrieval environments seems particularly important.

Automatic Processes in Recognition Memory: Theoretical Implications and Relation to Other Forms of Memory

Experiments 2 and 3 used a response signal procedure to investigate unconscious retrieval processes in recognition. Recognition was chosen on the basis of empirical and theoretical work (Gillund & Shiffrin, 1984; Jacoby & Dallas, 1981; Mandler, 1981) suggesting that it involves both conscious and unconscious components. In line with the assumption that retention measures are not process-pure (see above), recognition was found to depend on retrieval processes that can be descibed as automatic, unconscious, and unintentional. When the time avialable for retrieval was curtailed (Experiment 2, short-delay), recognition was marked by a substantial modality effect, an effect associated with indirect ("implicit") measures of memory. Nevertheless, a large effect of orienting task was obtained at all points in the recognition process. A similar result was found in Experiment 3, which employed an exclusion methodology to rule out the possibility of conscious mediation (cf. Jacoby et al., 1989; Jacoby & Whitehouse, 1989). Although subjects were given direct instructions to reject a particular class of items, prior semantic processing resulted in a high percentage of false recognitions when retrieval time was restricted.

The implications of these findings for conceptualizations of retention measures and the nature of unconscious retrieval processes were discussed above. The purpose of this section is twofold. The first half is devoted to relating the present findings to current theoretical approaches, specifically in terms of recognition memory. Note, however, that theoretical accounts of recognition are part of larger theoretical systems designed to capture a variety of phenomena. Thus, any required change in models of recognition will have ramifications for other aspects of theory. The second half of this section is devoted to what the present findings imply for memory more broadly conceived. Generally, what is the relationship between automatic responding in recognition and on indirect measures of memory? Also, what does the presence of automatic components in recognition imply for other forms of direct memory such as free recall? Speculation on these issues conclude this project.

Two of the most influential theories for explaining memory (for reviews, see Richardson-Klavehn & Bjork, 1988; Schacter, 1987) are the multiple memory systems approach (Tulving, 1983; Tulving & Schacter, 1990) and the processing approach (Roediger & Blaxton, 1987b; Roediger et al., 1989; see also Jacoby, 1983a). The memory systems approach is a structuralist position which proposes that the effects of prior experience are mediated by different underlying systems. In its most recent manifestation, memory is described as consisting of an episodic system, a semantic system, a procedural system, and a perceptual representation system (PRS); the latter is described as a "presemantic" system that "comprises several subsystems, including word form, structural description, and other subsystems" (Tulving & Schacter, 1990, p. 305). The processing view is a more functional approach and suggests that memory be understood in terms of the distinction between data-driven and conceptually driven processes. Conceptually driven processes are described as subject-initiated activities concerned with the meaning of an event. Elaboration of a study item and mental reconstruction of prior episode are conceptually driven processes. Data-driven processes are initiated and guided by the perceptual information provided in study or test materials. The results of Experiments 2 and 3 seem to require the modification of both of these theoretical approaches.

The theoretical strategy of the processing approach has been to classify encoding operations and retention measures in terms of conceptually driven and data-driven processes. Based on the principle of transfer appropriate processing (Morris, Bransford, & Franks, 1977), memory is said to be a function of the extent to which retrieval conditions recapitulate operations performed during the original (target) experience. In a sense, this position is indisputable. The question of theoretical interest is whether this principle is properly explicated by the distinction between these two forms of processing. In order for the distinction to be useful, it should be possible, at least in principle, to isolate data-driven and conceptually driven processes. Note that this requirement is analogous to the one demanded of the distinction between implicit and explicit memory (see above). If the two cannot be separated within a task, clear conclusions cannot be drawn concerning the mediation of performance and thus the distinction becomes theoretically impenetrable.

The present recognition results suggest just such an impenetrability. Keeping all other experimental factors constant, manipulations of retrieval time both induced and eliminated the effects of a shift in presentation modality. This would appear to constitute an empirical isolation of data-driven and conceptually driven processes. However, substantial effects of prior conceptual processing were apparent at both points in retrieval suggesting that the two forms of processing cannot entirely be separated. Similar demonstrations of the confluence of surface-related and conceptual factors have been reported in other studies. Hunt & Toth (1990; see also Hunt & Elliott, 1980; Hunt & Mitchell, 1978, 1982) showed that orthographic distinctiveness, a variable associated with data-driven processing, can influence performance on free recall, a highly conceptually driven test. Conversely, word identification, the paradigmatic data-driven measure, can be affected by prior conceptual operations (Toth & Hunt, 1990; see also Gardiner, 1989). Additionally, test expectancy (a self-initiated, conceptually driven process) can influence both direct and indirect memory performance (Neill, Beck, Bottalico, & Molloy, 1990). These results are consistent with the assumption that data-driven and conceptually driven processes are highly interactive and involved in all task environments.

The notion that psychological processes are highly interactive also suggests inadequacies in the memory systems view, although here there are a number of theoretical options. One possibility is that perceptual information is stored in the episodic memory system. This would seem to be demanded by the modality effect obtained in Experiment 2. The problem with this interpretation is that recognition is usually insensitive to manipulations of surface features (e.g., Roediger & Blaxton, 1987a). A second possibility is that conceptual information is stored in the procedural system, the perceptual-representation (word-form?) system, or both. This possibility is suggested by the effects of semantic encoding found in all three experiments. The problem with this view is that the PRS is supposedly a "presemantic" system which does not code for meaning. Thus, in general, both of these possibilities seem untenable because they violate the very rationale for a theoretical separation among memory systems; namely, that the various systems store different forms of information.

A third possibility is that a study experience produces memory traces in different systems which then interact to determine performance. For example, the episodic/semantic system (note 9) might record the operations involved in an elaborate encoding of a word whereas the PRS (word-form) system might record the physical characteristics (e.g., presentation modality) of the word. The problem with this possibility is the difficulty of explaining the highly interactive nature of retrieval. Experiment 2 demonstrated that conceptual information was available early in the recognition process, implicating the operation of episodic memory. However, the large modality effects indicate a strong perceptual component. Additionally, Experiment 3 showed that meaningful task instructions were not in effect at the same time that conceptual information influenced responding. Taken together, these results suggest that if memory is properly conceptualized as a number of modular systems, they are highly interactive and flexible, almost to the point of appearing unitary.

In contrast to the theoretical separation of memory systems or perception and conception, the present results are nicely captured by viewing performance as a function of automatic and consciously-controlled processes (see LaBerge & Samuels, 1974; Posner & Snyder, 1975; Shiffrin & Schneider, 1977). Dual-process theories of recognition

(Gillund & Shiffrin, 1984; Jacoby & Dallas, 1981; Mandler, 1980) propose that recognition decisions can be based on either familiarity or recollection; familiarity can be viewed as a fast, automatic process whereas recollection is a consciously-controlled, "search" process. The present results are generally consistent with this account. Fast recognition decisions prevented the use of consciously-controlled retrieval processes, forcing reponses to be made primarily on the basis of familiarity. Unlike consciously-controlled retrieval, which is dependent on the identification of contextual details, familiarity is a function of the overall similarity between the original (study) and subsequent (target) event. Thus, performance at the short delay was partly determined by perceptual similarity, resulting in a large modality effect (Experiment 2) and a high level of false recognitions (Experiment 3). At the long delay, consciously-controlled processes could be mobilized to override the discrepancy in perceptual information (Experiment 2) or reject items on the basis of a conscious, intentionally-set criterion (Experiment 3).

The dual-process model would therefore appear to provide the most appropriate framework for understanding the present set of recognition results. However, the effects of orienting task suggest the need to expand previous conceptualizations of familiarity. In contrast to the earlier proposals (Jacoby and Dallas, 1981; Mandler, 1980), familiarity is not a function of perceptual similarity alone; conceptual processes (or representations) also contribute to performance.

The identification of unconscious retrieval processes in recognition raises interesting theoretical questions: namely, what is the relationship between unconscious processes in this task and those involved on indirect measures of memory; also, do similar unconscious processes underlie performance on other direct measures such as free recall? One approach to these questions is to assume that automatic influences of prior experience are the common component on direct and indirect measures. According to this view, the difference between direct and indirect measures is that the former involve an additional, consciously-controlled component that specifies how prior experience is to be utilized. On indirect measures, utlization of past experience is constrained by the nature of test stimuli (e.g., completion of fragments or stems; identification of degraded stimuli).

Evidence supporting this formulation is suggested by the relationship between familiarity and perceptual fluency - that is, the ease with which items are perceived. Perceptual fluency can be viewed as an automatic influence of memory in that it assessed relatively quickly and does not depend on awareness of, or intention to retrieve, a prior event. The notion of perceptual fluency was originally derived from observations in word identification experiments. Anecdotal reports by subjects in those experiments indicated that previously presented words appeared to remain on the screen longer than new words even though, in actuality, all words had been presented for the same duration (Jacoby & Kelly, 1987). These reports were confirmed in later experiments which varied the presentation duration of old and new words; old words were consistently judged as staying on the screen longer than new words (Hunt & Toth, 1990; Witherspoon & Allen, 1985).

Jacoby and associates (Jacoby & Dallas, 1981; Jacoby & Witherspoon, 1982) have suggested that the feeling of familiarity be viewed as an attribution based on relative perceptual fluency. The idea here is that, when required to judge the old/new status of test words, subjects are sensitive to how easily an item is processed; differences in processing are interpreted as reflecting the effects of prior experience. In line with this assumption, perceptual fluency has been implicated in mediating recognition decisions (Johnston, Dark, & Jacoby, 1985). Recently, Jacoby & Whitehouse (1989) showed that false recognitions can be produced by subliminal presentation of test items just prior to their supralimnal test presentation. Apparently, processing of a word presented above threshold was facilitated by the earlier, subliminal presentation; because subjects were not aware of the subliminal presentation, the fluency with which the test item was processed was interpreted as due to an earlier study presentation. These observation suggest that the automatic component in recognition memory is best conceptualized in terms of processing fluency; familiarity is an attribution based on processing differences coupled with task demands (Jacoby et al., 1989).

Fluent processing may also mediate performance on indirect measures. The subjective experience of a reduction in background noise when hearing a previously presented sentence (Jacoby et al., 1988) can be interpreted as due to the relative ease of perceiving old, as opposed to new, sentences. Similarly, previously presented non-famous names are more likely to be judged as famous than names which have not been previously presented (Jacoby et al., 1989). The interesting aspect of this effect is that fluent processing could have been attributed to the effects prior experience if direct memory instructions had been provided; instead, differences in stimulus processing were attributed to dimensions specified in the indirect task instructions (i.e., fame or noise levels).

Fluent processing has also been implicated in mediating performance on more standard indirect tests such as lexical decision and naming (Masson & Freedman, 1990). Interestingly, these researchers provide evidence that fluent processing in these tasks does not reflect enhanced perceptual performance but rather depends "on the generation of a consistent semantic interpretation" which can be "highly context specific" (p. 371). Similarly, Toth and Hunt (1990) suggested that a process of "conceptual fluency" might underlie performance on tasks which are contextually similar to prior episodes in which conceptual processes were used. These interpretations could easily be extended to incorporate indirect measures that are based on semantic relations such as general knowledge questions (Blaxton, 1989) and category production (Graf et al., 1985).

The recognition results of Experiments 2 and 3 suggest the operation of both perceptual and conceptual fluency. The modality effect in Experiment 2 indicates that presentation of an old test word recruited prior perceptual operations; that is, words presented visually at study resulted in more fluent processing at test than words presented aurally at study. However, the effect of orienting task in both experiments indicates that prior conceptual operations were also recruited. Additional evidence for a process of conceptual fluency is provided by the fact that an effect of orienting task at the short delay was as apparent for old auditory words as it was for old visual words. Because all test words were presented visually, perceptual factors would seem to be ruled out in accounting for the obtained differences in performance.

These findings suggest a general model for the processes underlying recognition memory. Under appropriate conditions, presentation of a previously experienced item recruits prior perceptual and conceptual operations performed on that item. Recruitment of these operations affects the ease with which the test item is processed. If the current test item, relative to other test items, is fluently processed, a feeling of familiarity will result which can be used as the basis for a recognition decision. However, if the relative differences in processing fluency are not discriminable, and/or if there is sufficient time (and reason) for a more analytic judgment, consciously-controlled retrieval of the contextual details associated with the study experience can also be used as the basis for recognition.

A theoretical framework based on the distinction between automatic and consciously-controlled processes may also be applicable to recall. Recently, Jacoby and Hollingshead (1990) proposed a generate-recognize model of free-recall. An important difference between their approach and earlier generate/recognize models (e.g., Anderson & Bowers, 1972) is that the latter relied on abstract knowledge structures (e.g., associative networks) for the generation of candidates for recall. In contrast, Jacoby and Hollingshead (1990) propose that memory for prior episodes constrains the generation process. Essentially, retrieval cues which reference a specific episode result in the fluent generation of items from that episode or similar episodes. Which items are actually "recalled" (i.e., output) will depend on the results of the recognition process which can be based on either familiarity, recollection, or both. Analogous to the automatic component in recognition, some candidates for recall may be generated so fluently that a consciously-controlled recognition check is not performed, thus resulting in the "recall" of unrecognized words. Results from two experiments were consistent with predictions based on this model (Jacoby and Hollinghead, 1990).

This model suggests that, like recognition, recall can be related to indirect measures through the concept of fluency; fluency, in turn, is a result of automatic retrieval processes which are determined by contextual factors present in the cue environment. In this conceptualization, cued-recall shares generative processes with indirect measures such as stem-completion and general knowledge questions; cued-recall differs from these tests only in requiring an additional recognition process (Jacoby & Hollingshead, 1990).

Generation of response candidates can be viewed as a form of conceptual fluency (see above). Note, however, that recall invariably occurs within a context that contains both perceptual and conceptual features. Thus, recall should not be viewed as involving only conceptually-driven operations

(Hunt & Toth, 1990). Both the perceptual (e.g., environmental) and conceptual (e.g., cue information/ instructional) context can influence the level of performance. Thus, processing of context, either as provided in the retrieval environment or as self-generated by the subject, can be viewed as a "stage setting" operation (Bransford, McCarrel, Franks, & Nitsch, 1977) for the generation of candidates which meet the criteria defined by retrieval cues.

Obviously, the framework detailed above is speculative. However, the data presented here, as well as the results from a number of previous studies, are consistent with the assumptions made in the Introduction. Implicit and explicit memory are not mutually exclusive categories. Both conscious (controlled) and unconscious (automatic) processes are present in all task environments. In addition, memory performance depends upon the interaction of perceptual and conceptual processes used in the past and recruited in the present; contextual factors will often determine the nature of this interaction. These assumptions can be viewed as laying the groundwork for a unified theory of memory.

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FOOTNOTES

1. It is interesting to note that even this characteristic does not always apply. A number of experiments on "implicit" memory use procedures which make the relationship between the current task and prior study experiences obvious. Indeed, instructions to subjects in some of these experiments explicitly refer to this relationship.

2. Direct measures of memory are those which make reference to a specific past episode in the history of the subject. Performance is measured directly, in terms of the information retrieved from that episode. Indirect measures of memory are those which do not include references to prior events. Performance is measured indirectly, in terms of the amount of faciliation in the task that can be attributed to a specific past episode.

3. Whether retrieval is intentional may have less to do with the instructions than with the nature of the task itself. Although little research has been done concerning these issues, factors which might encourage intentional retrieval include the difficulty of reponding to (e.g., completing) individual test items and the similarity of the current task to past events. A task might act as a

persuasive retrieval cue for a past episode if similar items are present or similar processes required.

In line with the principles of encoding specificity and transfer-appropriate processing, it seems quite possible that the conditions for demonstrating an effect of previous conceptual operations on unintentional retrieval (i.e., reinstatement of the context available at encoding) may often be the same conditions which evoke awareness of a past episode. In the majority of studies on "implicit memory", subjects may not attempt to retrieve previously learned information, not because the instructions do not refer to the past learning episode, but rather because there is little overlap between that episode and current task demands.

4. With few modifications, the arguments against the second assumption could easily be applied to the idea that direct tests are "conceptually-driven" and indirect tests are "data-driven" (Roediger) and to the distinction between episodic/semantic memory and "perceptual-respresentation systems" (Tulving & Schacter, 1990).

5. As argued below, task dissociations cannot fill this role. Dissociations can only indicate that two tasks do not completely share the same component processes. Regardless of the extent of conscious-control, dissociations can be produced by any dissimilarity in process, however trivial.

Recall and recognition are often dissociated as a function of experimental manipulations (e.g., frequency), yet presumably, both engage conscious, intentional retrieval processes.

6. This observation was made by Larry Jacoby.

7. Cued-recall (i.e., intentional retrieval) of study items was ruled out as an explanation of this finding.

8. This point is relevant to theoretical accounts of generation effects on indirect measures. According to the processing view (Blaxton, 1989; Roediger & Blaxton, 1987; Roediger, Weldon, & Challis, 1989) generation effects should be found only on retention measures which require conceptually-driven processing. The use of semantic context cues can be interpreted as engaging conceptually-driven processing, therefore accounting for the generation effects obtained in some studies (Blaxton, 1989; Toth & Hunt, 1990, Experiments 2 and 3). However, it is unclear how this approach can account for generation effects when test items are presented in isolation as was the case with Gardiner (1989) using fragment completion and Toth & Hunt (1990, Experiment 1) using word identification. Both of these measures have been classified as data-driven.

9. The term "episodic/semantic system" is used as a shorthand for "either the episodic system, the semantic

system, or the interaction between the two." Presumably, both systems are required for the the encoding and retrieval of an elaborated study item (Tulving, 1983). However, the present arguments simply require that these systems, which are involved in episodic memory for prior meaningful processing, are distinguished from the procedural and perceptual-representation systems, which do not store conceptual information. For the same reason, the latter two systems do not require separate treatment.

Appendix A. Words and word-fragments used in Experiment 1.

Group A:

Animals

horse	: h-r-e
tiger	: t-g-r
elephant	: e-e-h-n-
mouse	: m-us-
squirrel	: s-u--r-l
donkey	: d-nk-y
antelope	: a-t-l-p-
monkey	: m-nk-y

Alcoholic Beverages

whiskey	: w--sk-
bourbon	: b-u-b-n
scotch	: s-ot-h
brandy	: b-an-y
champagne	: c-a-p-g-e
vermouth	: v-r-o-t-
martini	: m-r-i-i
sherry	: s-er-y

Occupations

doctor	: d-c-o-
lawyer	: l-w--r
teacher	: t-a-h-r
dentist	: d-n-i-t
engineer	: e-g-ne-r
plumber	: p-u-b-r
merchant	: m-r-h-nt
farmer	: fa-me-

Musical Instruments

trumpet	: t-u-p-t
violin	: v-o-i-
clarinet	: c-a-i-e-
flute	: f-ut-
guitar	: g-i-a-
trombone	: t-o-b-n-
harmonica	: h-r-o-i-a
accordion	: a-c-r-i-n

Group B:

Birds

robin	: r-b-n
sparrow	: s-a-r-w
cardinal	: c-r-in-l
canary	: c-n-ry
parrot	: p-r-ot
falcon	: f-l-on
chicken	: c-i-k-n
penguin	: p-n-u-n

Weapons

spear	: -pe-r
missile	: -i-s-le
arrow	: a-r-w
slingshot	: s-i-g-h-t
revolver	: r-v--v-r
grenade	: g-e-a-e
torpedo	: t-r-e-o
explosive	: e-p-o-i-e

Insects

spider	: -p-d-r
beetle	: b-e-l-
roach	: ro--h
termite	: t-rm-t-
cricket	: c-i-k-t
caterpillar	: c-t-r-i-l-r
centipede	: c-n-i-e-e
locust	: l-c-s-

Fruits

apple	: a-p-e
orange	: o-a-g-
banana	: b-n-n-
peach	: p-a-h
cherry	: c--rr-
strawberry	: s-r-w-e-r-
cantaloupe	: c-n-a-o-p-
raisin	: r-i-i-

Appendix B. Words used in Experiment 2.

Targets		Distractors	
Set 1	Set 2	Set 1	Set 2
trench	grape	sleet	broil
pillow	towel	salad	comb
bucket	rocket	mouse	grief
grease	globe	couch	cake
dice	chill	bark	thunder
shower	flag	arrow	reward
pipe	brick	flame	stove
clock	soap	lamp	meadow
flower	joke	planet	candle
swift	lunch	garage	drug
jacket	bride	museum	butter
blind	snake	tool	powder
gold	yellow	brush	smoke
truck	smile	stone	lake
rifle	dream	rain	shelter
dust	dress	bottle	knife
judge	boat	coffee	match
bank	winter	touch	train
king	rose	dinner	bridge
dance	glass	window	doctor
hotel	farm	blood	radio
police	river	game	letter
music	mother	stage	street
school	night	water	city

Appendix C. Words used in Experiment 3.

Visual		Auditory	
Set 1	Set 2	Set 1	Set 2
trench	trash	sleet	broil
grape	clown	comb	towel
kitten	vitamin	couch	globe
laundry	throne	bark	chill
trumpet	pillow	stove	tennis
bucket	rocket	flame	meadow
castle	sunshine	lamp	pipe
diamond	grease	clock	planet
mouse	salad	garage	soap
grief	poison	joke	flower
puzzle	cake	drug	butter
dice	thunder	powder	swift
arrow	reward	museum	lunch
shower	flag	jacket	bride
candle	brick	bench	noise
dance	dinner	tool	smoke
bridge	marriage	snake	brush
doctor	glass	blind	gold
energy	sunday	lake	yellow
machine	horse	truck	smile
window	radio	stone	rifle
farm	blood	dream	dress
hotel	game	dust	shelter
student	letter	rain	frame
stage	police	boat	bottle
military	river	knife	judge
mother	music	coffee	match
money	street	train	bank
city	school	winter	rose
night	water	touch	king