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The components of recollective experience: Remembering and knowing

Rajaram, Suparna, Ph.D.

Rice University, 1991

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RICE UNIVERSITY

THE COMPONENTS OF RECOLLECTIVE EXPERIENCE:
REMEMBERING AND KNOWING

by

SUPARNA RAJARAM

A THESIS SUBMITTED
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE

DOCTOR OF PHILOSOPHY

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THE COMPONENTS OF RECOLLECTIVE EXPERIENCE:
REMEMBERING AND KNOWING

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Abstract

This project was designed to examine the nature of recollective experience. Gardiner (1988) showed dissociations are obtained within an explicit memory test as a function of several independent variables when subjects classify recognized items into two types of recollection, one termed "Remember" (those items that subjects consciously recollect from the study list) and the other termed "Know" (those items that subjects recognize on some other basis, in the absence of conscious recollection). Gardiner and his colleagues concluded from their results that "Remember" responses are sensitive to conceptual and "Know" responses to perceptual processing. The present investigation tested this conclusion using the recognition memory task.

In Experiment 1 subjects produced semantic associates to some and rhyme associates to other study items. Levels-of-processing effects were observed for recognition and "Remember" judgments. For "Know" judgments, this effect was reversed. A modality match (visual - visual) between study and test events had no effect relative to a modality mismatch (auditory - visual) condition.

In Experiment 2, subjects studied pictures and words. The picture superiority effect was obtained for recognition

and "Remember" judgments and was reversed for "Know" judgments.

In Experiment 3, in the recognition phase, half the studied and nonstudied words were preceded by a brief (50 ms) and masked repetition, and the other items were preceded by masked presentations of unrelated words. Masked repetition enhanced recognition and "Know" responses, but did not affect "Remember" responses.

In Experiment 4, subjects made confidence judgments ("Sure"/"Not Sure") to primed or unprimed recognized items. The pattern of priming effects for "Sure"/"Not Sure" responses and "Remember"/"Know" responses (Experiment 3) were dissimilar.

In Experiment 5, the primes in the recognition test list were semantically related or unrelated to the test words and were presented longer than repeated primes (SOA = 250 ms). The semantic priming effect was observed only for nonstudied items and was distributed equivalently between "Remember" and "Know" judgments.

These results - 1) indicate that "Remember" and "Know" responses are sensitive to conceptual and perceptual factors respectively, 2) provide support for the two-factor theories of recognition memory, and 3) show that "Remember" responses are a "purer" measure of conscious recollection than standard explicit memory tests.

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Table of Contents

	Page
Abstract.....	II
Acknowledgements.....	IV
List of Tables.....	VI
Introduction.....	1
Experiment 1.....	28
Experiment 2.....	41
Experiment 3.....	51
Experiment 4.....	64
Experiment 5.....	72
General Discussion.....	84
Footnote.....	99
References.....	100
Appendix.....	113

List of Tables

	Page
Table 1. A Summary of Proportions of "Remember" and "Know" Judgments and "Sure" and "Unsure" Judgments as a Function of the Independent Variables in Previous Studies.....	13
Table 2. Mean Proportion of Hits and False Alarms as a Function of Study Conditions and Response Type in Experiment 1.....	37
Table 3. Mean Proportion of Hits and False alarms as a Function of Study Conditions and Response Type in Experiment 2.....	47
Table 4. The Design and Results for Proportion of Hits and False Alarms and the RT Data (in ms) in Experiment 3.....	60
Table 5. The Design and Results for Proportion of Hits and False Alarms and the RT Data (in ms) in Experiment 4.....	69
Table 6. The Design and Results for Proportion of Hits and False Alarms and the RT Data (in ms) in Experiment 5.....	79

Introduction

For decades, psychologists have treated consciousness as an epiphenomenon and an unsuitable topic for scientific enquiry. Although consciousness permeates a great deal of mental activity, psychologists have hesitated studying the nature of this experience. One exception to this state of affairs is research into subliminal perception which has produced controversial findings (see Holender, 1986; Marcel, 1983a).

Tulving (1985) points out that this neglect is especially noticeable in the study of memory. He says, "One might think that memory should have something to do with remembering, and remembering is a conscious experience. To remember an event means to be consciously aware now of something that happened on an earlier occasion. Nevertheless, through most of its history, including the current heyday of cognitive psychology, the psychological study of memory has largely proceeded without reference to the existence of conscious awareness in remembering" (p. 1).

In recent years however, there has been a resurgence of interest in this topic. Interest in the role of conscious awareness in memory has been expressed in two broad lines of research - the work on amnesics who suffer from memory loss as a result of certain types of brain damage (e.g., Warrington & Weiskrantz, 1968, 1970), and the work on

understanding the nature of recollective experience (Gardiner, 1988; Tulving, 1985).

Research with amnesics has shown that although amnesics are unable to perform at normal levels on tests such as recall and recognition, their performance is comparable to that of normals on a special class of memory tests called implicit memory tests (e.g., Warrington & Weiskrantz, 1968; 1970). Implicit memory tests refer to tests that do not require conscious recollection on the part of the subject. On these tests, subjects are simply required to perform a task without reference to the study event (e.g., solve fragments such as e-e-ha-- or stems such as ele---- with the first word that comes to mind). The extent to which performance on this task is influenced by earlier studied events (e.g., studying the word elephant) is assumed to reflect memory. The finding that amnesics show intact performance on implicit memory tests while being impaired on measures such as recall or recognition have led some theorists (Tulving & Schacter, 1990; Squire, 1987) to conclude that amnesics are impaired in their capacity to consciously recollect studied episodes. When conscious recollective experience is not necessary for performance on the task, amnesics perform as well as normals.

Differences between memory tests that require conscious recollection such as free recall and recognition, and memory tests that do not require conscious recollection (implicit

memory tests) have been shown with normal subjects as well. For instance, study manipulations that influence performance on recall and recognition tests in one manner often influence implicit memory tests in an opposite manner, or do not influence them at all (Jacoby, 1983a, 1983b, Jacoby & Dallas, 1981; Roediger, Weldon, & Challis, 1989). To take one example, if subjects are required to generate some items at study from semantic cues (HOT - ????) or to merely read the items in the presence of semantic cues (HOT-COLD), their memory for generated items is better than for read items in explicit memory tasks such as recognition, while this pattern of results is reversed for implicit memory tests such as those requiring the identification of briefly presented words (Jacoby, 1983, Experiment 2). Because explicit memory tasks such as recall and recognition benefit from meaningful processing (such as those involved in generation of words), these tasks are referred to as the conceptual explicit memory tests. On the other hand, because tasks such as perceptual identification and word fragment completion are sensitive to perceptual processing (for example, that involved in reading words), they are referred to as perceptual implicit memory tasks.¹

For many theorists (Tulving & Schacter, 1990; Squire, 1987), the dissociation data from explicit and implicit memory tests as described above indicate fundamental differences between measures of memory that require

conscious recollection (explicit memory tests) and measures of memory that do not require any conscious recollection (implicit memory tests). The assumption that underlies research on explicit and implicit memory is that explicit memory tests are faithful measures of conscious recollection. They are assumed to tap conscious recollection of the studied event simply because in explicit tests, subjects are instructed to recollect studied events, while in implicit tests they are not.

Such an approach to the study of conscious recollection is referred to by Tulving (1989) as the doctrine of concordance of behavior, cognition, and experience. That is, based on the subject's performance, the nature of the experience is inferred and the study of cognitive processes has been mistaken for a study of conscious experience. As Tulving (1989) suggests, there is no logical necessity for a relation between behavior or (performance) and conscious experience.

In fact, recent data show that performance on explicit memory tests does not depend solely on the conscious recollection of studied events by the rememberer. For instance, Tulving (1985) showed that not all the items that were recalled by the subject were solely products of conscious recollection. Similarly, Gardiner and his colleagues (1988; Gardiner & Java, 1990; Gardiner & Parkin, 1990) showed that recognition memory appears to involve two

components, only one of which is related to the conscious recollection of studied items. These studies will be reviewed in detail later because they are directly pertinent to the issues explored in this dissertation. Before this, relevant research on recognition memory is reviewed briefly because the notion that there are two bases to recognition memory had been proposed before Gardiner and his colleagues explored the components of recognition memory (1988; Gardiner & Java, 1990; Gardiner & Parkin, 1990). Gardiner used recognition memory to study the role of conscious recollection in memory, but many earlier researchers who were interested in the nature of recognition memory had suggested that it is composed of two components.

Two bases of recognition memory

Mandler (1979, 1980) and Jacoby (1983a, 1983b, Jacoby & Dallas, 1981) have been the two notable proponents of the theory that recognition memory is based on two basic components. Mandler (1980) termed these components as integration and elaboration. A process of intraitem integration occurs when, "repeated exposures of an event focus organizational processes on the perceptual, featural, and intrastructural aspects of the event; intraitem organization involves sensory and perceptual integrations of the elements of the target event. This increased integration....is perceived as the familiarity of the event" (p. 255). Elaborative processes depend on interitem

organization and include meaning-based analysis of the to-be-recognized material. These elaborative processes are termed retrieval processes in Mandler's model.

Some other models of recognition have also assumed familiarity and "retrieval" processes as the two bases underlying recognition memory performance (e.g., Atkinson & Juola, 1973, 1974; Atkinson & Westcourt, 1975). In Mandler's model, familiarity and retrieval processes in recognition are conceptualized as separate and additive processes. To separate these two components, Mandler (1980) used recall and recognition tasks in between-subjects or within-subjects (using successive testing) designs. In his model, the recall scores constituted the retrieval probability in recognition memory while the familiarity component was computed from the retrieval component using a formal model.

Jacoby (1983a, 1983b; Jacoby & Dallas, 1981) postulated two bases of recognition memory based on the findings that, on the one hand, parallel effects of perceptual variables are observed on recognition memory task and perceptual implicit memory tasks such as those requiring the identification of briefly presented words (perceptual identification). For example, when the spacing between the presentations at study or the frequency of study items was varied, parallel effects were found on recognition memory and perceptual identification performance. On the other

hand, dissociative effects of conceptual variables such as levels of processing were also observed for the two tasks. For example, in the levels-of-processing manipulation, subjects were asked whether a given word contained a letter ("Does the word brain contain the letter R?"), or whether it rhymed with another word ("Does it rhyme with train?"), or to answer a question that required processing the meaning of the word ("Is it a part of the central nervous system?"). The levels-of-processing manipulation (Craik & Lockhart, 1972; Craik & Tulving, 1975) had an effect on recognition memory such that subjects recognized words studied in the meaningful processing condition significantly better than words for which rhyme or letter decisions were made. However, there was no effect of the levels-of-processing manipulation on the perceptual identification task, although equivalent priming was obtained across conditions. Based on many such demonstrations, Jacoby argued that recognition memory has two bases - a conceptual component that is influenced by meaningful processing of the word, and a perceptual component (or familiarity) that is based on perceptual processing of the word.

As pointed out earlier, Tulving (1985) and Gardiner's (1988, Gardiner & Java, 1990; Gardiner & Parkin, 1990) data also support Mandler's and Jacoby's models of recognition memory although the central aim of their work was to use their paradigm to test whether explicit memory tests are

faithful measures of conscious recollective processes. This paradigm is described in the next section.

Explicit memory - "Remembering" and "Knowing"

The basic paradigm for exploring the role of conscious recollection on memory involves requiring people to make judgments regarding the nature of their memories for recalled or recognized items (e.g., Gardiner, 1988; Tulving, 1985). In other words, conscious recollection is not assumed on the basis of successful memory performance. Rather, subjects are required to indicate which of the recalled/recognized items they clearly remember from the study list.

In these studies, the tasks used were all explicit measures of retention (recall or recognition), but subjects were asked to differentiate the recalled or recognized responses on the basis of their subjective experience. One type of experience that subjects judged as "Remember" referred to those items for which the subject has vivid memory, a subjective feeling of having seen the item during the study episode, and has a conscious recollection of it as occurring on the study list. The other type of experience that subjects judged as "Know" referred to items for which the subject could tell (usually with certainty) that a given item was on the study list but could not recollect its actual occurrence. It is assumed that this judgment is made on some other basis because the subject does not remember

actually seeing the item on the list, and does not have a conscious recollection of it. For example, while describing a recent visit to a national park, one may recall all the details and mentally relive the events that took place. This would be an example of a "Remember" judgment. On the other hand, there are times when we meet someone on the street who we met at a party the previous night. Although we know that we met this person at the party, we may not remember actually meeting the person or his/her name. In this case, the recognition of this person is accompanied by a "Know" judgment, not a "Remember" judgment.

Thus, both "Remember" and "Know" judgments can be seen as stemming from episodic memory in that the personal, spatial, and temporal contexts of the study episode are preserved. However the vivid and concrete qualities that also characterize episodic memory are present only for items for which subjects make "Remember" responses. Thus, "Remember" and "Know" judgments presumably differentiate items that are accompanied by a subjective experience of remembering from those that are not. These judgments are however, different from other judgments about memory. The distinction between these various types of judgments is discussed briefly in the next section.

The distinction between metamemory measures and "Remember"/"Know" judgments

The distinction between "remembering" and "knowing" is

different from the feeling of knowing judgments and the accuracy of feeling of knowing judgments (Nelson & Narens, 1980; Schacter, 1983). The feeling of knowing paradigm is used as a measure of metamemory, that is, knowledge about what one does not remember. On the other hand, "Remember" and "Know" judgments measure the nature of the memory itself. Another related paradigm has been employed by Johnson (Johnson & Raye, 1981; Johnson, Raye, & Durso, 1980; Johnson, Raye, Foley, & Foley, 1981) on reality monitoring. Reality monitoring is similar to making "Remember" and "Know" judgments in that in both paradigms subjects are required to evaluate their memories. The critical difference between reality monitoring and making "Remember" and "Know" judgments is that the former is directed towards identifying the origin of an event as internally generated by the subject or as an event that has an external source, that is, an item presented by the experimenter. Reality monitoring is concerned with the distinction between memory for internal thoughts and memory for perceptions. On the other hand, both "Remember" and "Know" judgments are made to events that occur in the external world. The issue here is not that of identifying the source of the memory as external or internal (the source for both types of memories is known to be external), but identifying the quality of the memory.

"Remember" and "Know" judgments also differ from the study of source amnesia. Source amnesia is the finding that

people remember some newly-learned information but do not recall the source of this knowledge, i.e., the information was acquired in the earlier phase of the experiment (McIntyre & Craik, 1987; Schacter, Harbluk, & McLachlan, 1984). In the case of "Remember" and "Know" judgments, the source of the event is preserved because subjects are aware that they are making these judgments to items presented in the study list. The difference captured with these responses is whether or not the rememberer has a conscious and vivid recollection of the study event. What does the distinction between "Remember" and "Know" judgments tell us about the relationship between conscious recollection, and explicit measures of memory such as recall or recognition? In the next section, recent work on this issue is reviewed.

"Remember" and "Know" judgments - A review of previous studies

The first study that employed "Remember" and "Know" responses to study the nature of conscious experience was reported by Tulving (1985). The top section of Table 1 shows the relevant results from Tulving's study. In the first experiment in that paper, subjects studied a list of 27 category names and one instance for each category (e.g., musical instrument - VIOLA). This was followed by three successive recall tests. The first was a free recall test where subjects were asked to recall as many instances as they could remember. In the second test, category cued

recall, subjects were given the category names to be used as retrieval cues to recall the instances (e.g., musical instrument - _____). In the third test, category and letter cued recall, subjects were given the first letter of the instance name in addition to the category name to recall the instances (e.g., musical instrument - v_____).

In each of these tests, subjects were asked to indicate next to every recalled item whether they actually remembered seeing that item on the study list ("Remember") or whether they recalled it on some other basis ("Know"). The idea was that free recall involved maximum conscious awareness and the category recall a little less, and the category name plus letter recall even less. These predictions were borne out as the highest number of "Remember" responses were observed in the free recall task, followed by the category recall task, and finally by the category name plus letter recall task.

In the second, recognition memory experiment Tulving (1985) required subjects to recognize studied words intermingled with nonstudied ones, and also to indicate which of the recognized words they actually "remembered" seeing on the study list and which ones they just "knew" were on the study list. For half of the items subjects were given a recognition test in the same session as the study, and for the other half of the items the recognition test was given 8 days later. The results showed that "Remember"

Table 1

A Summary of Proportions of "Remember" and "Know" judgments and "Sure" and "Ursure" Judgments as a Function of the Independent Variables in Previous Studies.

<u>Tulving (1985, Experiment 1)</u>			
Tasks	Probability of recall (Conditionalized on remaining items)	"Remember"	
Free recall	.51	.88	
Category cued recall	.54	.75	
Category & letter cued recall	.74	.48	
<u>Gardiner's experiments</u>			
Study condition	"Remember"	"Know"	Recognition ("R" + "K")
Gardiner (1988, Experiment 1)			
Produce semantic associates	.68	.18	.86
Produce rhyme associates	.48	.17	.65
Gardiner (1988, Experiment 2)			
One hour retention interval:			
Generate at study	.69	.15	.84
Read at study	.38	.14	.52
One week retention interval:			
Generate at study	.44	.17	.61
Read at study	.28	.22	.50
Continued next page...			

Study Condition	"Remember"	"Know"	Recognition ("R" + "K")
Gardiner & Java (1990) Experiment 1			
Low frequency words	.44	.17	.61
High frequency words	.31	.17	.48
Experiment 2			
Words	.29	.17	.46
Nonwords	.19	.30	.49
Gardiner & Parkin (1990)			
Undivided attention	.50	.20	.70
Divided attention (Easy)	.38	.20	.58
Divided attention (Hard)	.27	.22	.49
Gardiner & Java (1990) Experiment 3			
	"Sure"	"Unsure"	Recognition ("S" + "US")
Words	.34	.27	.61
Nonwords	.39	.27	.66

responses declined with retention interval (from day 1 to day 8). For data pooled over retention interval, a positive correlation between "Remember" judgments and confidence (i.e., confidence for the recognition of the items) judgments was also obtained such that items that received "Remember" judgments were also recognized with high confidence. These data suggest that "Remember" and "Know" responses are made on the basis of different levels of confidence. This issue was addressed by Gardiner and Java (1990, Experiment 3) and they failed to find a positive correlation between high confidence judgments and "Remember" responses on the one hand, and low confidence judgments and "Know" responses on the other. We will return to this issue later and Experiment 4 reported in this present thesis also examines the relation between confidence judgments and "Remember"/"Know" judgments.

A series of experiments reported by Gardiner and his colleagues (1988; Gardiner & Java, 1990; Gardiner & Parkin, 1990) have shown that several variables produce dissociations between "Remember" and "Know" responses. These differences are similar to the dissociations observed as a function of the same variables between conceptual explicit memory tasks and perceptual implicit memory tasks. Specifically, "Remember" responses showed the same pattern of results that have been observed in conceptual explicit measures of retention, whereas "Know" responses showed a

pattern that resembles the pattern seen in perceptual implicit measures of retention. This is a very interesting trend, because both "Remember" and "Know" responses are presumably tapping episodic memory as measured by cued recall or recognition. To clarify the points made here, the specific encoding manipulations carried out by Gardiner and his colleagues (1988; Gardiner & Java, 1990; Gardiner & Parkin, 1990) are discussed below and a summary of their results is presented in Table 1. (The proportions reported in this table are computed from the bar graphs presented in the papers of Gardiner and his colleagues).

In all the experiments reported by Gardiner and his colleagues the nature of conscious recollection (i.e., "Remember" and "Know" responses) was measured using a recognition memory task. In the first phase, subjects studied some items under different study conditions. In a second phase, they were given a recognition memory test for these items in which they were presented with a list of items containing studied and nonstudied words. For items that subjects recognized from the study list, they were asked to indicate which ones they clearly "remembered" seeing on the study list and which ones they "knew" were on the study list. The important question was whether "Remember" and "Know" responses would show different effects of the encoding variables even though both responses were made to items that were recognized on an explicit memory

test.

One variable manipulated at the time of study was orienting task performed on the study items (Gardiner, 1988, Experiment 1), also known as the levels-of-processing manipulation. In a recognition memory test, semantically encoded items are recognized more accurately than phonetically encoded items (e.g., Craik & Lockhart, 1972; Craik & Tulving, 1975) and this pattern of results is referred to as the levels-of-processing effect. This variable has no effect on perceptual implicit memory tasks (Jacoby & Dallas, 1981). In Gardiner's (1988) experiment, half the subjects produced semantic associates for each studied word (Associate condition) and the other half produced a rhyming word for each studied word (Rhyme condition) in a between-subjects design. The levels-of-processing effect typically observed in recognition memory, that is, superior memory for semantically encoded items relative to phonetically encoded items, was observed for "Remember" responses. This manipulation had no effect on "Know" responses, a pattern similar to that observed in perceptual implicit memory tests.

In Gardiner's (1988) second experiment, the encoding conditions were manipulated by asking subjects to generate antonyms for half of the items and to read (without context) the other half of the items. Previous studies have shown that recognition memory is significantly better for items

that are generated at the time of study rather than read (e.g., Jacoby, 1978; Slamecka & Graf, 1978). The question now was whether "Remember" and "Know" responses would show same or different effects of the generate versus read manipulation.

In addition, the effect of retention interval on "Remember" and "Know" responses was also manipulated by testing half of the subjects an hour after the study phase and the other half of the subjects after a week. At the one hour retention interval, the generation effect (the superiority in recognition for items that were generated compared to items that were read) was observed for only "Remember" responses. This manipulation had no effect on the "Know" responses. The same pattern of results was found after one week except that response probabilities were attenuated for all responses and there was an increase in false positive responses. The absence of a greater proportion of "Know" responses for read words compared to generated words is inconsistent with the previous finding with perceptual implicit memory tests where performance in tasks such as perceptual identification (Jacoby, 1983) is better for read words than generated words. However, a numerical trend of a greater proportion of "Know" responses was observed for read items relative to generated items after one-week retention interval.

These experiments demonstrate that "Remember" and

"Know" responses show functional dissociations that are similar to those observed between explicit and implicit measures of retention (e.g., Jacoby & Dallas, 1981; Tulving, Schacter, & Stark, 1982). However, it is also possible that "Know" responses failed to show the levels-of-processing effect and the generation effect due to low levels of performance. According to this "weak trace strength" hypothesis, the lack of an effect of these variables could be due to a quantitative rather than a qualitative difference in the two types of responses. That is, if higher proportion of "Know" responses were obtained in these experiments, we may have observed the same pattern of results for "Know" responses as for "Remember" responses.

Gardiner and Java (1990) employed a number of other independent variables to test the "weak trace strength" hypothesis against a "dual-component hypothesis". According to the latter, "Know" responses should sometimes show a high level of performance and be systematically influenced by some other independent variable that does not influence the "Remember" responses or influences "Remember" responses in the opposite direction. In their first experiment, Gardiner and Java (1990) had subjects study a list of items in which half the items were high-frequency words and the other half were low frequency words. The recognition test was given 24 hours later and subjects once again classified the recognized items into "Remember" and "Know" responses.

In the recognition task, subjects recognized more low frequency words than high frequency words. For "Remember" and "Know" responses, this effect was restricted only to "Remember" responses. Thus, low frequency words yielded higher performance than high frequency words for "Remember" responses and this variable had no effect on the "Know" responses. This result is inconsistent with the hypothesis that "Remember" responses are sensitive only to conceptual factors because in previous studies the frequency effect in recognition has been linked to enhanced perceptual fluency (Jacoby & Dallas, 1981) or familiarity (Mandler, 1980).

In all of Gardiner's experiments described so far, the independent variable affected the "Remember" responses but had no effect on the "Know" responses. In their second experiment Gardiner and Java (1990) succeeded in demonstrating opposite effects of a variable on "Remember" and "Know" responses. Subjects studied a list of words and nonwords and were later given a recognition memory test and were asked to make "Remember" and "Know" judgments. For the recognized items, subjects gave significantly more "Know" responses to nonwords than to words. Conversely, they gave more "Remember" responses to words than to nonwords. This high level of performance for "Know" responses (for nonwords) argues against the "weak trace strength" hypothesis or floor effects for "Know" responses. These results show that the absence of an effect of a variable on

"Know" responses is not necessarily due to floor effects.

In another study, Gardiner & Parkin (1990) examined the effect of divided attention on "Remember" and "Know" responses. In the divided attention paradigm, subjects either participate, during study or test, in a condition where no distractions are presented to them (undivided attention condition) or where they are presented with a secondary task (such as monitoring tones) while paying attention to a study list or participating in a test. From previous research we know that divided attention has no detrimental effect on performance in perceptual implicit memory tests whereas performance in conceptual explicit memory tests such as free recall gets significantly worse (e.g., Jacoby, Woloshyn, & Kelley, 1989; Parkin & Russo, 1989).

Given that "Remember" and "Know" responses generally mimic the pattern of results shown by conceptual memory tasks and perceptual memory tasks, Gardiner and Parkin (1990) argued that divided attention would selectively impair "Remember" responses in a recognition memory task but would not affect "Know" responses. These predictions were borne out by the results which are described below.

Gardiner and Parkin (1990) manipulated divided attention in the study phase to test whether "Remember" responses would decline as a result of this manipulation while "Know" responses would be unaffected. Subjects in the

undivided attention condition studied words for a later memory test in the absence of any distractions. Subjects in the easy divided attention condition studied words while monitoring a sequence of tones and reporting whether the different pitches were low, medium, or high. In this condition, the tones occurred at intervals between 6 to 9 sec. In the hard divided attention condition, this task was made more difficult by doubling the rate of presentation of tones.

Gardiner and Parkin (1990) found that divided attention at study affected only the "Remember" responses. Subjects gave the highest proportion of "Remember" responses in the undivided condition, followed by the easy divided attention condition, and the lowest "Remember" responses were obtained in the hard divided attention condition. "Know" responses were equivalent for the three study conditions. These results once again indicate that "Remember" responses are affected by variables that affect conceptual explicit memory tasks whereas these variables have no effect on "Know" responses.

In another experiment, Gardiner and Java (1990, Experiment 3) attempted to rule out the possibility that increased level of performance for "Know" responses (for example, for nonwords in Gardiner & Java, 1990, Experiment 2) can be linked to confidence level. According to this argument, increase in "Know" responses for nonwords is due

to increased proportion of "unsure" responses. When subjects are not sure of having seen a nonword before, they assign a "Know" response to it, which results in a higher proportion of "Know" responses for nonwords relative to words. If this were true, then we should observe high proportion of "Unsure" responses for nonwords. A high proportion of "Unsure" responses for nonwords would indicate that "Know" responses are given to items that have "weak trace strength".

This logic was tested in Gardiner and Java's (1990) third experiment, in which subjects made confidence judgments ("Sure" or "Unsure") to words and nonwords at the time of recognition test instead of giving "Remember" and "Know" responses. Nonword target recognition was not accompanied by greater proportion of "Unsure" responses (see the last section of Table 1). This result indicates that "Know" responses cannot be equated with low confidence because the pattern of results with confidence judgments were different from the pattern of results obtained for "Remember" and "Know" judgments. For words and nonwords, a cross-over interaction was obtained with "Remember" and "Know" responses such that greater proportion of "Remember" responses were observed for words than for nonwords, and greater proportion of "Know" responses were observed for nonwords than for words. However, with "Sure" and "Unsure" responses, the proportion of "Sure" responses were

equivalent for words and nonwords and the proportion of "Unsure" responses were also equivalent for words and nonwords.

Gardiner and Parkin (1990) suggested that all the results for "Remember" and "Know" responses (Gardiner, 1988; Gardiner & Java, 1990; Gardiner & Parkin, 1990) could be explained by a relation of exclusivity between the two components that underlie these two types of responses. According to the authors, "Exclusivity assumes that the underlying components have no relation with one another such that the outcome of one component exerts no influence whatsoever over the other component." They suggested that this type of relation accounts well for the pattern of results described previously for "Remember" and "Know" responses. Also, the theoretical account offered by Gardiner and Parkin (1990) for all these results is that "Remember" responses are based on an episodic memory system which largely depends on conceptual processing whereas "Know" responses are possibly based on a procedural memory system that largely employs perceptual processing.

The present experiments were carried out to examine further the nature of conscious recollective experience as measured by "Remember" and "Know" responses. The goal was to identify the factors that influence "Remember" and "Know" responses. Specifically, I tested Gardiner's claim that "Remember" responses are sensitive to conceptual

manipulations whereas "Know" responses are sensitive to perceptual manipulations. Of special interest here is the nature of "Remember" responses because they are presumably the most direct measures of the subjective experience of remembering that characterizes the phenomenology of memory.

Measurement Issues

Some measurement issues must be addressed because of the nature of instructions given to the subjects to make "Remember" and "Know" judgments. Subjects are required to make the "Remember" response to a recognized item if they can bring the study event back to mind. If the recognition judgment is made on some other basis, then subjects are asked to make a "Know" judgment. These instructions thereby imply that subjects make a "Know" judgment to a recognized item whenever they fail to make a "Remember" judgment.

One potential problem with treating "Remember" and "Know" responses as two separate psychological entities is that "Know" responses are made by default and therefore may not correspond to a distinct psychological state. This argument may be true, but it does not undermine the implications of the pattern of data observed for these two types of responses. The main point to be demonstrated here is that recognition memory includes something more than conscious recollection. Conversely, to measure conscious recollection, one must separate the residual component (termed "Know" responses in this thesis) from the

performance in the memory task. Gardiner and his colleagues treated "Remember"/"Know" judgments as levels of an independent variable and conducted the analysis of variance to analyze the data. In this thesis also, "Remember" and "Know" judgments will be treated as levels of an independent variable. However, paired-comparison t tests will also be used to examine the effects of the other independent variables on "Remember" and "Know" responses separately since different a priori predictions for the two types of responses can be made.

Another measurement issue can be raised with reference to "Know" responses: Should relative proportions rather than absolute proportions be reported because "Know" responses are made only after subjects fail to make the "Remember" responses? Relative proportions would be the appropriate measure in an instance where subjects first make "Remember" judgments to all the items in the test list and then go back to the beginning of the list to make the "Know" judgments on the remaining items. However, in Gardiner's experiments and in the present experiments subjects first make a recognition judgment to an item and immediately following the recognition judgment, subjects make the "Remember/Know" judgments to that item before proceeding to the next item. In other words, recognition and "Remember/Know" judgments are made on an individual item basis. In this context, it would not be appropriate to compute the relative proportions

for "Know" responses.

In sum, the "Remember/Know" judgment paradigm provides a tool to investigate the underlying components involved in explicit measures of memory and to explore the nature of conscious recollection from the point of view of the subjective experience of the rememberer.

Experiment 1

The central aim in Experiment 1 was to replicate Gardiner's (1988) results with the orienting task (levels-of-processing) manipulation on "Remember" and "Know" judgments in a recognition memory task. The critical aspect of conducting experiments using "Remember" and "Know" responses is to ensure that subjects understand the two terms in the special way the experimenter intends them to be used. Therefore, the orienting task manipulation was used to ensure that the instructions for the task worked as expected, which would be indicated by replicating Gardiner's (1988, Experiment 1) results with this variable.

In addition, this experiment was an attempt to examine the effect of modality of presentation of study items (visual and auditory) on "Remember" and "Know" judgments in the recognition task (where all items were presented visually). The reports of the effect of modality in recognition tasks have been mixed. Some studies have reported slightly but significantly better recognition performance for items that were studied and tested in the same modality relative to items that were studied and tested in different modalities (e.g., Geiselman & Bjork, 1980; Kirsner, 1974; Kirsner & Smith, 1974). Other studies have either failed to find this effect or found that the effect of modality of presentation interacted with other variables (Kirsner, Milech, & Standen, 1983; Jacoby & Dallas, 1981;

Roediger & Blaxton, 1987).

If we were to obtain superior memory for items presented in the same mode at study and at test, then based on previous findings (Blaxton, 1989), we would predict that this perceptual effect will be reflected in "Know" responses, if "Know" responses are sensitive to perceptual factors. This prediction is based on some previous findings (Blaxton, 1989; Jacoby & Dallas, 1981; Roediger & Blaxton, 1987) of superior performance for items with preserved modality across study and test in perceptual implicit memory tasks.

"Remember" responses are not likely to reflect the same mode superiority because conceptual tasks are not sensitive to modality manipulation. For example, Blaxton (1989) found that subjects' performance in a free recall task was comparable for both visually and auditorily studied words.

The predictions for "Remember" and "Know" responses for the levels-of-processing manipulation are as follows.

"Remember" responses should show a significant levels-of-processing effect (Craik & Lockhart, 1972; Craik & Tulving, 1975; Gardiner, 1988) whereas we do not expect to find a levels-of-processing effect for "Know" responses, if "Know" responses depend on enhanced perceptual processing (see Jacoby & Dallas, 1981; Graf & Mandler, 1984). It is also possible that we may obtain a reversed level-of-processing effect for "Know" responses, where a greater proportion of

"Know" responses would be observed for items studied in the shallow condition (produce rhyme associates) relative to items studied in the deep condition (produce semantic associates). This prediction is based on the logic that the shallow processing condition produces greater perceptual processing relative to deep processing condition. If "Know" responses are sensitive to perceptual processing, then it is possible to obtain superior performance in the shallow condition relative to the deep condition.

Method

Subjects. Sixteen Rice University undergraduates participated in this experiment in partial fulfillment of course requirements.

Design and materials. This experiment employed a 2 (orienting task) x 2 (modality of presentation) x 2 (response type) within-subject design for the recognition task. The two levels of processing employed for the orienting task variable were the same as those used by Gardiner (1988) except that, unlike his study, the orienting task was manipulated as a within-subject variable. Subjects produced semantic associates to half of the study words (deep level of processing) and produced rhyming words to the other half of the study words (shallow level of processing). Also, half of the study words were presented visually whereas the other half were presented auditorily. Response type was manipulated through instructions at the time of

test where subjects made one of the two responses, "Remember" or "Know", for each recognized item.

The presentation of items was blocked by condition in such a way that in one block subjects produced semantic associates to visually presented words. In the second block, subjects produced rhyme associates to visually presented words. In the third block, subjects produced rhyme associates to auditorily presented words, and finally, for the fourth block, subjects produced semantic associates to auditorily presented words. The order of blocks was counterbalanced using a Latin-square design. Twenty words were presented in each of the four blocks. Each set of 20 words was rotated through every block.

A total of 160 medium to high frequency (20-50 per million, Kucera & Francis, 1967) common nouns of 5-9 letters in length were used. The presentation of words in the recognition test phase was random with reference to the study condition. All items presented as targets in the recognition task for eight subjects were presented as lures for the other eight subjects. In all, eight combinations of study and test lists were required to achieve complete counterbalancing.

Procedure. Subjects were tested in groups of 1 to 4. In the study phase, subjects produced semantic associates or rhyming words to the study words that were presented at the rate of 5 sec per item, either visually in a booklet, or

auditorily via a tape recorder. No mention of the test phase was made at this point and subjects were told that they were assisting the experimenter in preparing materials for other experiments. In the test phase, subjects participated in a recognition task following a 1-hour retention interval. During the retention interval, subjects participated in another experiment in which neither the materials nor the procedure overlapped with the present experiment.

For the recognition task, all the test items were presented visually. Subjects were asked to write whether the test words printed in a booklet were presented in the study list ("Y" for yes) or not ("N" for no). Subjects were given a blank yellow sheet to cover the items and to expose each item in turn as they proceeded down the list. For the words recognized as having been on the study list, subjects were asked to write "R" for "Remember", if their memory for the word was accompanied by a conscious recollection of its prior occurrence in the study phase, or "K" for "Know", if they did not consciously recollect the occurrence of the word in the study list but recognized it on some other basis. The recognition, "Remember", and "Know" judgments were made on an item-by-item basis. That is, if an item was recognized, subjects made the "Remember" or "Know" Response to it before proceeding to the next item. The entire procedure took one hour and 40 minutes, including the

retention interval.

The instructions to explain the "R" and "K" responses followed very closely those specified by Gardiner (1988). The instructions for the test phase were as follows: "Please read the following instructions carefully -- You will be presented with a booklet containing words. Work carefully down the column and indicate on the first blank next to each word whether you recognize each word from the study list. If you do recognize the word, write "Y" (for 'yes'), and if you do not recognize it, then write "N" (for 'no'). In addition, at the time you recognize the word, you should also write on the second blank next to the word, whether or not you remember the word from the list or you just know on some other basis that the word was on the study list. Please read the following instructions to find out how to make the "remember" (or "R") and "know" (or "K") judgments.

Remember judgments: If your recognition of the word is accompanied by a conscious recollection of its prior occurrence in the study list, then write "R". "Remember" is the ability to become consciously aware again of some aspect or aspects of what happened or what was experienced at the time the word was presented (e.g., aspects of the physical appearance of the word, or of something that happened in the room, or of what you were thinking and doing at the time.) In other words, the "remembered" word should bring back to

mind a particular association, image or something more personal from the time of study, or something about its appearance or position (i.e., what came before or after that word).

Know judgments: "Know" responses should be made when you recognize that the word was in the study list but you cannot consciously recollect anything about its actual occurrence or what happened or what was experienced at the time of its occurrence. In other words, write "K" (for "know") when you are certain of recognizing the words but these words fail to evoke any specific conscious recollection from the study list.

To further clarify the difference between these two judgments (i.e., "R" versus "K"), here are a few examples. If someone asks for your name, you would typically respond in the "know" sense without becoming consciously aware of anything about a particular event or experience; however, when asked the last movie you saw, you would typically respond in the "Remember" sense, that is, becoming consciously aware again of some aspects of the experience. If you have any questions regarding these judgments, please ask the experimenter. Thank you."

After reading these instructions, each subject was asked to explain to the experimenter how she/he would make the "Remember" and "Know" judgments based on the instructions provided to her/him. If subjects were confused

about the distinction, the experimenter clarified the instructions further before the test phase began. This procedure was adopted in all the subsequent experiments reported here.

Results and Discussion

The results from the recognition task are presented in Table 2, which displays proportion of hits as a function of different study conditions and proportion of false alarms for "Remember" and "Know" responses. The level of significance for this experiment and all the subsequent experiments reported in this thesis was set at $p < .05$ unless otherwise noted. Effect sizes reported in this thesis were calculated using procedures specified in Rosenthal and Rosnow (1991).

For the overall recognition data, a levels-of-processing effect was obtained such that items studied at a deeper level (those to which semantic associates were produced) were recognized significantly more often (.86) than items that were studied at a shallow level (those to which rhyme associates were produced; .62), $t(15) = 4.36$, $SE = .05$. On the other hand, for the overall recognition data, no effect of modality of presentation was obtained such that there was no difference in recognition between the proportion of items studied visually (.74) and the proportion of items studied auditorily (.74), $t(15) = -0.23$, $SE = .03$.

When the recognition data are broken down by "Remember" and "Know" responses, a significant Orienting Task x Response Type interaction was obtained, $F(1, 15) = 41.16$, $MSe = .02$. The nature of this interaction was that significantly more "Remember" responses were given to the items that were encoded at a deep level (.66) relative to the items that were encoded at a shallow level (.32), $t(15) = 5.96$, $SE = .06$. This pattern was reversed for "Know" responses where significantly more "Know" responses were given to items that were encoded at a shallow level (.30) than at a deep level (.20), $t(15) = 4.27$, $SE = .02$.

The overall recognition data for the modality manipulation showed that there was no effect of modality in recognition. That is, items studied auditorily were recognized as often (.74) as items studied visually (.74).

Table 2

Mean Proportion of Hits and False Alarms as a Function of Study Conditions and Response Type in Experiment 1.

Study Manipulation	Targets			Lures (False Alarms)
	Levels-of-Processing			
	Semantic	Rhyme	Modality Visual Auditory	
Overall				
Recognition	.86	.62	.74	.16
"Remember"	.66	.32	.49	.02
"Know"	.20	.30	.25	.14

The same pattern was obtained for "Remember" responses for auditorily (.49) and visually studied items (.49) ($t(15) = -0.32$, $SE = .02$), and for "Know" responses for auditorily (.25) and visually (.25) studied items ($t(15) = .07$, $SE = .02$).

In this experiment, the orienting task manipulation was successful in that Gardiner's recognition data and the "Remember" data were replicated. That is, significant levels-of-processing effects were observed for both the recognition judgments and "Remember" judgments. For the "Know" judgments, Gardiner (1988) had observed no levels-of-processing effect whereas in the present experiment the levels-of-processing was reversed in direction. Although, this finding lends support to the idea that "Know" judgments are sensitive to perceptual factors, the absence of a modality effect for "Know" judgments does not support such a conclusion.

The cross-over interaction between "Remember" and "Know" responses as a function of the orienting task can be used to understand the relation between the "Remember" responses and the overall recognition performance. The rationale for such a comparison lies in the assumption that "Remember" responses are a "purer" measure of conscious recollection than is overall recognition, and their comparison with recognition would indicate how similar or different the pattern of results are for the two types of

measures. The cross-over interaction between "Remember" and "Know" responses suggests that "Remember" responses are more sensitive to the levels-of-processing manipulation than are recognition memory responses. The levels-of-processing effect in recognition memory (.24) was smaller (effect size, $r = .75$) than the effect observed for "Remember" responses (.34), (effect size, $r = .84$). In fact, the enhancement in the levels-of processing effect in "Remember" responses relative to overall recognition responses can also be observed in the significant interaction between for the levels-of-processing effect between "Remember" and overall recognition responses, $F(1, 15) = 18.26$, $MSe = .009$. Such an interaction may not be appropriate because "Remember" and overall recognition responses are not independent. However, this interaction does provide a statistical analysis to corroborate the increase in the levels-of-processing effect for "Remember" responses relative to overall recognition. This difference suggests that there are other factors that influence recognition memory and these factors can be identified when "Remember" responses are taken out of the total recognition performance. The residual, termed "Know" responses here, presumably corresponds to perceptual fluency (Jacoby, 1983a, 1983b; Jacoby & Dallas, 1981) or familiarity (Mandler, 1979; 1980).

The modality manipulation produced no effect in the overall recognition data. The reports of the effect of

modality of presentation have not been consistent in the literature. The conditions under which this effect is observed are unclear. The purpose of the second experiment was to use a stronger manipulation to examine the possible role of perceptual features in influencing "Know" judgments. This manipulation also allowed for a straight-forward prediction for the "Remember" responses.

Experiment 2

As noted in the introduction, Gardiner and his colleagues suggest that "Remember" responses depend on an episodic memory system that employs conceptual processing and "Know" responses depend on a procedural memory system that employs perceptual processing. If this is true, we should be able to obtain dissociations between "Remember" and "Know" responses by manipulating the symbolic form (pictures versus words) of study items in a recognition memory task. Previous studies (Madigan, 1983) have shown that recognition memory for pictures is significantly better than for words. Subjects are presented with words and pictures at study and only the word counterparts are shown at test. Subjects' task in the test phase is to decide whether or not the given word or its pictorial counterpart was presented at study. In such experiments, memory for pictures is significantly better than memory for words, even though only the word counterparts are presented at test.

In the recognition task, we should obtain this picture superiority effect. The critical issue here was the pattern of results that we would obtain for "Remember" and "Know" responses. From previous studies we know that on perceptual tasks performance on items studied in the same symbolic form is superior to items that were studied in a different mode (Weldon & Roediger, 1987, Experiment 4). In Weldon and Roediger's (1987) experiment, subjects studied words

referring to concrete objects (e.g., table) and pictures (e.g., a line drawing of a table). At test, they participated in the word fragment completion task (e.g., t _ b l _) where they were asked to complete the fragment with the first word that came to mind. Test fragments were made from the studied words, from the word counterpart of the studied pictures, or from nonstudied words.

Interestingly, the picture superiority effect observed in free recall and recognition tasks was not obtained on word fragment completion. Instead, a greater proportion of fragments were completed if subjects had studied them in word form rather than pictorial form. This was presumably because the perceptual features between words and word fragments overlap to a greater degree than the between pictures and word fragments. Word fragment completion task benefits from the perceptual overlap of study and test items indicating that this task is sensitive to perceptual variables.

Taken together, the results from recognition task (Madigan, 1983) and word fragment completion task (Weldon & Roediger, 1987) predict that a picture superiority effect should be observed for overall recognition performance and for "Remember" responses. "Remember" responses should yield the picture superiority effect because these responses presumably tap conceptual processing. "Know" responses, on the other hand, are presumed to tap perceptual processing

and therefore, the pattern of results here should be similar to that observed in perceptual implicit memory tasks such as word fragment completion. Therefore, one would predict that greater proportion of "Know" responses would be obtained for studied words rather than studied pictures when the recognition test contains word counterparts for all the studied items. This cross-over interaction is critical for the argument that the two types of responses, "Remember" and "Know", employ different types of processing. If we observe no effect of mode of presentation on "Know" responses, we would again be faced with the "weak trace strength" hypothesis in interpreting these results.

In sum, the predictions for the three judgments were - a) a picture superiority effect should be observed for recognition judgments, b) a picture superiority should also be observed for "Remember" judgments, and c) greater proportion of "Know" judgments should be observed for studied words relative to studied pictures.

Method

Subjects. Twenty Rice University undergraduates participated in this experiment to fulfill course requirements.

Design and materials. This experiment employed a 2 (mode of presentation at study) x 2 (response type) within-subject design. For mode of presentation, study items were either presented in pictorial form or as words. At test,

all items were presented in word form. Response type was manipulated with instructions at the time of test.

The study items were selected from Snodgrass and Vanderwart (1980) norms. A total of 120 items were selected such that the name agreement on the pictorial representations of these items was 85% or above according to the norms. The digitized version of these line drawings on the Macintosh were converted to be displayed on IBM PCs. In the recognition task, 60 target items and 60 lures were presented in word form. Thus, 30 words representing the names of the 30 studied pictures, 30 studied words, and 60 lure words were presented to the subjects. Counterbalancing was achieved by rotating each set of items through every condition and by ensuring that all items appeared as words and pictures at study, and as targets and lures at test, equally often across subjects. Thus, a total of four study-test list combinations were required to achieve complete counterbalancing.

Procedure. Subjects were tested in groups of 1 to 4. At study, subjects were presented with pictures and words on the computer screen at the rate of 5 sec per item and they were asked to study these items for a later (unspecified) memory task. The presentation of words and pictures was controlled by a program written in MEL programming language, and the Micro Express-386SX computers with SuperSync 2A+ color monitors. Words and pictures were presented in

blocks. A 15-minute filled retention interval was introduced between the study and test phases. The retention interval was reduced from one hour to 15 minutes based on Gardiner's (personal communication) findings that a retention interval of 10 minutes is sufficient to stabilize "Remember" and "Know" responses. That is, the proportion of "Remember" and "Know" judgments stay more or less constant between 10-minute interval and 1-hr interval. Subjects solved word fragments in this interval with the help of semantic cues. None of the words used in the study and test phase of this experiment were presented during the retention interval task.

At the time of test, subjects were given a booklet containing both studied and nonstudied items. For the studied pictures, their word counterparts were presented at test. Therefore, all the test items were words. Subjects were asked to indicate which of the test items were on the study list ("Y" for yes) and which ones were not ("N" for no). In addition, they were asked to give "R" and "K" responses for the recognized items, the instructions for which were the same as those given in Experiment 1. Thus, subjects first made the recognition judgment to each item, then gave "Remember" and "Know" responses (for "Yes" responses in recognition), and then proceeded to the next test item. The entire procedure took 45 minutes.

Results and Discussion

Table 3 displays the data for Experiment 2 for proportion of hits as a function of study conditions, proportion of "Remember" and "Know" responses, and the proportion of false alarms.

The results for the overall recognition data indicate that a significant picture superiority effect was obtained, $t(19) = 5.39$, $SE = .04$, such that pictures were recognized significantly more often (.90) than were words (.69). When the recognition data were broken down by "Remember" and "Know" responses, a significant interaction was obtained, $F(1, 19) = 40.11$, $MSe = .02$. The nature of this interaction shows that significantly more "Remember" responses were given to pictures (.81) than to words (.51), $t(19) = 6.53$, $SE = .07$, whereas significantly more "Know" responses were given to words (.18) than to pictures (.09), $t(19) = -3.91$, $SE = .02$.

The results from this experiment reveal that "Remember" judgments show the pattern of results observed in tasks sensitive to conceptual factors (i.e., the picture superiority effect in recall and in recognition) and "Know" judgments show the pattern of results observed in tasks sensitive to perceptual factors (i.e., superior performance for studied words relative to studied pictures in word fragment completion). Taken together, results from Experiments 1 and 2 clearly support the idea that "Remember"

Table 3

Mean Proportion of Hits and False Alarms as a Function of Study Conditions and Response Type in Experiment 2.

	Targets		Lures (False Alarms)
	Pictures	Words	
Study Manipulation			
Overall			
Recognition	.90	.69	.19
"Remember"	.81	.51	.03
"Know"	.09	.18	.16

judgments are sensitive to conceptual factors (the levels-of-processing effect and the picture superiority effect). For "Know" judgments, the advantage for shallow processing relative to deep processing and the advantage for words relative pictures support the idea that they are sensitive to perceptual factors.

As discussed in Experiment 1, once again we can interpret the cross-over interaction between "Remember" and "Know" responses in terms of the observed effects of an independent variable on the recognition memory task and its enhanced effects in "Remember" responses. In other words, greater proportion of "Know" responses for words than for pictures suggests that the picture superiority effect obtained for "Remember" responses (picture superiority effect = .30, effect size, $r = .83$) was bigger than that for recognition responses (picture superiority effect = .21; effect size, $r = .78$). Here again, one can compute the interaction between the picture and word study variables and the "Remember" and overall recognition responses to see whether the picture superiority effect was bigger in "Remember" responses. This interaction was indeed found to be significant, $F(1, 19) = 15.31$, $MSe = .003$. Once again, it should be pointed out that this statistical analysis may not be appropriate because "Remember" and overall recognition responses are not independent. However, this interaction statistically captures the differences we

observe numerically in the data. Thus, we observe that the conceptual effects in recognition memory are dampened by the operation of other variables.

In all the experiments reported by Gardiner and in Experiments 1 and 2 reported here, the effects of independent variables were always present in the "Remember" responses. On the other hand, "Know" judgments were not consistently affected by the independent variables in prior work. In some instances, the dissociations between "Remember" and "Know" judgments were observed when only the "Remember" responses showed the effect of the independent variables and no effect was observed for "Know" responses (Gardiner, 1988; Gardiner and Java, 1990, Experiment 1; Gardiner and Parkin, 1990). In other cases, the independent variables influenced "Remember" responses in one direction and "Know" responses in the other direction (Gardiner and Java, 1990, Experiment 2; the Present Experiments 1 and 2).

In the cases where the independent variables failed to affect "Know" judgments, it is possible that "Know" judgments would have shown the same pattern as the "Remember" judgments if null effects were not observed for these judgments due to floor effects (the "weak trace strength" hypothesis). In cases where cross-over interactions were obtained between "Remember" and "Know" judgments, a stronger case could be made that "Know" judgments have a different basis than "Remember" judgments.

However, there was no instance where the effect of an independent variable was observed only on "Know" responses and not on "Remember" responses.

It is critical to demonstrate that a perceptual variable would selectively influence only "Know" judgments to bolster the idea that "Remember" and "Know" judgments are influenced by different factors. The aim in Experiment 3 was to manipulate an independent variable that would presumably leave the "Remember" responses unaffected but would influence the recognition performance, thereby producing an effect on the "Know" responses. Such a pattern of results would help us identify the types of variables that affect recognition memory while leaving the "Remember" responses unaffected.

Experiment 3

In this experiment, the relation between perceptual fluency in processing of test items and "Remember/Know" judgments was examined. Jacoby (1983a; 1983b; 1984; Jacoby & Dallas, 1981; Jacoby & Whitehouse, 1989; Jacoby & Witherspoon, 1982) and Mandler (1979; 1980; 1985; Mandler, Graf, & Kraft, 1986) have been the most notable proponents of the view that perceptual fluency or familiarity enhances recognition.

In Jacoby's formulations, subjects classify an item as familiar if it can be processed fluently or "brought to mind" easily. That is, subjects tend to attribute ease of processing to a feeling of familiarity. In Mandler's (1980) view, familiarity is a result of inraitem integration of the perceptual and featural attributes of an event and repeated exposures lead to such an inraitem integration. The familiarity that results from such an integration is one basis of recognition.

It should be noted that Watkins and Gibson (1988) have reported an experiment in which manipulating perceptual fluency did not influence recognition memory. They reasoned that the relationship between perceptual fluency and recognition is due to item selection effects. That is, items that are easily identified in a perceptual identification task are also easily recognized in a recognition memory task. On the other hand, some reported

studies have shown an effect of perceptual priming on recognition performance (e.g., Feustel, Shiffrin, & Salasoo, 1983; Jacoby & Whitehouse, 1989; Johnston, Dark, & Jacoby, 1983; Johnston, Hawley, & Elliott, 1991).

One way to enhance the fluency of processing is to immediately precede the presentation of a target item by its own masked presentation. That is, the first presentation of the item is very rapid and preceded by a mask (e.g., '&&&&&&') so that subjects are unable to identify the first presentation but they can clearly see the second presentation. This repeated exposure is presumed to enhance the perceptual fluency with which the target item is processed.

Previous studies have shown that when a target is immediately preceded by its own masked presentation, performance on a recognition task is facilitated for the studied items relative to when the target is preceded by an unrelated word (Forster, 1985; Jacoby & Whitehouse, 1989). In fact, masked repetition of the item also increases the number of false positive responses to nonstudied items (Jacoby & Whitehouse, 1989). Jacoby and Whitehouse (1989) explained this increase in false positives for repeated items as the increased fluency with which these items were processed by the subjects and their attribution of this fluency to familiarity. That is, because these items were easier to perceive, subjects falsely called them "old".

As noted before, "Remember" judgments presumably depend on conceptual processing, and "Know" judgments on perceptual processing. Given these assumptions, one may hypothesize that "Remember" responses should be relatively insensitive to changes in perceptual fluency whereas "Know" responses should be sensitive to such changes. If this assumption is correct, facilitation of the perceptual processing of a target item by masked priming should increase "Know" responses selectively.

Here, no claim is being made that the masked word is presented subliminally but only that subjects be unable to read it or to report its presence. The question addressed in this experiment was whether this facilitation in performance on studied items and increased false positive to lures (due to increased fluency in processing) would be restricted to "Know" judgments, or whether it would be observed for both "Know" and "Remember" judgments. The former would be true if only "Know" judgments are based on perceptual fluency of processing. Further, if only "Know" judgments were sensitive to perceptual fluency of processing, then this would indicate that the pattern of results for "Know" judgments can be manipulated independently of the effect of that manipulation upon "Remember" judgments.

Method

Subjects. Twenty-four Rice University undergraduates

participated in this experiment for partial fulfillment of a course requirement.

Design and materials. The present experiment employed the paradigm used by Jacoby and Whitehouse (1989) to examine whether "Remember" and "Know" responses are affected similarly by masked repetition priming. A 2 x 2 x 2 within-subject design was used where study status (targets versus lures), priming (a test word immediately preceded by its own masked presentation or by the masked presentation of an unrelated word), and response type ("Remember" and "Know") were the three factors.

A set of 240 common nouns of high frequency (20 to 60 per million, Kucera & Francis, 1967) and 5 to 7 letters in length were used. These words were divided into four groups of 60 words each. For the first three groups, one group constituted "old" and another group "new" words in the test list. The third group of 60 words was used for the masked unrelated primes presented in the test list. The first group of words (to be classified as "old" or "studied" in the test list) was also presented in the study list. Thus, in the test list, 60 words were previously studied, and 60 were new. Of these 120 words, 30 studied and 30 nonstudied words were preceded by the masked repetition of their own (in lowercase) and the other 30 studied and 30 nonstudied words were preceded by a masked presentation of an unrelated word in lowercase letters. The fourth group of 60 words was

required in order to complete the counterbalancing such that all the words were presented in all conditions both as repeated and unrelated primes, and studied and nonstudied test words across subjects. To achieve this, eight study-test list combinations were constructed.

In addition to the 60 words in the study list, four words were added as buffer items, two at the beginning of the list and two at the end of the list. In the test list, the first eight trials were practice trials where four of the trials contained studied test words and the other four contained nonstudied test words. Also, two studied and two nonstudied test words were preceded by their own masked repetition and the rest were preceded by a different word under the masked condition. The order of words in the test list was random with reference to their conditions.

Procedure. The presentation of words was controlled by a program written in Turbo PASCAL programming language, and the Micro Express-386SX computers with SuperSync 2A+ color monitors were used to display study and test items and also to collect reaction time (RT) data in milliseconds and the accuracy data.

Items were presented at the center of the screen both in the study and test phases. For the test phase, the response keys were labelled as "Y" ("Yes, the item was on the study list") or "N" ("No, the item was not on the study list") such that they were adjacent on the keyboard (the key

'u' was labelled "N" to ensure that subjects could use their index and middle fingers of their preferred hand to press the two keys). For the "Remember" and "Know" judgments, key 'r' and key 'k' were labelled "R" and "K" respectively. The nonadjacent positions of these keys were not problematic because speeded responses were not required for "Remember" and "Know" judgments.

Subjects were asked to use only their preferred hand for all the keys used in the test phase. They were also told that the first eight items on the test list would be counted as practice items so that they could get used to the sequence of keys to be operated.

The study list and the masked primes in the test list were presented in lowercase letters whereas the test words in the test list were presented in uppercase letters. The masked primes and the unmasked test words were presented in different cases to ensure that the two presentations did not effectively become just one presentation lasting 550 ms. The computers recorded the subjects' responses and response times.

In the first phase of the experiment, subjects were presented with the study list where each word appeared at the center of the computer screen for five seconds each. Subjects were asked to study these words for a later (unspecified) memory task. After a 15-minute retention interval, subjects participated in a recognition test.

During the retention interval, subjects completed some word fragments with the help of semantic cues. The materials and procedure of the retention interval task did not overlap with the present experiment.

In the test phase, every trial contained four items - a dashed signal ('--- ---') for 2 sec to ensure that subjects' attention was focussed on the screen before the presentation of the remaining stimuli, a mask of ampersands ('&&&&&&&') presented for 500 ms, followed by the prime word in lowercase letters (either the same as the target or an unrelated word) presented for 50 ms, and finally the unmasked presentation of the test word in uppercase letters (which was either studied or nonstudied).

Subjects first made recognition judgments on the unmasked target words. They were told that the mask was a "Get Ready" signal and nothing was said about the masked (repeated or unrelated) primes. When subjects classified an item as "New" ("N"), the computer prompted them to press "Enter" to proceed to the next item. When subjects classified a target as "old" (by pressing the key labelled "Y"), they were prompted to make the "Know" or "Remember" judgment on that target. The instructions for the "Remember" and "Know" judgments were the same as in Experiments 1 and 2.

For recognition judgments, both speed and accuracy of response was emphasized. A speeded recognition task was

used because masked repetition priming effects have been typically reported in speeded tasks and last only for a short period of time (Forster, 1985; Forster & Davis, 1984). However, subjects were instructed to take their own time for "Remember" and "Know" responses. Once again, the experimenter ensured that each subject described the difference between "Remember" and "Know" judgments before the test phase started. After the test list ended, subjects were asked to report if they saw anything on the computer screen other than the mask ('&&&&&&') or the test items in uppercase letters during any part of the test list.

To reiterate the logic of the current experiment, masked repetition of items was expected to enhance recognition performance relative to the unrelated prime condition (Forster, 1985; Jacoby & Whitehouse, 1989). Further, if masked repetition enhances perceptual fluency of processing and if "Know" responses depend on (perceptual) fluency, one would predict that for target (i.e., studied) items, the masked repetition condition would produce more "Know" responses than would the masked unrelated prime condition. On the other hand, masked repetition of studied items is not likely to influence "Remember" responses. For false alarms, one would expect more "Know" responses in the masked repetition condition compared to the unrelated prime condition, again because of enhanced perceptual fluency. "Remember" responses should be low (and equivalent) for

false alarms in both primed and unprimed conditions.

Results and Discussion

Table 4 gives the design and results for Experiment 3. None of the subjects participating in this experiment reported seeing the prime or reading it. Some subjects noticed a "flicker" on the screen on some trials and they invariably attributed it to computer malfunction.

The overall recognition data indicate that the masked repetition manipulation was successful because subjects recognized significantly more studied words when they were primed by their own presentation (.67) compared to when they were preceded by unrelated primes (.60), $t(23) = 3.41$, $SE = .02$. Similarly, significantly more false alarms were observed for nonstudied words when the test items were primed by their own presentation (.23) rather than preceded by unrelated primes (.18), $t(23) = 3.33$, $SE = .01$. This pattern replicates the results obtained by Forster (1985) and by Jacoby and Whitehouse (1989).

Table 4 also displays the mean RT data for the recognition judgments in Experiment 3. The response times (in milliseconds) are reported for hits and correct rejections. For studied words, there was no effect of masked repetition priming since the mean response time obtained in the primed condition (1296 ms) was statistically equivalent to the mean response time obtained in the unprimed condition (1275 ms), $t(23) = -0.34$, $SE = 62.37$.

Table 4

The Design and Results for Proportion of Hits and False Alarms and the RT data (in ms) in Experiment 3.

Study items (target) - table, plate

	Targets		Lures	
	Masked Repetition	Unrelated Prime	Masked Repetition	Unrelated Prime
Mask Prime Test Word	XXXXX table TABLE	XXXXX scale PLATE	XXXXX glass GLASS	XXXXX chalk SHIRT
Response Required	"Yes"	"Yes"	"No"	"No"
RT Data	1296	1275	1354	1293
Recognition	"Yes"	"Yes"	"Yes" (FA)	"Yes" (FA)
"Remember" Responses	.67	.60	.23	.18
"Know" Responses	.43	.42	.05	.05
	.24	.18	.18	.13

Similarly, for nonstudied words, masked repetition priming did not produce a statistical difference in the mean response times in the primed condition (1354 ms) relative to the unprimed condition (1293 ms), $t(23) = -1.15$, $SE = 52.56$. Essentially, the null results obtained for the RT data do not undermine the effects observed with the accuracy data.

When the accuracy data are broken down by "Remember" and "Know" responses (as shown in Table 4), the results show that only "Know" responses were influenced by the masked repetition manipulation. For studied words, more "Know" responses were observed in the masked repetition condition (.24) than in the unrelated prime condition (.18), $t(23) = 2.66$, $SE = .02$. Similarly, for nonstudied words, more "Know" responses were obtained in the masked repetition condition (.18) than in the unrelated prime condition (.13), $t(23) = 3.61$, $SE = .01$. For "Remember" responses, there was no effect of the masked repetition manipulation either for studied words, $t(23) = -.31$, $SE = .02$, or for nonstudied words, $t(23) = .43$, $SE = .01$.

These results indicate that priming enhanced recognition memory but did not affect "Remember" responses. These data provide strong support for the trend observed in the previous experiments that recognition memory includes a perceptual component that does not influence the "Remember" responses.

Results from this experiment support the claim of Gardiner and his colleagues that "Know" responses are sensitive to perceptual factors. These data are also the first report of an instance where the effect of a manipulation is observed solely in the "Know" responses and not in the "Remember" responses. A critic might argue that we observed an effect in the "Know" judgments because the "Remember" judgments failed to show an effect. In other words, "Know" judgments are made by default whenever the subject does not have a "Remember" experience. However, this argument does not undermine the usefulness of using these judgments to separate the conceptual and perceptual components involved in recollective experience. "Remember" judgments appear to be an index of the conceptual processes employed in recognition memory. The other, perceptual, component involved in the recollective experience is captured in "Know" judgments here. Jacoby (1983a; 1983b; Jacoby & Dallas, 1981) refers to this process as perceptual fluency and Mandler (1980) as familiarity.

The argument that subjects make the "Know" judgment only when they fail to make the "Remember" judgment to a recognized item implies that "Know" judgments do not represent a psychological entity or state as "Remember" judgments do. This may indeed be the case. However, we observe systematic effects for the residual responses after we partial out the "Remember" responses from the total

recognition data. For ease of explication, they are termed as "Know" responses. The critical point made by results of Experiment 3 is that "Know" responses are sensitive to perceptual variables. This technique of using "Remember" and "Know" responses thus helps us separate the components involved in the recollective experience.

Experiment 4

The purpose of Experiment 4 was to demonstrate that "Remember" and "Know" judgments are not the same as confidence judgments. Tulving (1985) reported that "Remember" judgments are correlated with high confidence in recognition judgment. Gardiner and Java (1990) argued that one may obtain a correlation between "Remember" judgments and high confidence in explicit memory tasks but this does not necessarily imply that "Remember" judgments are made solely or even mainly on the basis of high confidence and "Know" judgments are assigned to items that would be given a low confidence rating.

In Tulving's (1985) Experiment 2, subjects made recognition judgments and "Remember/Know" judgments to studied and nonstudied items. In addition, subjects also indicated their level of confidence in their recognition decision on a 3-point scale. A positive correlation between "Remember" judgments and high confidence judgments was obtained in this experiment.

It is not surprising that "Remember" judgments receive high confidence ratings. However, this does not necessarily imply that these judgments are made on the basis of confidence. Rather, these judgments represent a different mental experience and confidence responses are only a part of this experience. Gardiner and Java (1990) have shown that when subjects are asked to make "Remember"/"Know"

judgments (Experiment 2) and confidence judgments (Experiment 3) in separate experiments, the pattern of results obtained for "Remember"/"Know" judgments and "Sure"/"Unsure" judgments are different. Specifically, in Gardiner and Java's (1990, Experiments 2 and 3) study, subjects made recognition judgments to words and nonwords that were studied or nonstudied in both Experiments. In the second experiment, subjects made "Remember" and "Know" judgments to the recognized words and nonwords. In the third experiment, subjects made "Sure" and "Unsure" judgments to the recognized words and nonwords. Although a greater proportion of "Know" responses was given to nonwords than to words (Experiment 2), nonwords did not receive a greater proportion of "Unsure" responses relative to words. In other words, these results refute the idea that "Know" responses are made whenever subjects are not very confident that a test item was also present in the study list.

The present experiment was designed to provide converging evidence for Gardiner and Java's (1990) conclusion that measures of conscious recollection are not simply equivalent to confidence levels. In the present experiment, the same design was used as in Experiment 3. The only difference was that instead of making "Remember"/"Know" judgments to the recognized items, subjects now made "Sure"/"Not Sure" (that the item was on the study list) judgments.

Results of Experiment 3 represent the first report where the effect of a variable on recognition performance was observed only on "Know" judgments and not on "Remember" judgments. The same variable was used in the present experiment to test whether the effect of increased perceptual fluency would be observed on only "Not Sure" responses or on both "Sure" and "Not Sure" responses. If increased perceptual fluency merely increases the proportion of "Not Sure" responses, then "Know" judgments in Experiment 3 reflect nothing more than increased "Unsure" responses. However, if both "Sure" and "Unsure" responses are enhanced in the masked repetition condition, then "Know" judgments cannot be interpreted as only an index of low confidence.

Method

Subjects. Forty-eight Rice University undergraduates participated in this experiment for partial fulfillment of a course requirement.

Design and Materials. The design and materials employed in this experiment were identical to those employed in Experiment 3. However, instead of making "Remember"/"Know" judgments, subjects made confidence judgments to the recognized items in the test list.

Procedure. The procedure in this experiment was also similar to that used in Experiment 3. However, the instructions in the test phase were somewhat different. For every trial, a dashed signal ('--- ---') was

presented for 2 sec before the presentation of the mask. This dashed signal was presented to ensure that subjects' attention was focussed on the screen when the forward mask ('&&&&&&&&') came on the screen. Subjects were asked to respond as quickly and as accurately as possible to the word that was presented in uppercase letters on the computer screen following this 'get ready' signal (i.e., '&&&&&&&&'). Following this stage, if the subject pressed the "N" key ("No, the items was not on the study list"), the computer prompted her/him to press the key labelled "Enter" to proceed to the next item. If the subject pressed the key labelled "Y" ("Yes, the item was on the study list"), the computer prompted her/him to make confidence judgments. Subjects were instructed to press the key labelled "S" (for "sure") if they were absolutely sure that the test item was on the study list. However, if they were not completely sure that the item was on the study list, they were asked to press the key labelled "NS" (for "Not Sure"). Once again, the "Y" and "N" keys were in adjacent positions on the keyboard for recognition judgments and the speed and accuracy of response was emphasized for these judgments. For the confidence judgments, the 's' key on the keyboard was labelled "S" and the 'n' key was labelled "NS". Subjects were not required to make speeded responses for the confidence judgments.

Results and Discussion

The design and accuracy data of Experiment 4 are presented in Table 5 as proportion correct for targets and proportion of false alarms for lures. The recognition data broken down by "Sure" and "Not Sure" responses are also presented.

For the overall recognition data, the masked repetition priming effect was once again obtained such that studied items that were primed by their own presentation were recognized more accurately (.75) than studied items that were preceded by unrelated primes (.70), $t(47) = 2.49$, $SE = .02$. Similarly, for lures, subjects gave more false alarms to items that were in the masked repetition condition (.25) than to items that were in the unrelated prime condition (.20), $t(47) = 3.85$, $SE = .01$.

Table 5 also displays the RT data obtained for hits and correct rejections in Experiment 4. Marginally faster RTs were obtained for studied items in the masked repetition condition (1251 ms) compared to items in the unrelated prime condition (1297), $t(47) = 1.86$, $p = .07$, $SE = 24.53$. For the nonstudied items, this difference was in the opposite direction such that items preceded by masked repetitions produced slower RTs (1391 ms) relative to items preceded by unrelated primes (1340 ms). This pattern was similar to the

Table 5

The Design and Results for Proportion of Hits and False Alarms and the RT Data
(in ms) in Experiment 4.

Study items (target) - table, plate

	Targets		Lures	
	Masked Repetition	Unrelated Prime	Masked Repetition	Unrelated Prime
Mask Prime Test Word	XXXXX table TABLE	XXXXX scale PLATE	XXXXX glass GLASS	XXXXX chalk SHIRT
Response Required	"Yes "	"Yes "	"No "	"No "
RT Data	1251	1297	1391	1340
Recognition	"Yes "	"Yes "	"Yes " (FA)	"Yes " (FA)
	.75	.70	.25	.20
"Sure" Responses	.57	.54	.06	.04
"Not Sure" Responses	.18	.16	.19	.16

pattern obtained for nonstudied items in Experiment 3 but once again it failed to reach significance, $t(47) = 1.73$, $p = .09$, $SE = 28.86$. Taken together, the accuracy and RT data for the overall recognition responses indicate that masked repetition priming led to more accurate and faster recognition responses for targets, and less accurate and slower responses for the lures.

Turning to "Sure" and "Not Sure" recognition responses, although priming effects were present numerically for both studied items and lures, they were significant only for the lures. For lures, subjects gave more "Sure" responses in the masked repetition condition (.06) compared to the unrelated prime condition (.04), $t(47) = 2.78$, $SE = .005$. Similarly, subjects gave more "Not Sure" responses for lures in the masked repetition condition (.19) than for lures in the unrelated prime condition (.16), $t(47) = 2.57$, $SE = .01$. Similar directions of priming effects were obtained for studied items. That is, more targets in the masked repetition condition received "Sure" responses (.57) than targets in the unrelated prime condition (.54). However, this difference was not statistically significant, $t(47) = 1.49$, $SE = .02$. Similarly, more targets in the masked repetition condition received "Not Sure" responses (.18) than targets in the unrelated prime condition (.16), but this difference was also not significant, $t(47) = .99$, $SE = .01$. Clearly, the pattern of results obtained with

"Sure"/"Not Sure" judgments in Experiment 4 were different from those obtained with "Remember"/"Know" judgments in Experiment 3. These results indicate that "Remember"/"Know" judgments are not made solely on the basis of confidence.

Experiment 5

In Experiment 3, overall recognition performance was improved by increased fluency of processing, but "Remember" responses were unaffected. The manipulation used in Experiment 3 for increasing the fluency of processing could be classified as perceptual in nature since the same word was presented twice. Although the lexical status of the prime and the test word was the same, the typography varied across the two presentations (the rationale for which was described in the procedure section in Experiment 3). It is possible that the benefit from repetition was not restricted to the pre-lexical or lexical information alone. That is, the priming effects could also be due to accessing the meaning of the word twice. Experiment 5 was designed to test whether we would obtain similar effects of fluency of processing with primes that are semantically related to the test word. This manipulation will provide us the opportunity to see whether ease of processing the meaning of the test word, or conceptual fluency in processing, will influence the recognition performance. These semantically related primes when presented at very short stimulus onset asynchronies (SOA) would presumably bring to mind the test word with greater ease as a result of their semantic relation (see Neely, 1977), thereby enhancing the conceptual fluency with which an item is processed. If this effect is obtained for the overall recognition performance, then the

related question of interest is whether only "Know" responses would be affected by this variable.

This idea of conceptual fluency affecting explicit memory has also been discussed by Jacoby, Kelly, and Dywan (1989) in their discussion of attributional processes involved in the recollective experience. Jacoby et al. (1989) claim that, "The notion of fluency as the basis for an attribution of familiarity is not restricted to the perceptual level of analysis" (p. 398). According to these authors, fluency of generating an idea is also used to make attributions to a past event. But the generation of specific details of the event also do not ensure that one is "really remembering". Even the fluent generation of detail does not guarantee that subjects will not make misattributions. Subjects would be less prone to making such errors if they used a more analytic basis for judgments. The logic in this experiment was to see whether "Know" responses depend only on perceptual fluency of processing or whether they could also be based on conceptual fluency. Similarly, another question addressed here was whether "Remember" responses are based solely on an analytic basis of judgment or could they also be influenced by conceptual fluency.

Method

Subjects. Forty-four Rice University undergraduates participated in this experiment in partial fulfillment of a

course requirement.

Design and Materials. In this experiment, a 2 x 2 x 2 within-subjects design was used to determine whether "Remember" and "Know" responses are influenced similarly by conceptual fluency. Conceptual fluency was manipulated by preceding half of the test items with a semantically related prime. The other half of the primes were unrelated words. The second factor used was the study status of the test items. Half of the test items were earlier presented in the study list and the other half were not. Finally, the third factor was the response type, where subjects made "Remember" or "Know" judgments to the recognized items.

A total of 120 word pairs were selected from the Shapiro and Palermo (1968) association norms to meet the criterion of .50 or above probability of obtaining the primary response given the first word of the pair. The probability of obtaining the primary response ranged from .50 to .92 (mean = .64). Another set of 120 words were collected to be used as unrelated primes. The word pairs and the unrelated primes used in this experiment are presented in the Appendix.

Of the 120 word pairs, the second word from 60 pairs was used in the study list. Of the 60 studied words, 30 were preceded by their semantically related primes, and the other 30 were preceded by unrelated primes. Similarly, of the 60 nonstudied test words, 30 were preceded by

semantically related primes and the other 30 by unrelated primes. Table 6 includes an example to illustrate the design. Four lists were prepared to ensure that across subjects each test word was presented as a studied or nonstudied item and would be preceded by a semantically related or an unrelated prime. The test words could not be presented as primes, because the strength of the semantic association in each word pair was often unidirectional.

Procedure. The presentation of words was controlled by a program written in Turbo PASCAL. Micro Express-386SX computers with SuperSync 2A+ color monitors were used to display study and test items and also to collect the RT data (in milliseconds) and the accuracy data. One to four subjects were tested at a time.

In the study phase, subjects were presented with a list of 60 words; each word was presented at the center of the monitor screen for 5 seconds. Subjects were asked to study these words for a later (unspecified) memory task. This phase was followed by a 45-minute retention interval. In this retention interval, subjects participated in another experiment, which consisted of non-overlapping materials and procedure. Following this, the test phase began. In the test phase, subjects were asked to read printed instructions that described the recognition task and the "Remember"/"Know" judgment task. After reading the instructions, each subject was asked to explain to the

experimenter how she/he would make the "Remember" and "Know" judgments, and questions and confusions were clarified by the experimenter at this time.

In the test list, subjects were presented with a triad of stimuli on every trial. The first stimulus in each triad, presented for 2 sec, was explained as the "get ready" signal and consisted of dashed lines flanking a blank space ('---   ---'). Immediately following this, the prime word in lowercase was presented for 150 ms. After 100 ms of this presentation, the test word was presented in uppercase letters. Thus, the SOA between the presentation of the prime and the test word lasted for 250 ms. The test word was present on the screen in uppercase letters until the subject made the recognition judgment. As in Experiment 3, if the subject pressed the "N" key, the computer prompted her/him to proceed to the next item, and if the subject pressed the "Y" key, the computer prompted her/him to make the "Remember"/"Know" judgment. The "Y", "N", "R", and "K" keys were labelled as in Experiment 3. Speed and accuracy of response were emphasized for the recognition response but speeded responses were not required for the "Remember" and "Know" judgments.

The display time for the primes was increased in this experiment relative to Experiment 3 because there is no published report where semantic primes were presented for brief durations (50 ms) in an (episodic) recognition task.

A recently published study by Johnston et al. (1991) failed to observe any effects of briefly presented semantic primes (primes presented for 83 ms.) in a perceptual clarification task where the subjects' task was to identify the test word that gradually came into view. No benefit was observed in identification of test words that were preceded by a briefly presented semantic prime relative to those that were not primed. Masked presentation of semantic primes has produced priming in other tasks such as the lexical decision task (e.g., Balota, 1983; Fischler & Goodman, 1978; Fowler, Wolford, Slade, & Tassinary, 1981; Marcel, 1983b) and the word naming task (Carr, McCauley, Sperber, & Parmelee, 1982; Hines, Czerwinski, Sawyer, & Dwyer, 1986). In order to ensure that the semantic/unrelated prime manipulation would be effective, the display time of the primes was increased to 150 ms. In addition, a 100 ms inter-stimulus interval between the prime and the test word was introduced. These parameters were employed to achieve the semantic priming effect by the automatic spreading activation mechanism (Neely, 1977).

Results and Discussion

Table 6 displays the design and results for proportion of hits and false alarms. For the overall recognition data, there was no effect of the semantic primes upon recognition of studied items: semantically primed items were recognized about as often (.69) as studied items preceded by unrelated

primes (.67), $t(43) = 1.22$, $SE = .02$. On the other hand, the effect of semantic primes was significant for the nonstudied items such that more false alarms were observed for nonstudied items following semantically related primes (.25) relative to the nonstudied items that were preceded by unrelated primes (.20), $t(43) = -3.24$, $SE = .02$. The RT data are also presented in Table 6. As in Experiments 3 and 4, no effect of the priming manipulation was obtained in RTs for the studied items. The RTs for the semantically primed studied items (1366 ms) did not differ from the RTs for the test items preceded by unrelated primes (1389 ms), $t(43) = .56$, $SE = 38.01$. On the other hand, for the nonstudied items, a significant effect of priming was obtained, such that semantically primed nonstudied items were responded to more slowly (1530 ms) than nonstudied items preceded by unrelated primes (1459), $t(43) = -2.59$, $SE = 27.75$. This slowing of response time for the primed nonstudied items was also observed numerically in Experiments 3 and 4 with masked repetition primes.

Table 6

The Design and Results for Proportion of Hits and False Alarms and the RT Data
(in ms) in Experiment 5.

Study items (target) - table, white

	Targets		Lures	
	Masked Repetition	Unrelated Prime	Masked Repetition	Unrelated Prime
Mask Prime Test Word	XXXXXX chair TABLE	XXXXXX scale WHITE	XXXXXX boy GIRL	XXXXXX chalk SWEET
Response Required	"Yes"	"Yes"	"No"	"No"
RT Data	1366	1389	1530	1459
Recognition	"Yes"	"Yes"	"Yes" (FA)	"Yes" (FA)
	.69	.67	.25	.20
"Remember" Responses	.44	.44	.06	.04
"Know" Responses	.25	.23	.19	.16

When the responses were broken down by "Remember" and "Know" responses (see table 6), there was no effect of semantic primes in the studied items either for "Remember" responses (semantically related condition = .44 and semantically unrelated condition = .44), $t(43) = .47$, $SE = .02$, or for "Know" responses (semantically related condition = .25 and semantically unrelated condition = .23), $t(43) = .80$, $SE = .02$. For the false alarm data, a significant effect of semantic primes was obtained for both "Remember" and "Know" judgments. For the "Remember" judgments, subjects gave more false alarm responses when the nonstudied items were preceded by a semantically related prime (.06) than when nonstudied items were preceded by semantically unrelated primes (.04), $t(43) = 2.47$, $SE = .007$. Similarly, for "Know" judgments, more false alarm responses were observed when the nonstudied items were preceded by semantically related primes (.19) than when they were preceded by semantically unrelated primes (.16), $t(43) = -2.30$, $SE = .01$.

In this experiment, for the overall recognition data, no effect of semantic primes was obtained for studied items either in accuracy data or in RT data. This result is noteworthy in the context of numerous published reports of semantic priming effects in the lexical decision and pronunciation tasks (De Groot, 1985; Den Heyer, Briand, & Smith, 1985; Smith, Briand, Klein, & Den Heyer, 1987). In

the present experiment, the effect of semantic primes was observed only for the nonstudied items, where subjects made more false alarm responses and were slower in doing so for those nonstudied items that were preceded by semantically related primes, relative to those test items that were preceded by unrelated primes.

The studied items in this experiment did not show any effect of semantic priming. This finding is inconsistent with the data reported by Neely, Schmidt, and Roediger (1983). In their study, studied items immediately preceded by semantically related primes produced faster response times than studied items that were separated from the preceding semantic primes by two unrelated intervening items. One possible reason for the discrepancy between Neely et al.'s (1983) results with studied items and the present results may be the presentation duration of the primes. In their experiment, the primes were presented for 2.8 sec each with an interval of 1.2 sec between the primes and the test words, whereas in the present experiment, primes were presented for 150 ms with an interval of 150 ms between the prime and the test word. Lewandowsky (1986) also reported facilitatory effects of semantic primes in an episodic recognition task. However, in his experiments, the prime words required an episodic recognition judgment or a semantic judgment and they stayed on the screen until a decision was made to them, whereas in the present

experiment, no response was made to the briefly presented primes.

The results from this experiment and the other studies reported here indicate that the semantic priming effects in episodic recognition tasks may be quite sensitive to time parameters used in the procedure. The present results are also quite different from those obtained in the lexical decision and naming tasks. In the latter two tasks, items that are semantically primed are responded to faster and more accurately than items that are not primed.

In terms of "Remember" and "Know" judgments, it appears that if an item is new, conceptual fluency increases the probability of both "Remember" and "Know" responses. This implies that when conceptual fluency of processing is introduced at the time of test via semantic context, subjects tend to reconstruct memories in the absence of real memories. This result is somewhat similar to Rabinowitz's (1990) finding that subjects misattribute the origins of their memories as having generated the item at study even if they had read it (Johnson & Raye, 1981) when the test phase requires generation rather than reading of items before recognition. This bias to respond "generated at study" to items that were actually read at study was found for both studied and nonstudied items. In the present experiment, however, real memories (studied items) were not susceptible to errors in conscious recollection even with a semantic

context. Subjects in Rabinowitz's (1990) study were not required to make "Remember" and "Know" judgments; they were asked to decide whether a test item was read or generated at study. Although there may be overlap between the two types of judgments in that subjects have to make specific decisions about the studied items, "Remember" and "Know" judgments explicitly require subjects to attempt recollection of the study event. This conscious recollection may or may not have occurred in Rabinowitz's experiment where subjects identified the test items as read or generated.

It is also possible that using a brief semantic context may not strongly induce conceptual fluency at test, at least with the parameters used in this experiment. It may be that requiring subjects to generate test items will influence "Remember" and "Know" judgments in the same way for the studied items as for the nonstudied items. If this were to be found, it would indicate that conceptual fluency affects "Remember" and "Know" responses in the same way.

General Discussion

The aim of this thesis was to examine the nature of conscious recollection. In the past, it was believed that explicit tests of memory measured conscious recollection whereas implicit tests of memory measured "unaware" or unconscious memories. The present experiments, in conjunction with those reported by Gardiner (1988; Gardiner & Java, 1990; Gardiner & Parkin, 1990), provide evidence that recognition memory task which is typically classified as an explicit measures of memory, contains a component that is typically associated with perceptual implicit memory. Additionally, the present data show that conscious recollection measures ("Remember" responses) can be dissociated from overall recognition performance. "Remember" responses may either show stronger effects of the independent variables relative to the effects observed in recognition, or show no effect of an independent variable relative to recognition task (if the variable affects perceptual fluency).

Five experiments were conducted to identify the processes that influence "Remember" and "Know" judgments in a recognition memory task. In the first experiment, the levels of processing of items and the modality of presentation of items were manipulated in the study phase. The results showed that the levels-of-processing effect is observed in the overall recognition data and in "Remember"

responses. "Know" responses, on the other hand, are more sensitive to items studied in the shallow condition relative to items studied in the deep condition. Modality of presentation of items (visual and auditory) had no effect on any of the three measures, i.e., recognition, "Remember", or "Know".

In the second experiment, a stronger manipulation was employed to examine the effect of modality of presentation by presenting pictures and words at study and presenting only words at test. A picture superiority effect was observed for recognition performance, and this effect was enhanced for "Remember" responses. However, more studied words received "Know" responses than studied pictures.

In the third experiment, the effect of enhanced perceptual fluency was examined for "Remember" and "Know" responses. Subjects studied a list of words and were later given a recognition test. In the test phase, targets and lures were either preceded by a masked repetition of their own presentation or by the masked presentation of an unrelated word. "Remember" responses were not affected by enhanced perceptual fluency, but a greater proportion of "Know" responses were given for words in the masked repetition condition relative to words in the unrelated prime condition.

In the fourth experiment, subjects were required to make confidence judgments on their recognition of targets

and lures that were presented either in the masked repetition condition or the unrelated prime condition. The pattern of results obtained for "Sure" and "Not Sure" responses as a function of perceptual fluency were different from the pattern of results obtained for "Remember" and "Know" responses in Experiment 3. These results indicate that "Remember" and "Know" responses are not solely made on the basis of confidence level.

In the fifth experiment, the effect of conceptual fluency was examined on "Remember" and "Know" responses. The results showed that only lures were influenced by the manipulation of conceptual fluency in the recognition task, and this effect was distributed in both "Remember" and "Know" responses given to the lures.

The data reported in this thesis have implications for two broad classes of processes, namely conceptual and perceptual, involved in memory, which have been the central concern of theories of memory in the last decade. The conceptual processes involved in memory were well-established with tasks such as free recall, cued recall, and recognition (e.g., Bousfield, 1953; Bower, Clark, Lesgold, & Winzenz, 1969; Craik & Lockhart, 1972; Craik & Tulving, 1975). In fact, the inability of amnesics to perform these tasks led researchers to believe they could not consolidate newly learned verbal information (e.g., Baddeley & Warrington, 1970).

In recent years, the perceptual processes involved in memory have been the focus of much empirical and theoretical work. Typically, the tasks that employ perceptual processes also use implicit instructions in the test phase (where no reference is made to the study phase), and these are the tasks that amnesics can also perform normally (e.g., Warrington & Weiskrantz, 1968, 1970). The results from the "Remember" and "Know" responses in the present experiments are relevant to the issue of both perceptual and conceptual processes involved in memory. The discussion of the results reported in this thesis is organized into following sections - first, the results for "Remember" and "Know" responses are discussed in the context of implicit/explicit memory dichotomy. Second, the "Remember" and "Know" response are discussed as two bases of recognition memory. In the third section, "Remember" and "Know" judgment paradigm is discussed as a technique to separate perceptual and conceptual processes in explicit memory. In the fourth section, we consider "Remember" responses as a sensitive measure of conscious recollective processes. Finally, we will return to a brief discussion of some measurement issues that were described in the Introduction.

The dissociations observed between "Remember" and "Know" responses warrant discussion within two related theoretical contexts. First, these dissociations bear a striking similarity to those observed between the perceptual

memory tasks and conceptual memory tasks. Additionally, the pattern of results obtained with "Remember" and "Know" responses support the notion of two bases for recognition memory (Jacoby, 1983a; 1983b; Jacoby & Dallas, 1981; Mandler, 1979; 1980). Results of this thesis will be discussed within each of these two theoretical contexts in the next two sections.

Dissociations between perceptual memory tasks and conceptual memory tasks

In the last decade, theorists of memory have attempted to explain the dissociations in performance that are observed between perceptual implicit memory tests and conceptual explicit memory tests (Roediger, et al., 1989; Schacter, 1990; Squire, 1987; Tulving, 1985). Not only are these dissociations observed in memory-impaired subjects (who show poor performance on explicit measures of memory but intact performance on implicit memory tasks), numerous studies have also demonstrated dissociations in performance between these tests in normal subjects as a function of several independent variables. (In the rest of this section the reference to explicit memory tasks is restricted only to conceptual explicit memory tasks.)

By the memory systems account (Tulving, 1985), dissociations between "Remember" and "Know" responses may reflect the operations of two separate memory systems - one, the episodic memory system that employs conceptual

processing, and two, the semantic or procedural memory system that employs perceptual processing. In other words, performance on recognition memory would be attributed to two separate and independent memory systems.

The transfer-appropriate processing framework (Blaxton, 1989; Roediger et al., 1989; Roediger, Srinivas, & Weldon, 1989) allows for the possibility that a task may employ more than one process. In this processing account, a task may be predominantly perceptual, predominantly conceptual, or may employ different combinations of both types of processes. Thus, the perceptual and conceptual processes observed in the present experiment fit in nicely with the processing account of memory. In fact, "Remember" and "Know" responses serve as a useful tool in separating the two types of processes, a point to which we will return later.

The two bases of recognition memory

Some researchers have emphasized the role of conceptual and semantic aspects in recognition memory (e.g., Bransford & Franks, 1972; Sachs, 1967) whereas others have emphasized the perceptual operations involved in recognition memory (e.g., Kolers & Ostry, 1974).

Detailed analyses of recognition memory involving two separate bases, perceptual and conceptual, came from the works of Mandler and Jacoby. Mandler (1979, 1980) has provided extensive empirical findings and a theoretical model to articulate the two bases of recognition memory,

namely integration and elaboration. Essentially, the concept of integration can be roughly equated with that of perceptual fluency and the concept of elaboration with that of conceptual processes.

Jacoby (1983a, 1983b; Jacoby & Dallas, 1981) proffered the processing framework to account for the parallel effects he and his colleagues (see also Jacoby & Witherspoon, 1982; Johnston, et al., 1985) obtained in recognition memory and perceptual identification tasks. Jacoby and his colleagues also proposed two bases that mediate performance in a recognition memory task. One is a perceptual basis, which is responsible for the parallel effects observed in recognition memory and perceptual identification. The other basis mediating performance in the recognition task is a conceptual basis.

The present data, in conjunction with Gardiner's (1988; Gardiner & Java, 1990; Gardiner & Parkin, 1990), provide empirical support to Jacoby and Mandler's formulations of the two bases of recognition memory. The processes captured by the "Remember" responses mimic or enhance the effects of conceptual variables observed in conceptual explicit memory tasks (as also in the overall recognition performance in the present experiments). For example, "Remember" responses show large effects of levels of processing (Gardiner, 1988, Experiment 1, and Experiment 1 in this thesis), generation (Gardiner, 1988, Experiment 2), picture superiority

(Experiment 2 in this thesis), and divided attention (Gardiner & Parkin, 1990). On the other hand, "Know" responses either show no effect of the conceptual variables (Gardiner, 1988, Experiments 1 and 2; Gardiner & Parkin, 1990) or greater effects from perceptual processing (present Experiments 1 and 2). It is important to note that the pattern of dissociations between "Remember" and "Know" responses as a function of conceptual variables is very similar to the pattern of dissociations between conceptual explicit memory tests and perceptual implicit memory tests (e.g., Blaxton, 1989; Srinivas & Roediger, 1990). Thus, separating recognition performance into components on the basis of the subjective experience of remembering provides an effective tool to separate the perceptual and conceptual components in recognition memory.

"Remember"/"Know" judgment paradigm as a tool

In Mandler's (1980) work, the familiarity component (also called the perceptual component) was estimated based on the recall and recognition scores where the two tasks were administered between subjects or the two tasks were administered in the successive testing paradigm. In Jacoby's early work (1983a, 1983b, Jacoby & Dallas, 1981) the familiarity component in recognition memory is assessed from the parallel effects of independent variables on recognition memory and perceptual identification.

The "Remember/Know" judgment paradigm provides a more

direct way of separating the familiarity and elaborative (conceptual) components involved in recognition memory. "Remember" responses by definition require recollecting the study phase and reinstating its context. The elaborative or conceptual variables that typically improve memory performance in recognition have an even stronger effect on "Remember" responses. Thus, "Remember" responses capture the elaborative or conceptual component involved in recognition memory performance. After subtracting the "Remember" responses in recognition memory performance, the remainder ("Know" responses) prompts the question as to what other factors affect recognition memory. A large body of data from previous research by Jacoby, Mandler, and Gardiner suggests that this other factor in recognition memory is perceptual in nature. The present experiments also provide similar evidence, with Experiment 3 providing the strongest support for the idea that enhanced perceptual processing of items improves recognition memory and increases "Know" responses while leaving the "Remember" responses virtually unaffected.

Recently, Jacoby and his colleagues (Jacoby et al., 1989) have advocated a new framework, which they call an attributional analysis of remembering. This attributional analysis emphasizes the role of the subjective experience of the rememberer and provides a framework to examine the influence of perceptual and conceptual processes on the

attributions subjects make while participating in memory tasks. In this analysis, Jacoby et al. (1989) emphasize the distinction between using an analytic basis for judgment and using fluency of processing as the basis of judgment. In some ways, these bases of recollecting a prior event are similar to conceptual and perceptual bases of memory, respectively. Elaborative and conceptual processes do underlie an analytic basis of judgment and perceptual factors do influence the fluency of processing (Jacoby & Whitehouse, 1990). However, in this analysis, fluency of processing may also be influenced by conceptual factors. As a result, inducing conceptual and elaborative processing experimentally would not necessarily ensure that subjects will make an analytic basis of judgment to the test item.

"Remember" and "Know" judgments constitute a useful tool to examine these two bases - analytic judgments and fluency of processing - in recollection. "Remember" responses could be used as a measure of an analytic basis of judgment. The effect of fluency of processing, both perceptual and conceptual, may be measured by "Know" responses (present Experiments 3 and 5 respectively). The necessity for an analysis of subjective experience of remembering is discussed in the next section.

Recently, Jacoby (in press; Jacoby & Kelley, in press) has also proposed another dichotomy, consciously-controlled and automatic processing, to account for the two basic

processes involved in memory. According to this theoretical account, memory performance is best captured by analyzing the contribution of these two processes. However, this analysis does not permit an examination of the recollective process as characterized by "Remember" responses.

"Remember" responses are a purer measure of conscious recollection of a prior event than conventional measures of explicit memory

In 1985, Tulving reported the first study that employed "Remember" and "Know" judgments in recall tests. He made a persuasive case for using a measure like "Remember" judgments to study conscious recollection by showing that across free recall, category cued recall, and category and letter cued recall tasks, the proportion of "Remember" responses decreased (although the overall proportion of recalled items increased.) Overall recall performance increased because subjects were given more cues to aid their recall across the three tasks. However, providing subjects with more cues reduced the necessity to rely on their own conscious recollective processes. Tulving's study thus demonstrated that many of the standard explicit measures of memory are not faithful indicators of conscious recollection whereas "Remember" responses by definition reflect such a recollective process. It would be useful to employ the "Remember"/"Know" judgment paradigm to study the recollective processes captured in other measures of

explicit memory such as serial recall, paired associate recall etc.

In the present study, the levels of processing effect and the picture superiority effect were observed in both recognition memory and the "Remember" judgments. However, both these effects were greater in "Remember" judgments than in recognition memory. These data compel us to re-evaluate the measures that are used as an index of conscious recollection. Recently, Tulving (1985; 1989) and Jacoby (Jacoby et al., 1989) have addressed this issue in detail. Tulving (1989) points out that cognitive psychologists tend to equate performance on a given task with experience. The results from Tulving's (1985) work and from the present experiments (reiterated above) indicate that performance on explicit memory tests is not a reflection of the operation of conscious recollection alone.

Jacoby and his colleagues (Jacoby et al., 1989) also make a strong case for the study of memory from the point of view of the rememberer. Jacoby's attribution theory is concerned with examining the conditions under which subjects are likely to attribute the fluency or the "ease" with which events come to mind to familiarity with that event, and the conditions under which subjects engage in a more analytic judgment to classify an event as "old". Gardiner's work and the work reported in this thesis indicate that "Remember" and "Know" judgments can be used effectively to study the

subjective experience of the rememberer and to study the nature of conscious recollection.

Measurement Issues

Some measurement issues were addressed in the Introduction because of the nature of instructions given to the subjects to make "Remember" and "Know" judgments. One potential problem raised earlier was that treating "Remember" and "Know" responses as two separate psychological entities may not be appropriate because "Know" responses are made by default and therefore may not correspond to a distinct psychological state. Even if this argument is correct, the data obtained for "Remember" and "Know" responses allow us to separate the components involved in recognition memory.

"Remember" responses do not capture the effects of all the variables that influence recognition memory. For example, in Experiment 3 of the present series, if "Remember" responses were the only measure of memory, we would not observe the effect of masked repetition. However, recognition memory was found to be sensitive to masked repetition. All the effects observed in "Know" responses can be discussed in terms a comparison between overall recognition memory and "Remember" responses. However, "Know" responses provide us with a simple way to capture other components involved in explicit memory that "Remember" responses do not capture. For example, in some experiments

there was no effect of the independent variables on "Know" responses (e.g., Gardiner, 1988, Experiments 1 & 2; Gardiner & Java, 1990, Experiment 1; Gardiner & Parkin, 1990), in some other experiments, the effect of the independent variables on "Know" responses was opposite to that observed on "Remember" responses (Gardiner & Java, 1990, Experiment 2; present Experiments 1 & 2). Finally, there is also an instance where the effect of the independent variable was observed solely on the "Know" responses. The utility of using "Know" responses lies in the fact that the operation of components other than the ones employed by "Remember" responses is easily observed in "Know" responses, and these other components are so far identified as perceptual fluency operations.

Conclusions

Experiments reported in this thesis support Gardiner's (1988; Gardiner & Java, 1990; Gardiner & Parkin, 1990) claim that "Remember" responses are sensitive to conceptual factors and "Know" responses are sensitive to perceptual factors. For example, "Remember" responses were influenced by factors such as levels of processing, generation versus reading, picture versus words, and divided attention, which are typically known to affect conceptual explicit memory tests. The effects of these variables on "Know" responses were similar to those observed in perceptual implicit memory tasks. Results from Gardiner and Java (1990, Experiment 3)

and the present Experiment 4 also show that "Remember"/"Know" judgments cannot be equated with confidence judgments. The "Remember"/"Know" judgment paradigm provides a useful technique to understand the bases of explicit memory tasks and to delineate the factors that influence conscious recollection.

Footnote

¹ Explicit memory tasks may also be predominantly perceptual in nature and implicit memory tasks may also be predominantly conceptual in nature (see Blaxton, 1989; Srinivas & Roediger, 1990; Rappold & Hashtroudi, 1991 for details). In this thesis, the discussion is restricted to explicit memory tasks that are typically characterized as conceptual and implicit memory tasks that are typically characterized as perceptual in nature.

References

- Atkinson, R.C., & Juola, J.F. (1973). Factors influencing speed and accuracy of word recognition. In S. Kornblum (Ed.), Attention & Performance IV. New York: Academic Press.
- Atkinson, R.C., & Juola, J.F. (1974). Search and decision processes in recognition memory. In D.H. Krantz, R.C. Atkinson, R.D. Luce, & P. Suppes (Eds.), Contemporary developments in mathematical psychology (Vol. 1): Learning, memory and thinking, San Francisco: Freeman.
- Atkinson, R.C., & Wescourt, K.T. (1975). Some remarks on a theory of memory. In P.M.A. Rabbitt & S. Dornic (Eds.), Attention and performance V, London: Academic Press.
- Baddeley, A., & Warrington, E.K. (1970). Amnesia and the distinction between long- and short-term memory. Journal of Experimental Psychology, 9, 176-189.
- Balota, D.A. (1983). Automatic spreading activation and episodic memory encoding. Journal of Verbal Learning and Verbal Behavior, 22, 88-104.
- Blaxton, T. A. (1989). Investigating dissociations among memory measures: Support for a transfer appropriate processing framework. Journal of Experimental Psychology: Learning, Memory and Cognition, 15, 657-668.
- Bransford, J.D., & Franks, J.J. (1972). The abstraction of

- linguistic ideas: A review. Cognition, 1, 211-249.
- Bousfield, W.A. (1953). The occurrence of clustering in the recall of randomly arranged associates. The Journal of General Psychology, 49, 229-240.
- Bower, G.H., Clark, M.C., Lesgold, A.M., & Winzenz, D. (1969). Hierarchical retrieval schemes in recall of categorized word lists. Journal of Verbal Learning and Verbal Behavior, 8, 323-343.
- Carr, T.H., McCauley, C., Sperber, R.D., & Parmelee, C.M. (1982). Words, pictures, and priming: On semantic activation and conscious identification, and the automaticity of information processing. Journal of Experimental Psychology: Human Perception and Performance, 8, 757-777.
- Craik, F.I.M., & Lockhart, R.S. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 11, 671-684.
- Craik, F. I. M., & Tulving, E. (1975). Depth of processing and retention of words in episodic memory. Journal of Experimental Psychology: General, 104, 268-294.
- De Groot, A.M.B. (1985). Word context effects in word naming and lexical decision. Quarterly Journal of Experimental Psychology, 37A, 281-297.
- Den Heyer, K., Briand, K., & Smith, L. (1985). Automatic and strategic factors in semantic priming: An examination of Becker's model. Memory & Cognition, 13,

228-232.

Feustel, T.C., Shiffrin, R.M., & Salasoo, A. (1983).

Episodic and lexical contributions to the repetition effect in word identification. Journal of Experimental Psychology, 112, 306-346.

Fischler, I., & Goodman, G.O. (1978). Latency of associative activation in memory. Journal of Experimental Psychology: Human Perception and Performance, 4, 455-470.

Forster, K. I. (1985). Lexical acquisition and the modular lexicon. Language and Cognitive Processes, 2, 87-108.

Forster, K.I., & Davis, C. (1984). Repetition priming and frequency attenuation in lexical access. Journal of Experimental Psychology: Learning, Memory, and Cognition, 10, 680-698.

Fowler, C.A., Wolford, G., Slade, R., & Tassinary, L. (1981). Lexical access with and without awareness. Journal of Experimental Psychology: General, 110, 341-362.

Gardiner, J. M. (1988). Functional aspects of recollective experience. Memory and Cognition, 16, 309-313.

Gardiner, J. M., & Java, R. I. (1990). Recollective experience in word and nonword recognition. Memory and Cognition, 18, 23-30.

Gardiner, J.M., & Parkin, A.J. (1990). Attention and recollective experience in recognition memory. Memory

& Cognition, 18, 579-583.

Geiselman, R.E., & Bjork, R.A. (1980). Primary versus secondary rehearsal in imagined voices: Differential effects on recognition. Cognitive Psychology, 12, 188-205.

Graf, P., Squire, L.R., & Mandler, G. (1984). The information that amnesic patients do not forget. Journal of Experimental Psychology: Learning, Memory, and Cognition, 10, 164-178.

Hines, D., Czerwinski, M., Sawyer, P.K., & Dwyer, M. (1986). Automatic semantic priming: Effect of category exemplar level and word association level. Journal of Experimental Psychology: Human Perception and Performance, 12, 370-379.

Holender, D. (1986). Semantic activation without conscious identification in dichotic listening, parafoveal vision, and visual masking. Behavioral and Brain Sciences, 9, 1-66.

Jacoby, L.L. (1978). On interpreting the effects of repetition: Solving a problem versus remembering a solution. Journal of Verbal Learning and Verbal Behavior, 17, 649-667.

Jacoby, L.L. (1983a). Perceptual enhancement: Persistent effects of an experience. Journal of Experimental Psychology: Learning, Memory, and Cognition, 9, 21-38.

Jacoby, L.L. (1983b). Remembering the data: Analyzing

interactive processes in reading. Journal of Verbal Learning and Verbal Behavior, 22, 485-508.

- Jacoby, L.L. (1984). Incidental versus intentional retrieval: Remembering and awareness as separate issues. in N. Butters & L. Squire, (Eds.), The neuropsychology of memory (pp. 97-122). New York: Guilford Press.
- Jacoby, L.L. (in press). A process dissociation framework: Separating automatic from from intentional uses of memory. Journal of Memory and Language.
- Jacoby, L. L., & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. Journal of Experimental Psychology: General, 110, 306-340.
- Jacoby, L.L. & Kelley, C. (in press). Unconscious influences of memory: Dissociations and automaticity. In D. Milner and M. Rugg (Eds.), The neuropsychology of consciousness.
- Jacoby, L. L., Whitehouse, K. (1989). An illusion of memory: False recognition influenced by unconscious perception. Journal of Experimental Psychology: General, 118(2), 126-135.
- Jacoby, L.L., & Witherspoon, D. (1982). Remembering without awareness. Canadian Journal of Psychology, 32, 300-324.
- Jacoby, L. L., Kelley, C. M., & Dywan, J. (1989). Memory

- attributions. In H. L. Roediger, & F. I. M. Craik (Eds.), Varieties of memory and consciousness: Essays in honour of Endel Tulving (pp. 391-422). Hillsdale, N. J.: Lawrence Erlbaum Associates.
- Jacoby, L. L., Woloshyn, V., & Kelley, C. (1989). Becoming famous without being recognized: Unconscious influences of memory produced by dividing attention. Journal of Experimental Psychology: General, 118, 115-125.
- Johnson, M.K., & Raye, C.L. (1981). Reality monitoring. Psychological Review, 88, 67-85.
- Johnson, M.K., Raye, C.L., & Durso, F.T. (1980). Reality monitoring: Second thoughts and perceptions. Bulletin of the Psychonomic Society, 15, 402-404.
- Johnson, M.K., Raye, C.L., Foley, H.J., Foley, M.A. (1981). Cognitive operations and decision bias in reality monitoring. American Journal of Psychology, 94, 37-64.
- Johnston, W.A., Dark, V.J., & Jacoby, L.L. (1985). Perceptual fluency and recognition judgments. Journal of Experimental Psychology: Learning, Memory, and Cognition, 11, 3-11.
- Johnston, W.A., Hawley, K.J., & Elliott, J.M.G. (1991). Contribution of perceptual fluency to recognition judgments. Journal of Experimental Psychology: Learning, Memory, and Cognition, 17, 210-223.
- Kirsner, K. (1974). Modality differences in recognition memory for words and their attributes. Journal of

Experimental Psychology, 102, 579-584.

Kirsner, K., Milech, D., & Standen, P. (1983). Common and modality-specific processes in the mental lexicon.

Memory & Cognition, 11, 621-630.

Kirsner, K., & Smith, M.C. (1974). Modality effects in word identification. Memory & Cognition, 2, 637-640.

Kolers, P.A., & Ostry, D.J. (1974). Time course of loss of information regarding pattern-analyzing operations.

Journal of Verbal Learning and Verbal Behavior, 13, 599-612.

Kolers, P.A., & Roediger, H.L. (1984). Procedures of mind.

Journal of Verbal Learning and Verbal Behavior, 23, 425-449.

Kucera, H., & Francis, W. N. (1967). Computational analysis of present-day American English. Providence, RI: Brown University Press.

Lewandowsky, S. (1986). Priming in recognition memory for categorized lists. Journal of Experimental Psychology: Learning, Memory, and Cognition, 12, 562-574.

Madigan, S. (1983). Picture memory. In J. C. Yuille (Ed.), Imagery, memory, and cognition: Essays in honour of Allan Paivio (pp. 65-89). Hillsdale, N. J.: Lawrence Erlbaum Associates.

Mandler, G. (1979). Organization and repetition: Organization principles with special reference to rote learning. In L. Nilsson (Ed.), Perspectives on memory

- research. Hillsdale, NJ: Erlbaum.
- Mandler, G. (1980). Recognizing: The judgment of previous occurrence. Psychological Review, 87, 252-271.
- Mandler, G. (1985). Cognitive Psychology. Hillsdale, NJ: Erlbaum.
- Mandler, G., Graf, P., & Kraft, D. (1986). Activation and elaboration effects in recognition and word priming. The Quarterly Journal of Experimental Psychology, 38A, 645-662.
- Marcel, A.J. (1983a). Conscious and unconscious perception: An approach to the relation between phenomenal experience and perceptual processes. Cognitive Psychology, 15, 238-300.
- Marcel, A.J. (1983b). Conscious and unconscious perception: Experiments on visual masking and word recognition. Cognitive Psychology, 15, 197-237.
- McIntyre, J.A., & Craik, F.I.M. (1987). Age differences in memory for item and source information. Canadian Journal of Psychology, 41, 175-192.
- Morris, C. D., Bransford, J. D., & Franks, J. J. (1977). Levels of processing versus transfer appropriate processing. Journal of Verbal Learning and Verbal Behavior, 16, 519-533.
- Neely, J.H. (1977). Semantic priming and retrieval from lexical memory: Roles of inhibitionless spreading activation and limited-capacity attention. Journal of

- Experimental Psychology: General, 106, 226-254.
- Neely, J.H., Schmidt, S.R., & Roediger, H.L. (1983).
Inhibition from related primes in recognition memory.
Journal of Experimental Psychology: Learning, Memory,
and Cognition, 9, 196-211.
- Nelson, T.O., & Narens, L.A. (1980). A new technique for
investigating the feeling of knowing. Acta
Psychologica, 46, 69-80.
- Parkin, A. J., & Russo, R. (1989). Implicit and explicit
memory and the automatic/effortful distinction.
European Journal of Cognitive Psychology, 2(1), 71-80.
- Rabinowitz, J.C. (1990). Effects of repetition on mental
operations on memory for occurrence and origin. Memory
& Cognition, 18, 72-82.
- Rappold, V.A., & Hashtroudi, S. (1991). Does organization
improve priming? Journal of Experimental Psychology:
Learning, Memory, and Cognition, 17, 103-114.
- Roediger, H. L., & Blaxton, T. A. (1987). Retrieval modes
produce dissociations in memory for surface
information. In D. Gorfein, & R. R. Hoffman (Eds.),
Memory and cognitive processes: The Ebbinghaus
Centennial Conference (pp. 349-379). Hillsdale, N. J.:
Lawrence Erlbaum Associates.
- Roediger, H.L., Srinivas, K., & Weldon, M.S. (1989).
Dissociations between implicit measures of retention.
In S. Lewandowsky, J.C. Dunn, & K. Kirsner (Eds.),

Implicit memory: Theoretical issues. Hillsdale, NJ:
Lawrence Erlbaum Associates.

Roediger, H. L., Weldon, M. S., & Challis, B. H. (1989).
Explaining dissociations between implicit and explicit
measures of retention: A processing account. In H. L.
Roediger, & F. I. M. Craik (Eds.), Varieties of memory
and consciousness: Essays in honour of Endel Tulving
(pp. 3-41). Hillsdale, N. J.: Lawrence Erlbaum
Associates.

Rosenthal, R., & Rosnow, R.L. (1991). Essentials of
behavioral research: Methods and data analysis.
McGraw-Hill, Inc. NY.

Sachs, J.D.S. (1967). Recognition memory for syntactic and
semantic aspects of connected discourse. Perception &
Psychophysics, 2, 437-442.

Schacter, D.L. (1983). Feeling of knowing in episodic
memory. Journal of Experimental Psychology: Learning,
Memory, & Cognition, 9, 39-54.

Schacter, D.L. (1987). Implicit memory: History and current
status. Journal of Experimental Psychology: Learning,
Memory, and Cognition, 13, 501-518.

Schacter, D.L. (1990). Perceptual representation systems
and implicit memory: Toward a resolution of the
multiple memory systems debate. In A. Diamond (Ed.),
The development and neural bases of higher cognitive
functions (p. 543-571). Annals of the New York Academy

of Sciences.

- Schacter, D.L., Harbluk, J.L., & McLachlan, D.R. (1984). Retrieval without recollection: An experimental analysis of source amnesia. Journal of Verbal Learning and Verbal Behavior, 23, 593-611.
- Shapiro, S.I., & Palermo, D.S. (1968). An atlas of normative free association data. Psychonomic Monograph Supplements, 2, 219-250.
- Shimamura, A.P. (1986). Priming effects in amnesia: Evidence for a dissociable memory function. Quarterly Journal of Experimental Psychology, 38A, 619-644.
- Slamecka N. J., & Graf P. (1978). The generation effect: Delineation of a phenomenon. Journal of Experimental Psychology: Human Learning and Memory, 4, 592-604.
- Smith, L.C., Briand, K., Klein, R.M., & Den Heyer, K. (1987). On the generality of Becker's Verification Model. Canadian Journal of Psychology, 41, 379-386.
- Snodgrass, J. G., & Vanderwart, M. (1980). A standardized set of 260 pictures: Norms for name agreement, image agreement, familiarity, and visual complexity. Journal of Experimental Psychology: Human, Learning, and Memory, 6, 174-215.
- Squire, L.R. (1987). Memory and Brain, New York:Oxford University Press.
- Squire, L. R., & Cohen, N. J. (1984). Human memory and amnesia. In J. McGaugh, G. Lynch, & N. Weinberger

- (Eds.), Proceedings of the conference on the neurobiology of learning and memory (pp. 3-64). New York: Guilford Press.
- Srinivas, K., & Roediger, H.L. (1990). Testing the nature of two implicit tests: Dissociations between conceptually-driven and data-driven processes. Journal of Memory and Language, 28, 389-412.
- Tulving, E. (1985). Memory and consciousness. Canadian Psychologist, 26, 1-12.
- Tulving, E. (1986). What kind of hypothesis is the distinction between episodic and semantic memory? Journal of Experimental Psychology: Learning, Memory, and Cognition, 12, 307-311.
- Tulving E. (1989). Memory: Performance, knowledge, and experience. European Journal of Cognitive Psychology, 1, 3-26.
- Tulving, E., & Schacter, D. L. (1990). Priming and human memory systems. Science, 247, 301-306.
- Tulving, E., Schacter, D. L., & Stark, H. A. (1982). Priming effects in word fragment completion are independent of recognition memory. Journal of Experimental Psychology: Learning, Memory, and Cognition, 8, 336-342.
- Warrington, E.K., & Weiskrantz, L. (1968). New method of testing long-term retention with special reference to amnesic patients. Nature, 217, 972-974.

- Warrington, E.K., & Weiskrantz, L. (1970). The amnesic syndrome: Consolidation or retrieval? Nature, 228, 628-630.
- Watkins, M.J., & Gibson, J.M. (1988). On the relation between perceptual priming and recognition memory. Journal of Experimental Psychology: Learning, Memory, and Cognition, 14, 477-483.
- Weldon, M. S., & Roediger, H. L. (1987). Altering retrieval demands reverses the picture superiority effect. Memory and Cognition, 15, 269-280.

Appendix

Semantically Related Prime Pairs and Unrelated Primes in
Experiment 5

Presented below are the semantically related prime-target pairs used in Experiment 5. The words in parentheses are the semantically unrelated primes used in the experiment.

above-below (insight)	silver-gold (minor)
ale-beer (trail)	slow-fast (burden)
arm-leg (merit)	sober-drunk (budget)
ate-food (prince)	stop-go (meal)
avenue-street (bride)	strong-weak (liquid)
waltz-dance (guest)	frame-picture (rhythm)
belly-stomach (estate)	then-now (pilot)
black-white (lunch)	thorough-complete (powder)
bow-arrow (fruit)	toe-foot (abroad)
brother-sister (stream)	torso-body (profit)
buy-sell (verse)	trout-fish (critic)
chapel-church (remark)	us-we (pen)
clean-dirty (limit)	you-me (book)
closed-open (grace)	railway-train (studio)
cow-milk (onset)	remember-forget (minute)
dark-light (owner)	wrath-anger (double)
digit-number (shame)	abandon-leave (tactics)
dry-wet (humor)	hammer-nail (sample)
hard-soft (crowd)	sill-window (scheme)
father-mother (border)	sunken-ship (correct)
elm-tree (delay)	young-old (bake)
female-male (angle)	add-subtract (virtue)
give-take (fiber)	always-never (cotton)
glue-sticky (survey)	army-navy (height)
grisly-bear (tissue)	author-book (terror)
here-there (vital)	bad-good (ocean)
him-her (theme)	bed-sleep (plain)
hot-cold (fault)	bitter-sweet (proof)
in-out (suite)	blow-wind (drama)
labor-work (notion)	boy-girl (pages)
life-death (fence)	bust-break (route)
lost-found (debate)	cat-dog (curve)
man-woman (plenty)	city-town (error)
noise-loud (shadow)	clearer-foggy (trend)
ounce-pound (artist)	cork-bottle (motive)
pain-hurt (opera)	cube-ice (skill)
pepper-salt (dozen)	cradle-baby (ratio)
poor-rich (panic)	day-night (bench)
reply -answer (parade)	up-down (magic)
rinse-wash (talent)	eagle-bird (panel)
rough -smooth (ceiling)	false-true (scope)
shote-push (glory)	eight-nine (notes)

exactly-precise (regime)
flock-sheep (charm)
garment-clothes (pencil)
globe-world (tongue)
grass-green (lesson)
halt-stop (treaty)
high-low (habit)
idea-thought (passage)
king-queen (version)
lagging-behind (excuse)
latch-door (sphere)
long-short (content)
major-minor (bureau)
mashed-potato (review)
one-two (drill)
outside-inside (counter)
payroll-money (harbor)
peace-war (taxes)
perhaps-maybe (native)
python-snake (agency)
wrong -right (package)
rocky-mountain (percent)
sing-song (muscle)
sky-blue (ritual)
small-large (secure)
starved-hungry (mantle)
stout-fat (storm)
table-chair (species)
wagon-wheels (colony)
this-that (melody)
thread-needle (mirror)
toil-work (phrase)
touch-feel (vision)
uncle-aunt (split)
yolk-egg (smile)
blood-red (planet)
sickness-health (arrival)
tobacco-smoke (contest)
skyscraper-building
(reader)
interstate-commerce
(shadow)