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# States of awareness across multiple memory tasks: obtaining a "pure" measure of conscious recollection ☆

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**Abstract**

Four experiments were conducted to examine the nature of recollective experience across different explicit memory tests. Experiments 1 and 2 showed that the proportion of retrieved items that were given Remember responses were equivalent across free recall, category cued recall, category plus letter cued recall, and recognition memory tests unlike the result reported by Tulving [Can. Psychol. 26 (1985) 1]. Experiments 3 and 4 revealed that Remember judgments are influenced by both conceptual and perceptual variables not only in the recognition task but in other explicit memory tasks as well. Taken together, the empirical evidence from this study demonstrates that explicit memory performance is accompanied by different states of awareness not only in recognition but also across other memory tasks including free recall.


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The nature of subjective experience during retrieval has become a focus of extensive investigation in recent years. This interest in the study of recollective experience was sparked by a seminal article published by Tulving (1985). In this article, Tulving

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expressed concern about the paucity of research on the nature of conscious awareness during retrieval even though such awareness is an integral part of the retrieval act. The standard approach in memory research has been to assume that explicit memory performance provides an accurate measure of conscious recollection (Tulving, 1989). This assumption is based on the type of instructions given to participants in explicit memory tasks in contrast to implicit memory tasks. In the former, participants are asked to retrieve items from a previous study episode whereas in the latter, no mention of the study episode is made. These differences in instructions have proven useful in that systematic dissociations between explicit and implicit memory performance in normals as well as amnesics have greatly informed theories of memory (see Roediger & McDermott, 1993 for a review). At the same time, theoretical and empirical concerns have also been raised with respect to contamination in the measurement of "pure" implicit memory on the one hand (see Roediger & McDermott, 1993) and "pure" measures of conscious recollection on the other (Tulving, 1985, 1989). The present article focuses on the latter concern about the nature and measurement of conscious recollection across various explicit memory tasks.

The approach of equating explicit memory performance with conscious recollective experience overlooks the differences in the states of awareness that accompany explicit memory. In order to rectify the problem of isomorphism between performance and the accompanying experience, Tulving (1985) introduced a new paradigm to capture the varieties of subjective experience and revolutionized the study of conscious experience in memory research. The central goal of Tulving's (1985) work, and of the subsequent researchers in this field (for reviews see Gardiner & Richardson-Klavehn, 2000; Rajaram, 1999), has been to use this new paradigm to examine whether the standard explicit memory tasks provide an accurate or "pure" measure of conscious recollection.

In the Remember/Know paradigm, participants give *Remember* or "R" responses to those recognized items that are accompanied by a conscious awareness of its occurrence during the study episode. Participants give *Know* or "K" responses to those items that do not invoke any specific recollective detail but are recognized on some other basis. The detailed instructions given to the participants to make Remember/Know judgments can be found in Gardiner's (1988) and Rajaram's (1993, 1996) articles.

The use of this paradigm has yielded a large body of systematic data demonstrating that Remembering constitutes only one experiential component of explicit memory performance. A number of studies have shown that not only do participants reliably distinguish between two types of subjective experience during retrieval, a variety of experimental manipulations in fact produce dissociations between Remember and Know judgments within a standard explicit memory task such as recognition (see Gardiner & Richardson-Klavehn, 2000; Rajaram, 1999, for reviews). In the initial set of studies using this paradigm, Remember judgments appeared to be influenced by independent variables that also affect performance on conceptual explicit memory tasks such as recall and recognition whereas Know judgments appeared to be sensitive to variables that affected perceptual implicit memory tasks such as word fragment completion. [1] However, later findings did not always support such parallels in the pattern of results between the experiential judgments and the implicit/explicit memory distinction.

In this article, we focus on Remember judgments because our aim was to explore the nature of conscious recollective experience that accompanies retrieval, and Remember judgments by definition constitute a pure measure of conscious recollection (see Gardiner, 1988; Rajaram, 1993; Tulving, 1985). In fact, our view is also consistent with other recent models of explicit memory performance in that these models also assume Remember judgments to represent the recollective component of explicit memory performance (Donaldson, 1996; Jacoby, Yonelinas, & Jennings, 1997; Knowlton & Squire, 1995; Lindsay & Kelley, 1996). In addition, recent data from amnesic participants also support the view that Remembering constitutes a "pure" measure of conscious recollection because amnesic participants are impaired in making recollective judgments (Anes, Schacter, & Verfaellie, 1997; Keane, Verfaellie, Giovanello, & Sullivan, 2001; Knowlton & Squire, 1995; Mishkin, Baddeley, & Vargha-Khaden, 2001; Rajaram, Hamilton, & Bolton, in press; Schacter, Verfaellie, & Pradere, 1996; Yonelinas, Kroll, Dobbings, Lazzara, & Knight, 1998). Further they often show a much larger decrement in their ability to make Remember judgments compared to Know judgments (Anes et al., 1997; Keane et al., 2001; Knowlton & Squire, 1995; Schacter et al., 1996; Yonelinas et al., 1998).

Most of the data on the nature of Remembering largely come from studies that utilized the recognition memory task. These studies initially revealed that Remember judgments were more sensitive to conceptual manipulations than Know judgments (see Gardiner & Richardson-Klavehn, 2000; Rajaram, 1999, for reviews). This pattern was interpreted to indicate that Remember judgments reflect the conceptual operations of the episodic memory system (Gardiner & Parkin, 1990) or rely on conceptual processing (Rajaram, 1993), and that Know judgments arise from the perceptual operations of the procedural memory system (Gardiner & Parkin, 1990) or rely more on perceptual processing (Rajaram, 1993).

However, subsequent studies using the recognition memory task revealed effects of certain perceptual variables on Remember judgments as well (Rajaram, 1996, 1998). These findings demonstrate that recollective experience (as measured by Remember judgments) is affected by the manipulations of both conceptual and perceptual attributes in the to-be-retrieved material. Based on the ideas proposed by Hunt and McDaniel (1993), Rajaram (1996) hypothesized that the overarching principle that captures the range of variables that affect Remember judgments is the distinctive and salient properties of the stimuli or the distinctive processing engendered by the variables, be they perceptual or conceptual. This principle has been subsequently

[1] Throughout this article, all references to explicit memory tasks are restricted to conceptually-driven explicit tasks and all references to implicit memory tasks are restricted to perceptually-driven implicit tasks. It should be noted that considerable evidence exists for explicit tasks that are perceptually-driven (Blaxton, 1989), and implicit tasks that are conceptually-driven (Blaxton, 1989; Hamann, 1990; Srinivas & Roediger, 1990).

tested and confirmed in other empirical studies (Mäntylä, 1997; Mäntylä & Cornoldi, 2002; Rajaram, 1998).

It is also worth noting that these two states of awareness, Remembering and Knowing, function independently in that they are dissociated and associated in principled ways as a function of numerous independent variables. So, studies have reported effects of independent variables on Remembering but not Knowing (Gardiner, 1988; Gardiner & Parkin, 1990; Jones & Roediger, 1995), Knowing but not Remembering (Gardiner & Gregg, 1997; Gregg & Gardiner, 1994; Mäntylä & Raudsepp, 1996; Rajaram, 1993), opposite effects on Remembering and Knowing (Gardiner, Gawlik, & Richardson-Kalvehn, 1994; Gardiner & Java, 1990; Rajaram, 1993), and parallel effects on Remembering and Knowing (Gardiner, Kaminska, Dixon, & Java, 1996; Rajaram & Hamilton, 2001). The empirical questions addressed in the present article were motivated by one notable commonality in this extensive literature. Of these nearly 150 empirical studies, most have used only the recognition memory task to measure the nature of conscious experience in explicit memory.

The extensive use of the recognition memory task in the literature is not a coincidence. The proposed dual bases of recognition memory (Atkinson & Juola, 1973, 1974; Jacoby, 1983a,b; Jacoby & Dallas, 1981; Mandler, 1980) permits a study of differences in the subjective experience quite naturally. Specifically, earlier models of recognition memory hypothesized a recollective (e.g., Jacoby, 1983b) or an elaborative (e.g., Mandler, 1980) component on the one hand, and a familiarity (e.g., Jacoby, 1983b) or an integrative component (e.g., Mandler, 1980) on the other. Recent models of recognition memory by Jacoby and colleagues (Jacoby, Toth, & Yonelinas, 1993; Jacoby et al., 1997) also posit a recollective, consciously-controlled, or intentional processing component on the one hand, and a familiarity, unconscious, or automatic processing component on the other. Thus, there has been a strong theoretical, and subsequently empirical, impetus for using the recognition memory task to study the states of awareness during retrieval.

In contrast to this practice in the study of awareness, the study of explicit memory in general has historically included a large number of tasks. [2] In addition to the recognition memory task, the prototypical memory tasks used to examine the nature of explicit memory include free recall, cued recall, and paired-associate recall. The variety of explicit tasks represents the varied ways in which mnemonic functions are used in daily life. Thus, explicit tasks range from retrieval efforts in the absence of any cues, as in free recall at one end of the continuum, to retrieval efforts where the to-be-retrieved items are actually presented, as in recognition at the other end of the continuum. Other explicit memory tasks fall in between these two endpoints such that some combination of conceptual, associative, or perceptual cues are provided in these tasks to aid retrieval. These myriad explicit tasks simulate the real world situations in which we bring the existing cues together to access past information.

[2] This is true of the study of implicit memory also (see Roediger & McDermott, 1993 for a review). However, in this article our focus is on explicit memory tasks.

However, as just noted, our present understanding of the nature of Remembering is based largely on findings from only one task, recognition memory. Given the widespread assumption that explicit memory tasks, particularly free recall, are measures of conscious recollective experience, it is critical that these tasks also be utilized in the study of recollective experience. At present, it is not known whether the nature and incidence of recollective experience varies, or is similar, across different explicit tasks. A systematic examination of these issues will enable us to make empirical generalizations about, and consequently better understand, the nature of conscious recollective experience during retrieval. This is the goal of the present article.

A review of the literature identified a handful of studies that report the use of explicit memory tasks other than recognition. In these studies, tasks such as word fragment cued recall (Lindsay & Kelley, 1996), word association with self-generated or other-generated cues (Mäntylä, 1994), word association cued recall (Java, 1996), stem cued recall (Java, 1994) or successive testing with recognition and cued recall (Sikstroem & Gardiner, 1997) have been used. Although only one of these tasks was used within each of these studies, and the focus in these studies was not on comparing Remembering across a variety of tasks, the results of these studies show that Remembering constitutes only one type of awareness that accompanies accurate retrieval performance on different memory tests.

To date, only one published study has used multiple explicit memory tasks to compare states of awareness across these tasks. This study by Tulving (1985) served as the springboard in the development of the specific hypotheses and predictions of our experiments. Tulving (1985) used three different tasks in Experiment 1 to introduce the Remember/Know paradigm to test his retrieval model of synergistic ecphory: free recall, category cued recall, and category plus letter cued recall. These tasks were selected to measure the products of three memory systems. Tulving (1985) hypothesized that Remember judgments were a measure of autonoetic (self-knowing) consciousness arising from the episodic memory system, whereas Know judgments were a measure of noetic (knowing) and anoetic (nonknowing) consciousness arising from the semantic and procedural memory systems, respectively.

In Tulving's (1985) study, participants were presented with 27 pairs of category names and instances at study (e.g., *musical instrument – viola*). At test, a within-subject design was used where each participant received three memory tests in the following order – free recall, category cued recall, and category plus letter cued recall. In free recall, participants wrote down all the instances of the categories that they could recall. In category cued recall, category cues were presented to aid recall (e.g., *musical instrument –* ____). In the last task the initial letter of the instance was provided as well (e.g., *musical instrument – v*____). Participants also made Remember and Know judgments to each recalled item in each of the memory tests.

The results showed that with an increase in cues across tests, the overall recall increased, but the probability of assigning Remember responses to recalled items declined. Based on these results, Tulving concluded that the use of autonoetic consciousness (as measured by the proportion of items given Remember judgments) varies with the retrieval support provided. That is, as retrieval support increases at test, the need to rely on autonoetic consciousness decreases. Tulving's (1985) design provided an opportunity to test the important idea that *for a given individual* an increase in cues for the same items may improve recall but not necessarily the concomitant autonoetic consciousness (or Remembering). These results also showed that retrieval is accompanied by different states of awareness across many explicit memory tasks. However, the same design (and results) cannot be used to answer the following question: What proportions of retrieved items are accompanied by the recollective experience (captured by Remember judgments) in each of these tasks? This question tests the long-held assumption that most explicit memory tasks, particularly free recall, are appropriate measures of conscious recollection.

To test this idea, a between-subject design is more appropriate than a within-subject design. This is because the patterns of data and their interpretation from the successive testing, within-subject design may be subject to the following alternate explanations: passage of time, item selection, and output interference. With respect to passage of time, in a within-subject design the increase in cues provided across tests is confounded with the passage of a longer amount of time since the study episode. Because we know that Remember judgments decline as the retention interval is increased between study and test (e.g., Gardiner & Java, 1991; Rajaram & Hamilton, 2001), it is possible that fewer Remember judgments on later tests are a result of passage of time rather than increased cues across tests.

With respect to the effects of item selection, a comparison of the proportion of Remember judgments across tests in a successive testing paradigm is made difficult by the fact that the retrievable item pool reduces in size as each task is conducted. Specifically, one could argue that most of the items which would receive Remember judgments may be recalled in the first test (free recall), leaving fewer additional items available for recall, and therefore available to receive Remember judgments, on later tests.

Finally, a direct comparison of Remember judgments across multiple tasks in a within-subject design is made difficult by the potential problem of output interference. Output interference refers to the fact that recall of some items inhibits the recall of other items that have not yet been recalled (Roediger, 1974; Smith, 1971). For example, Smith (1971) demonstrated that participants who were given a free recall test prior to a category cued recall test exhibited poorer performance on the category cued recall test than participants who were not given a prior test. Thus, in a successive testing paradigm, the problem of output interference could lead to a decrease in the number of recalled items across successive tests, and consequently, the number of items that are assigned Remember judgments.

To summarize, Tulving's (1985) findings demonstrate the important contrast that increased cues can improve recall without a proportional increase in awareness *for a given individual*. However, these findings cannot be used to determine how Remember judgments distribute across different explicit memory measures. The answer to the latter question is important towards understanding the nature of recollective experience that accompanies performance across different memory tasks. Experiment 1 in the present series was designed to examine this issue. Because Tulving had utilized free recall, category cued recall, and category plus letter cued recall, we used the same tasks in our study. In addition, we also used a recognition task to serve as a basis for comparison because Remember judgments have been studied extensively using this task. The straightforward prediction in this experiment was that as retrieval cues increase across the four tasks (free recall, category cued recall, category plus letter cued recall, and recognition), the overall level of retrieval would also increase. With respect to the proportion of retrieved responses that received Remember judgments, we sought to determine whether these responses would decline even when the design of the experiment eliminated the potential contributions of passage of time, item selection, and output interference.

## 1. Experiment 1

### 1.1. Method

#### 1.1.1. Participants

Sixty-four undergraduates from the State University of New York at Stony Brook participated for credit in partial fulfillment of requirements for an Introduction to Psychology course. Sixteen participants were randomly assigned to each of the four memory tasks.

#### 1.1.2. Design and materials

Fifty category names and one instance for each category were chosen from Battig and Montague's (1969) and Hunt and Hodge's (1971) category norms. Instances chosen were of medium to low frequency in response to category names, varying from the fifth most common response to the 28th most common response ($M = 21.72$). Instances that were so low in frequency as to be unlikely responses, or so high in frequency as to be obvious responses to the respective categories were not included. Each instance varied in length from 5 to 9 letters with a mean of 6.7 letters. According to Thorndike and Lorge's (1944) norms, the frequency of instances ranged from 1 to 49 appearances per million words, with a mean of 15.31.

Two study lists were created by randomly selecting 25 pairs of the 50 category names and instances. No category or instance was repeated within each list or across the lists. Two random presentation orders were created for each list. In the study phase, all items were presented on a Sony CSF 1030 tape recorder in a male voice at a constant volume. Each study list contained only 25 of the 50 pairs for two reasons: One, we wanted to keep our list length comparable to that used by Tulving (1985, list length 27 pairs), and two, the instances in the remaining 25 pairs served as lures in the recognition task.

For the test phase, four types of test booklets were created: free recall, category cued recall, category plus letter cued recall, and recognition. The free recall test contained two columns, one for the items recalled and one for the Remember/Know responses. In the category cued recall task, the 25 category names that the participants had previously studied were presented followed by a blank line for participants to write the instance. Adjacent to each blank line was a second line for participants to write their Remember and Know responses. Similarly, for category plus letter cued recall, participants were provided with the 25 categories from study. They were also provided with the first letter of the instances. Again the test had two blank lines, one for recalled instances and one for Remember/Know responses. The recognition test consisted of 50 instances, 25 of which were studied and 25 were new. The new items constituted the study instances (of a different set of categories) for another group. Again two lines were provided, one of which was for the recognition responses (Yes/No) and the other for Remember/Know responses. Two presentation orders were created for each type of test.

*1.1.3. Procedure*

Participants were tested in groups of two to four. Each participant was randomly assigned to different study lists and test conditions. All aspects of the procedure were kept as similar to Tulving's (1985) as possible (except for the between-subject design). At the start of the study phase, participants were informed that the first word would always be a category and the second word would be an instance of that category. Incidental encoding instructions were given to participants by asking them to simply pay attention to each pair of items. The 25 category names and their instances in each list were presented auditorily at the rate of one pair per 2 s.

After study, participants took part in two filler tasks, each lasting for 6 min. First, they wrote down the names of all the US presidents that they could recall, and then wrote the names of all the US cities that they could recall. Following this, participants were given the instructions on how to make Remember/Know judgments. These instructions were taken from Rajaram (1993). The entire retention interval including the Remember/Know instructions period lasted approximately 20 min.

At test, each participant received one of four possible tasks: free recall, category cued recall, category plus letter cued recall, or recognition. Participants were given cover sheets that permitted viewing of only one item at a time and were prevented from working on the previous items. In the free recall condition, participants were asked to write down, in any order, all of the instances that they could recall from the list that they had heard earlier. They were reminded that the instances were the second word in the word pairs. In the category cued recall condition, participants were given a booklet containing the list of the 25 category names that they had heard. Participants were instructed to write down the instance that accompanied each category from the list presented earlier. In the category plus letter cued recall condition, participants were presented with a list of the categories that they had heard earlier, along with the first letter of each instance. Participants were asked to provide the studied instance that started with the letter given. In the recognition condition, participants were presented with a list of 50 instances and were asked to identify the instances that were presented earlier. Participants in each condition were provided with two practice items (not used in the study lists) prior to test. Also, in the last three tasks, the lists of cues were presented in a different random order from that used in the study list. In writing their responses, participants were specifically instructed not to guess.

In each of these test conditions, participants were also asked to provide Remember/Know judgments immediately after each recalled or recognized (henceforth commonly referred to as "retrieved") response. For each test, identical Remember/Know instructions were used. These instructions were presented both in written format and read aloud to the participants. Participants were also presented with examples (not taken from the study lists) of Remember and Know responses. The test phase did not begin until it was clear that all of the participants understood the distinction between Remember and Know responses.

### 1.2. Results

For each task, the mean proportion of items correctly retrieved broken down by Remember or Know judgments and the mean proportion of correctly retrieved items that were given a Remember response (Remember/total Retrieved) are shown in Fig. 1. In the recognition task, the false alarms for Remember responses were 0.02 and for Know responses 0.07. Note that these mean values are within the range reported in the literature.

Based on our hypotheses, the analyses in this and the subsequent experiments reported in this article focused on two measures. One, the overall level of retrieval (recall or recognition) was compared across tasks, and two, the Remember/total Retrieved values were compared across tasks. The former measure allowed us to test

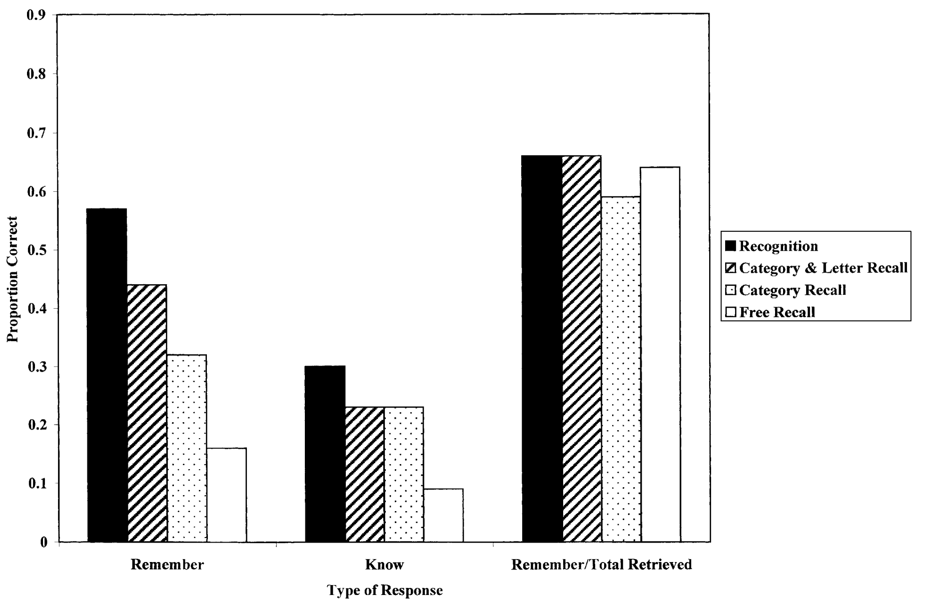


Fig. 1. Mean proportion of targets retrieved (i.e., recalled or recognized) as a function of type of memory task and the type of memory measure in Experiment 1.

the basic hypothesis that overall level of retrieval would increase with an increase in the retrieval cues provided to the participants. The latter measure allowed us to determine whether the proportion of retrieved items that were also recollected (i.e., given a Remember response) decreased across different explicit memory tasks in our between-subject design. For all the statistical analyses reported here and in the subsequent experiments, the two-tailed alpha level was set at $p < 0.05$, unless noted otherwise.

A between-subject, one-way analysis of variance (ANOVA) revealed significant differences among the proportion of total items correctly retrieved (Remember plus Know) for the four tests ($F(3,60) = 48.86$, $\mathrm{MSE} = 0.02$). The overall levels of retrieval were found to be significantly different in all but one comparison of tasks: free recall and category cued recall ($t(30) = 5.96$, $\mathrm{SE} = 0.05$); free recall and category plus letter cued recall ($t(30) = 7.28$, $\mathrm{SE} = 0.06$); free recall and recognition ($t(30) = 20.25$, $\mathrm{SE} = 0.03$); recognition and category cued recall ($t(30) = 6.92$, $\mathrm{SE} = 0.05$); category plus letter cued recall and recognition ($t(30) = 3.65$, $\mathrm{SE} = 0.05$). The difference between category cued recall ($M = 0.54$) versus category plus letter cued recall ($M = 0.67$) did not reach significance by adjusted alpha but is in the same direction as the other comparisons.

A between-subject, one-way ANOVA was also employed to determine whether any differences existed among the proportions of correctly retrieved items that received a Remember response (i.e., the Remember/total Retrieved measure) for each of the four tests (see Fig. 1). No significant differences were obtained among these means ($F(3,60) < 1$). [3]

### 1.3. Discussion

The results of Experiment 1 were consistent with the first prediction: As cues at test increased, the proportion of total items retrieved (that is, recalled or recognized) also increased. This pattern replicates Tulving's (1985, Experiment 1) results for the overall recall in the three explicit memory tasks, i.e., free recall, category cued recall, and category plus letter cued recall. Consistent with this pattern, our results also demonstrate that when the study item itself is given as a cue in the memory test, as was the case in recognition, the level of retrieval is the highest.

Our results for Remember judgments differed from what Tulving (1985) had found. Specifically, Remember judgments did not decline across tasks despite an increase in the retrieval cues that were provided. In fact, our results show that

[3] The Remember/total Retrieved unit of analysis was selected to test our second hypothesis: Do the proportion of items given Remember responses vary across tasks? It should be noted that a precedence for the use of this unit of analysis already exists (Rajaram, 1993, 1996). Furthermore, the proportion of correctly retrieved items given a Know response were not examined, since these responses are not statistically independent from Remember responses and the rationale for this omission has also been explained in earlier studies (Rajaram, 1993, 1996).

Remember judgments increased as the retrieval cues increased such that the proportion of retrieved items that received remember responses remained constant across tasks.

Several implications of these findings are noteworthy. First, these findings clearly show that recognition memory is not the only candidate task for studying qualitatively different retrieval experiences. Performance on other explicit memory tasks used in this experiment was also characterized by at least two different states of awareness.

Second, a remarkable finding in this experiment was that the free recall task, considered to be the quintessential measure of conscious recollection, also elicited Know responses that represent a failure to evoke a specific and vivid recreation of the study episode. It should be noted that even in the original experiment by Tulving (1985, Experiment 1), where free recall was the first memory task given to the participants, only 88% of the recalled items were given Remember responses. In our experiment, this percentage was a bit lower (66%). Thus, contrary to the widespread assumption, it appears that a "pure" measure of conscious recollection may be more accurately provided by Remember responses and not by other measures of explicit memory including free recall.

The third notable implication of these findings, particularly with reference to the cued recall and recognition tasks used in this experiment, is that Remember responses can be based on multiple attributes of the to-be-retrieved stimuli. In other words, presentation of cues in other memory tasks does not necessarily reduce access to episodic information compared to free recall (Tulving, 1985). On the contrary, such cue information probably invokes other specific attributes of the to-be-retrieved material, and this access to episodic details becomes evident when the contributions of passage of time, item selection, and output interference are reduced.

The effects of multiple attributes, semantic *and* nonsemantic, have been obtained in cued recall tasks (Moscovitch & Craik, 1976; Nelson, Fosselman, & Peebles, 1971; Nelson & Garland, 1969; Slamecka & Barlow, 1979; Stein, 1977). We extend the implications of these findings to Remembering in our study. Prior studies have shown that Remembering is sensitive to both conceptual and perceptual aspects of the stimuli in recognition memory (Rajaram, 1996, 1998; Rajaram & Roediger, 1997). Experiment 1 findings suggest that both conceptual and perceptual operations can influence Remembering across various explicit memory tasks.

In Experiment 2 we focus on a conceptual effect to test this hypothesis for Remember judgments. Specifically, we manipulated levels of processing at encoding to examine a conceptual or semantic effect across the recall tasks of Experiment 1. The levels-of-processing effect on Remembering is well documented in the recognition task (e.g., Gardiner, 1988; Rajaram, 1993). The use of this variable allowed us to simultaneously obtain a systematic replication of Experiment 1 findings by testing a different set of participants on four explicit memory tasks and extend the levels of processing effect on Remember judgments from recognition memory to the recall tasks of Experiment 1.

## 2. Experiment 2

### 2.1. Method

#### 2.1.1. Participants

A new group of 96 undergraduates at the State University of New York at Stony Brook participated for credit in partial fulfillment of requirements for an Introductory Psychology course. Twenty-four participants were randomly assigned to each of four memory tasks.

#### 2.1.2. Design and materials

The same 50 pairs consisting of category names and instances from Experiment 1 and two additional pairs were used. Of these 52 pairs, four pairs served as practice items and 48 pairs served as critical items. In order to keep the list length comparable to the list length used in Experiment 1, two study lists with 24 pairs each were created by randomly assigning the pairs from the 48 pair pool. In each study list, the four practice pairs were added to bring the total in each study list to 28 pairs. The critical 24 pairs in each study list were further subdivided into two sets of 12 pairs such that one set of 12 pairs was presented for Deep encoding whereas the other set of 12 pairs was presented for Shallow encoding. Four presentation orders for each study list were created in order to ensure that the order of encoding condition (Deep versus Shallow) was counterbalanced across participants and that each set of 12 pairs in each study list appeared both in Deep and Shallow encoding conditions across participants.

At test, the same four tasks used in Experiment 1 (i.e., free recall, category cued recall, category plus letter cued recall, and recognition) were again used. All memory tests except free recall were presented on the computer for this experiment.

#### 2.1.3. Procedure

Participants were tested in groups of one to three and were randomly assigned to the study and test conditions. All materials were presented on Zeos 486 personal computers by using Schneider's (1990) Micro-Experimental Laboratory (MEL; Version 1.0) software system. Participants were presented with 28 category–instance pairs, where each pair was presented for 5 s at the center of the computer screen. Prior to the presentation of each pair, an asterisk appeared for 1 s demonstrating where the items would appear. Participants were informed that the first word would always be a category name while the second word would be an instance of that category (i.e., *musical instrument – viola*) and were given two examples (of practice items). As in Experiment 1, incidental encoding instructions were used such that participants were not informed of a later memory test. The presentation of the items was divided in half. Participants were told the instructions for both halves of the lists prior to the start of the list. Additionally, prior to the start of each half of the list, written instructions were provided on the computer screen for each of the encoding conditions.

For one half of the study list (14 pairs, 12 critical and 2 practice pairs), participants were instructed that their task was to read the word pair carefully and then write down a word that sounded like the second word of the word pair (Shallow processing condition) on the sheet provided to them. Participants were instructed to read both the category and the instance to enable them to answer some questions later but were also instructed to write down similar sounding words only with reference to the instances. They were informed that if they could not come up with an item that sounded like the second word of the word pair, either because there was not enough time or because they could not think of a word, then they were to skip a line for that item. Participants were given two examples of how to do this task with items not included in the study list.

The instructions for the other half of the list were identical, except that the participants were asked to provide a word which was meaningfully related to the second word of the word pair (Deep processing condition) instead of a word that sounded like the second word. Again, they were provided with two examples of how to perform this task. The two halves of the list were presented in succession, separated by a 15 s pause.

After study, participants performed filler tasks in which they were first asked to write down the names of all the US presidents they could recall for 7 min. Next, they were asked to write down the names of all the US cities for seven additional minutes. [4] The remaining time was used to give test instructions, Remember/Know instructions, and to provide practice totaling the duration of the retention interval to 30 min.

At test, each participant was presented with one of four possible tasks: free recall, category cued recall, category plus letter cued recall, or recognition. In all test conditions, participants were instructed not to guess during retrieval. For the three tests given on the computer, a practice session with four practice items from the study list was held in order to familiarize the participants with the necessary keystrokes. The instructions were identical to those used in Experiment 1 for retrieval and for Remember/Know response assignments, and were given both verbally and on the computer screen (where applicable) prior to the practice session. Category cued recall and category plus letter cued recall tests consisted of the 24 category names from the critical study pairs. The recognition test consisted of all 48 critical instances, 24 of which were from the studied list and 24 were new items that constituted the study items for another group. The cues/instances on the test list were presented in a random order with respect to the encoding conditions.

### 2.2. Results

For each task, the mean proportion of total items retrieved (Remember + Know) (Row 1), the mean proportion of items given Remember (Row 2) or Know (Row 3)

[4] For the free recall condition participants were given 8 min each, for naming US presidents and US cities. The additional minutes were provided to equate the time between free recall and the other three tests. The extra time was needed because free recall was a paper–pencil test, and therefore, did not need a computer practice session.

Table 1
Mean proportion of total items retrieved, items given "Remember" responses, and items given "Know" responses for both Deep and Shallow processing conditions and the proportion of correctly retrieved items given "Remember" responses

| | Type of test | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Free recall | | Cat recall[a] | | Cat and letter[b] | | Recognition | |
| | Deep | Shallow | Deep | Shallow | Deep | Shallow | Deep | Shallow |
| Total retrieved | 0.26 | 0.15 | 0.62 | 0.17 | 0.66 | 0.46 | 0.95 | 0.79 |
| "Remember" | 0.18 | 0.08 | 0.45 | 0.10 | 0.44 | 0.26 | 0.77 | 0.48 |
| "Know" | 0.08 | 0.07 | 0.17 | 0.07 | 0.22 | 0.19 | 0.18 | 0.30 |
| "Remember"/ Retrieved | 0.69 | 0.53 | 0.73 | 0.59 | 0.67 | 0.56 | 0.81 | 0.61 |

[a] Category cued recall.
[b] Category plus initial letter of instance recall.

judgments, and the mean proportion of correctly retrieved items assigned Remember judgments (Remember/total Retrieved) (Row 4), for Deep and Shallow encoding conditions in each task are displayed in Table 1. In the recognition task, the false alarm rates for Remember (0.01) and Know (0.02) were quite low. Given the high level of recognition memory performance for hits, these false alarm data suggest high discriminability in the participants' performance.

A between-subject, one-way ANOVA revealed differences among the total proportion of items retrieved (Row 1 values collapsed across the levels of processing manipulation) for the four types of tests ($F(3,92) = 78.64$, $\mathrm{MSE} = 0.02$). The differences in the levels of retrieval were significant between all the tasks: free recall and category cued recall ($t(46) = 4.59$, $\mathrm{SE} = 0.04$); free recall and category plus letter cued recall ($t(46) = 8.18$, $\mathrm{SE} = 0.04$); free recall and recognition ($t(46) = 17.59$, $\mathrm{SE} = 0.04$); category cued recall and category plus letter cued recall ($t(46) = 2.89$, $\mathrm{SE} = 0.05$); category cued recall and recognition ($t(46) = 9.89$, $\mathrm{SE} = 0.05$); category plus letter cued recall and recognition ($t(46) = 6.9$, $\mathrm{SE} = 0.05$).

A between-subject, one-way ANOVA was employed to determine whether any differences existed among the proportion of correctly retrieved items that received a Remember response (Remember/total Retrieved) for each of the four tests (Row 4 collapsed across the levels of processing manipulation). No significant difference was obtained among these means ($F(3,92) = 1.56$, $p = 0.20$). These two sets of results provide a straightforward replication of Experiment 1 findings with a new group of participants.

The next analysis consisted of an examination of the levels of processing effect in each test. For the proportion of total items retrieved (Row 1), a significant difference between the Deep and Shallow processing conditions was obtained in each of the four explicit memory tests; free recall ($t(23) = 3.3$, $\mathrm{SE} = 0.04$), category cued recall ($t(23) = 9.84$, $\mathrm{SE} = 0.04$) category plus letter cued recall ($t(23) = 6.81$, $\mathrm{SE} = 0.06$), and recognition ($t(23) = 4.08$, $\mathrm{SE} = 0.03$).

The critical measure for the present purposes was the effect of the levels of processing manipulation at encoding on the proportion of total items retrieved that were also assigned a Remember response (i.e., the Remember/total Retrieved measure). In three of four tests, a significant difference was found between the Deep and the Shallow encoding conditions for the Remember/total Retrieved measure; free recall ($t(23) = 2.9$, $SE = 0.09$), category cued recall ($t(23) = 2.25$, $SE = 0.10$), category plus letter cued recall ($t(23) = 1.23$, $p = 0.23$), and recognition ($t(23) = 5.19$, $SE = 0.04$). [5] Although the levels of processing effect for Remember/total Retrieved measure was not significant for the category plus letter cued recall task, note that the numerical trend was in the expected direction.

### 2.3. Discussion

As expected, the pattern of results in this experiment replicated the findings from Experiment 1. Specifically it was found that as cues at test increased, the proportion of items retrieved also increased. Once again, as in Experiment 1 it was also found that the proportions of correctly retrieved items given a Remember response were equivalent across the four tests.

The analysis of interest in Experiment 2 was the effect of the levels of processing manipulation on the participant's recollective experience in these various memory tests. The levels of processing effect was examined for two units of analysis; one, for the overall level of retrieval within each task for the Deep versus Shallow encoding conditions, and two, for the Remember/total Retrieved measure within each task for the Deep versus Shallow encoding conditions. For the overall retrieval measure, a typical level of processing effect was found for the total items retrieved in each of the four memory tests, replicating studies in which the levels of processing effect has been obtained for these memory tasks (e.g., Craik & Tulving, 1975; Lewandowsky & Hockley, 1987; Vochatzer & Blick, 1989).

More importantly, we observed a significant levels-of-processing effect with the Remember/total Retrieved measure in three out of four tasks, and a numerical trend in the expected direction (Deep greater than Shallow) in the category plus letter cued recall task. Taken together, these findings replicate the patterns of Remember judgments observed in Experiment 1 across the four explicit memory tasks and generalize the levels of processing effect on Remember judgments across these tasks.

As noted in the Introduction, Remember judgments in recognition memory have been shown to be sensitive to both conceptual and perceptual processes (Rajaram, 1996, 1998; Rajaram & Roediger, 1997; Yonelinas & Jacoby, 1995). Results from Experiments 1 and 2 where Remember responses increase with an increase in conceptual and perceptual attributes of test cues are consistent with these demonstrations. In order to examine the similarities across recognition and other memory tasks for

[5] An analysis of the levels of processing effects for the absolute measure of Remember responses also produced the same pattern of results in each of the four tasks. That is, a significant level of processing effect was obtained in all four tasks for Remember judgments.

states of awareness observed in Experiments 1 and 2, we examined the effects of both conceptual and perceptual operations on Remembering in cued recall tasks in Experiments 3 and 4. The predictions for Experiments 3 and 4 were further motivated by the observation that the increasing cues across various tasks in Experiments 1 and 2 overlapped with the study materials along both conceptual and perceptual dimensions. For example, for the category–instance pair *musical instrument – viola*, the test cues *musical instrument –* ____ or *musical instrument – v*____ provide both conceptual (the category information) and perceptual overlap (that is, the phonological and lexical features of the cues across study and test). The purpose of Experiments 3 and 4 was to empirically demonstrate the separable contributions of the perceptual and conceptual attributes to Remembering across a variety of memory tasks.

In order to determine the specific influences of perceptual and conceptual cues on Remember judgments in explicit memory tasks, we compared three cued recall tasks that varied along the conceptual/perceptual dimension in the test cues. The first task used was a paired-associate recall test in which participants studied related word pairs (*copper–tin*) and were later cued with the first word (*copper*) of the study pair for recall. Thus, this test was similar to the cued recall tests in Experiments 1 and 2 in that there was complete conceptual and perceptual overlap between the cue at test and the cue at study. In comparison to this task, the separate contributions of the perceptual and conceptual properties of the test cue to Remembering were examined in two other memory tests. In one test, cues were related to the study items perceptually (that is, looked like the first words of the study pairs) and in the second test, the cues were related conceptually (that is, were similar in meaning to the first words of the study pairs). Thus, the influence of perceptual information on Remembering was tested in a perceptual cued recall test and the influence of conceptual information was tested in a conceptual cued recall test.

These tasks were adaptations of Blaxton's (1989) graphemic cued recall and semantic cued recall tasks, respectively, with the necessary alterations. In a series of elegant experiments, Blaxton (1989) showed that the semantic cued recall task, in which the test cue (*timid*) was semantically related to the to-be-retrieved item (*bashful*), was sensitive to manipulations of conceptual encoding. On the other hand, the graphemic cued recall test in which the test cue (*bushel*) was graphemically (and not semantically) related to the to-be-retrieved item (*bashful*), was sensitive to perceptual variations in encoding. Because of the conceptual nature of the semantic cued recall task and perceptual nature of the graphemic cued recall task in Blaxton's (1989) study, we adapted these two tasks in Experiment 3 to determine the conceptual versus perceptual effectiveness of test cues on Remember judgments. [6]

In our experiment, we altered these two tasks to separate the conceptual and perceptual dimensions of the test cues *in relation to the study cues, not targets*. Thus, we matched the test cue for its semantic or perceptual similarity, not with the second

[6] We note that conceptual and perceptual variables can also effect Know judgments (see Gardiner & Gregg, 1997; Rajaram, 1993; Rajaram & Geraci, 2000). However, in this study our focus is on Remember judgments and specifically on determining the effects of retrieval cues on Remember judgments. Therefore, our predictions concern Remember judgments.

word of the study pair (e.g., *tin* in *copper–tin*) as in Blaxton (1989) study, but with the first word of the study pair (e.g., *copper*). This change was necessary in order to separate the effectiveness of the perceptual and conceptual attributes of the test cue. Specifically, in the paired-associate recall, the test cue (e.g., *copper*) bore perceptual and conceptual similarity to the study cue (e.g., *copper*). The test cue in conceptual cued recall task (e.g., *bronze*) and the test cue in our perceptual cued recall task (e.g., *chopper*) allowed us to compare the individual contribution of these two types of cues with the original test cue (e.g., *copper*).

We predicted that the *overall levels of retrieval* would be the highest in the paired-associate recall task where the test cue was identical to the encoded information, if both conceptual and perceptual attributes affect explicit memory. The level of retrieval was expected to be lower in the conceptual cued recall and the perceptual cued recall tasks than the paired associate task if both semantic and nonsemantic attributes of the cues are effective in cued recall tasks.

With respect to *Remember judgments*, we predicted a similar pattern of performance across the three cued recall tasks. Because Remember judgments are sensitive to both conceptual and perceptual manipulations in recognition, we expected these manipulations to influence Remembering in recall tasks as well. As such, we expected a higher level of Remember judgments in paired-associate recall compared to conceptual cued recall and perceptual cued recall. Thus, we predicted the proportion of retrieved items given Remember judgments to be equivalent across the three tasks.

## 3. Experiment 3

### *3.1. Method*

#### *3.1.1. Participants*

Sixty undergraduates from the State University of New York at Stony Brook participated for credit in partial fulfillment of requirements for a Psychology course. Twenty participants were randomly assigned to each of the three memory tasks used.

#### *3.1.2. Design and materials*

The stimuli were derived from Blaxton's (1989) study. Twenty-eight word pairs with their conceptual and perceptual cues were selected. All stimuli were presented and data were collected on Zeos 486 personal computers by using Schneider's (1990) Micro-Experimental Laboratory (MEL; Version 1.0) software system. The 28 word pairs were presented in a random order during the study phase. From these 28 pairs, 22 target pairs were randomly selected for later testing. Four of the remaining pairs served as practice items, and two as buffer items.

Three types of tests were created: paired-associate recall, conceptual cued recall, and perceptual cued recall. In the paired-associate recall test, participants were provided with the first word of the studied word pair. In the conceptual cued recall test, participants were provided with a word that was semantically related to the first word of the studied word pair. In the perceptual cued recall test, participants were provided with a word that was perceptually related to the first word of the studied word pair. In all three conditions, participants were asked to provide the second word of the studied word pairs and make Remember/Know judg ments.

### 3.1.3. Procedure

Participants were tested in groups of one to three, and were randomly assigned to one of three test conditions. At study, each of the 28 word pairs was preceded by an asterisk for 1 s and was presented one at a time (e.g., *copper–tin*) at the center of the computer monitor for 5 s. Incidental encoding instructions were given such that participants were asked simply to read the word pairs and pay careful attention to the items. These instructions were also repeated prior to the start of the word pair list in a written format on the computer screen. In the 30-min retention interval that followed, two filler tasks were given. Participants wrote down the names of all the US presidents and all the US cities they could think of for 6 min each. The remaining time was used to give test instructions and Remember/Know instructions along with some practice examples (not taken from the study list). The same procedure as used in Experiments 1 and 2 was followed to ensure that participants understood the distinction between Remembering and Knowing.

At test, each participant was presented with one of three possible tests on the computer: paired-associate recall, perceptual cued recall, or conceptual cued recall. In each test condition, participants were told that the cue always pertained to the first word of the study pairs, and that they were to provide the second word of the study pair. As in Experiment 1, in all test conditions participants were specifically instructed not to guess during retrieval. For each test, a practice session was held to familiarize the participants with both the tasks and the keys used with the help of the practice items. Written instructions for the tasks and for the Remember/Know judgments were presented once again on the computer screen and explained verbally before the start of practice.

In the paired-associate recall condition, participants were provided with the first-words of the 22 studied pairs (e.g., *copper–tin*) followed by a blank line (e.g., *copper* – ____). In the conceptual cued recall condition, participants were provided with words that were semantically related to the first words of the studied pairs. The participants were given the cue accompanied by a blank line (e.g., *bronze* – ____). In the perceptual cued recall condition, participants were presented with cues that were perceptually related to the first words of the studied pairs (e.g., *chopper* – ____). In all conditions, the participants were being asked to provide the second word of the original word pairs (i.e., *tin*). All cues were presented one at a time in a random order, on the computer screen. Each cue was accompanied by a prompt which asked "Recall, Y or N?" until the participant responded. The "Y" and "N" keys were specially labeled keys, adjacent to each other on the keyboard. If the participants chose the "N" key, then the next item automatically appeared. If the participants chose the "Y" key, the prompt "Type the word and press enter" appeared. In each task, participants were also asked to provide Remember/Know judgments immediately after typing each retrieved response by pressing the keys labeled R or K. Again, specifically marked adjacent keys on the keyboard were used for R and K. As soon as the participants pressed the R or the K key, the next item appeared.

### 3.2. Results

The mean proportion of Remember and Know judgments and the mean proportion correctly retrieved items assigned Remember responses (Remember/total Retrieved) are shown in Fig. 2.

A between-subject, one-way ANOVA revealed differences among the proportion of total items correctly retrieved for the three types of tests ($F(2,57) = 27.54$, $MSE = 0.02$). The overall level of retrieval was significantly higher in paired-associate recall compared to conceptual cued recall ($t(38) = 6.93$, $SE = 0.05$), and was also higher in paired-associate recall compared to perceptual cued recall ($t(38) = 5.83$, $SE = 0.05$). The overall level of retrieval did not differ between conceptual cued recall and perceptual cued recall ($t(38) = 0.85$).

A between-subject, one-way ANOVA, employed to determine whether any differences existed among the proportion of correctly retrieved items that received a Remember response (i.e., the Remember/total Retrieved measure), was not significant ($F(2,57) = 1.94$, $p = 0.15$).

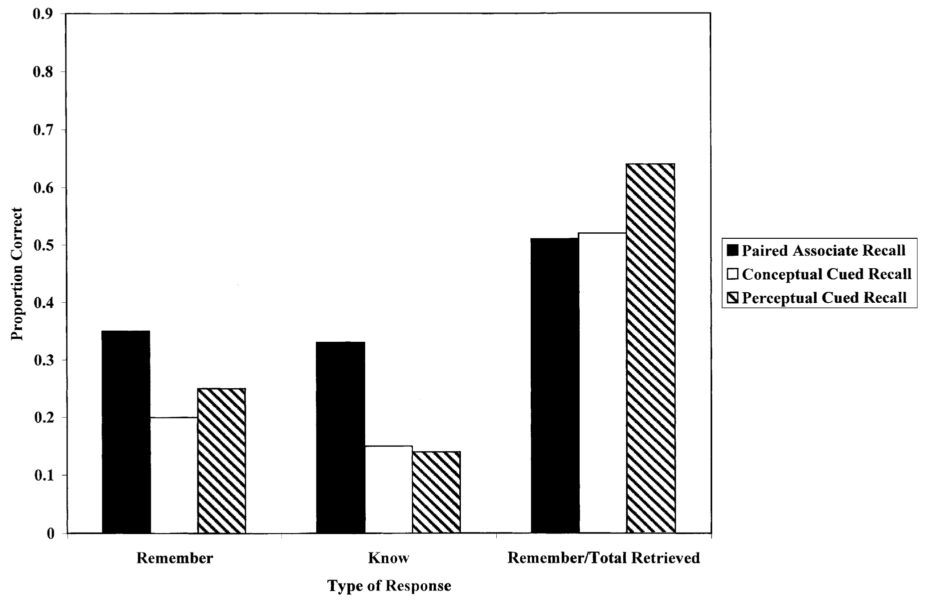


Fig. 2. Mean proportion of targets recalled as a function of type of memory task and the type of memory measure in Experiment 2.

### 3.3. Discussion

Two main findings emerged from Experiment 3. First, the overall level of retrieval was higher in paired-associate recall test than in conceptual cued recall or perceptual cued recall tests. The latter two tests did not differ from each other in the overall level of retrieval. These findings are consistent with our prediction that identical cues would be more effective than either conceptual or perceptual cues individually. Second, both conceptual and perceptual cues were similarly effective in eliciting a Remember experience for the retrieved item as shown by the equivalent proportions of Remember/total Retrieved scores in conceptual cued recall and perceptual cued recall tests. These results are consistent with earlier reports of conceptual and perceptual influences on Remember judgments in recognition memory (Dewhurst & Conway, 1994; Gardiner, 1988; Rajaram, 1993, 1996, 1998). Our present findings extend this pattern to cued recall tasks.

One potential concern in the interpretation of the results from this experiment needs to be ruled out with respect to the conceptual cued recall test relative to the perceptual cued recall test. Specifically, the word pairs shown at study in Experiment 3 were conceptually related (i.e., *copper–tin*). In the conceptual cued recall test, participants were presented with a conceptually related test cue (e.g., *bronze*) and were asked to provide the second word of the word pairs (*tin*). Thus, the word *bronze* was related both to the first (*copper*) and the second (*tin*) word of the study pair. The semantic relation between the test cue (*bronze*) and the study target (*tin*) might have enhanced the recall of the target in the conceptual cued recall task. Such an enhancement was not possible in the perceptual cued recall task because the test cue (*chopper*) was related perceptually only to the first word (*copper*), and not the second word (*tin*) of the study pair. Therefore, the related nature of the original study pairs themselves might have influenced the overall level of retrieval, and possibly, the concomitant states of awareness in conceptual cued recall.

This possibility is attenuated by the finding that performance on the conceptual cued recall test was not enhanced in comparison to the perceptual cued recall test. Nonetheless, the purpose of Experiment 4 was to rule out the effects of relatedness between the words in the study word pairs on retrieval performance and experience. This was accomplished by using unrelated word pairs at study. While an overall decrement in performance was predicted in Experiment 4 relative to Experiment 3 because of the use of unrelated pairs at study, the general pattern of results was expected to be the same. Specifically, the overall level of retrieval was expected to be higher in paired-associate recall (to be called the cued recall test in Experiment 4 for reasons described below in the Design and materials section) compared to conceptual cued recall and perceptual cued recall tasks. No difference in the overall level of retrieval was expected for the latter two tasks. Furthermore, for the recollective experience measure, it was expected that the proportion retrieved items given a Remember response would be equivalent across the three memory tests. This experiment also allowed us to systematically replicate the findings of Experiment 3.

## 4. Experiment 4

### 4.1. Method

#### 4.1.1. Participants

A new group of 60 undergraduates from the State University of New York at Stony Brook participated for credit in partial fulfillment of requirements for a Psychology course. Twenty participants were randomly assigned to each of three memory tasks used.

#### 4.1.2. Design and materials

All materials were the same as those used in Experiment 3 except for the target items that were now unrelated words. Specifically, the 28 first words of the study pairs from Experiment 3 were used and the second words in the pairs were 28 words unrelated to these first words (e.g., *copper–halibut*). The second words in the study pairs were selected from the materials of Experiments 1 and 2. All the other aspects of the stimuli (except the three procedural changes noted below) were constant across Experiments 3 and 4 except that the paired-associate recall test was now referred to as a cued recall test because the pairs were unrelated. Once again, each participant participated in only one of three memory tasks, cued recall, conceptual cued recall, and perceptual cued recall.

#### 4.1.3. Procedure

The procedure was identical to that of Experiment 3 with the following changes. Because unrelated study pairs were used in this experiment, three minor procedural changes were introduced to avoid potential floor effects in performance. One, intentional encoding instructions were used in this experiment unlike the previous experiments. Participants were asked to learn the items for an unspecified memory task to be administered later. Second, each pair was shown for 10 s instead of 5 s. Third, the retention interval was reduced to 15 min such that now the retention interval consisted of providing Remember/Know instructions and practice immediately following the study session.

### 4.2. Results

The mean proportion of Remember or a Know judgment and the mean proportion of correctly retrieved items assigned Remember judgments (Remember/total Retrieved) in the three tasks are displayed in Fig. 3.

A between-subject, one-way ANOVA revealed differences among the proportion of items retrieved for the three types of tests ($F(2,57) = 7.71$, $\mathrm{MSE} = 0.04$). The overall level of retrieval was significantly higher in cued recall relative to conceptual cued recall ($t(38) = 3.56$, $\mathrm{SE} = 0.07$), as well as perceptual cued recall ($t(38) = 2.5$, $\mathrm{SE} = 0.07$). The conceptual cued recall test and perceptual cued recall test did not differ from each other on this measure ($t(38) = 1.24$).

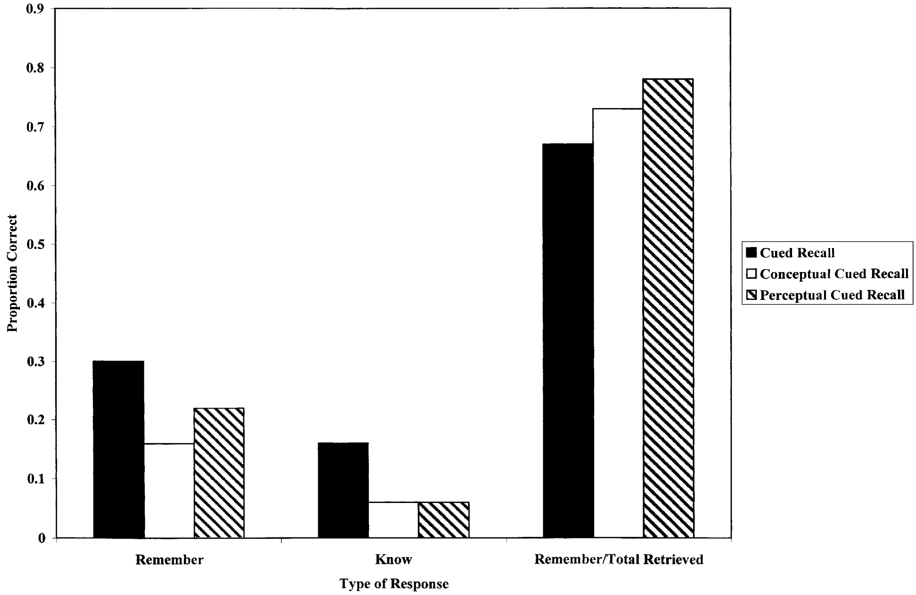


Fig. 3. Mean proportion of targets recalled as a function of type of memory task and the type of memory measure in Experiment 3.

With respect to the proportion of correctly retrieved items that received a Remember response (Remember/total Retrieved), a between-subject, one-way ANOVA revealed no significant differences among the three tests ($F(2,57) < 1$). While a numerical decrement in the overall level of performance was evident in Experiment 4 compared to Experiment 3, the *pattern* of results for the retrieval and the Remember/total Retrieved measures replicated the findings observed in Experiment 3.

### *4.3. Discussion*

As expected, the results of Experiment 4 replicated the findings of Experiment 3. Specifically, a higher level of retrieval was obtained for the cued recall task compared to conceptual cued recall and perceptual cued recall tasks, which did not differ. Also, equivalent proportions of retrieved items were assigned Remember judgments for the three tasks, suggesting that Remember judgments are influenced by both perceptual and conceptual factors.

## 5. General discussion

Tulving's (1985) experiment demonstrated that increases in retrieval diminished reliance on episodic memory as measured by Remember judgments. However, this pattern of results could have been, at least in part, due to the successive testing within-subject design used in that study. Specifically, the operational factors such as passage of time, item selection, and output interference in a within subject successive testing design complicate the assessment of the role of episodic memory. Our experiments addressed this question by implementing a between-subject design. We found that as retrieval cues increased, the proportion of retrieved items that were given Remember responses did not decline, and instead, remained equivalent. These data suggest that increases in retrieval cues can facilitate access to episodic memory. As stated earlier, increased cue information likely invokes other specific attributes of the to-be-retrieved material, and thereby, leads to an increase in Remember judgments.

Three other findings of interest emerged from the experiments reported in this article. One, different subjective states of awareness during retrieval can be experimentally captured in a number of different explicit memory tasks. Two, performance in a free recall task is also composed of distinct states of awareness. Three, recollective experience as captured by Remember judgments is influenced by different factors and the present data point towards at least two classes of variables, conceptual and perceptual, that affect Remembering.

The present study intentionally deviated from the standard practice of using only the recognition memory task and explored distinct states of awareness in a number of explicit memory tasks. In doing so, the present findings permit generalizations regarding the nature of retrieval experience to a greater variety of retrieval situations than possible with the use of a single task. Although, as noted in the Introduction, a few studies have reported using Remember judgments with tasks other than recognition, to our knowledge no single study (with the exception of Tulving's) has examined states of awareness across multiple memory tasks within one study for the purpose of direct comparison. Our findings reveal important similarities in the states of awareness that accompany retrieval across a wide variety of situations. Specifically, in all four experiments we observed the striking pattern that the proportion of retrieved responses that were given Remember judgments remained constant. Thus, it appears that performance on various recall tasks, that are not traditionally purported to have dual bases, is also accompanied by distinct states of Remembering and Knowing.

A striking instance of this pattern was found in the free recall task in Experiments 1 and 2 where Remember responses were given only to a subset of the total number of items correctly recalled. Recollective judgments for only a subset of recalled items were also obtained in Tulving's (1985) study. Free recall has long been considered the best measure of conscious recollection but the present findings, in conjunction with Tulving's, suggest that Remember responses provide a better measure of this state of awareness.

A possible explanation for two states of awareness in free recall relates to the effects of associative attributes and discriminative attributes presumed to affect free recall performance (Hunt & Elliott, 1980; Underwood, 1969). Associative attributes such as meaningfulness of items are assumed to influence the initial search/reconstruction processes in item retrieval such that better semantic encoding improves the search and reconstruction process. After the completion of the search/reconstruction stage, discriminative attributes (such as orthography, see Hunt & Elliott, 1980) can help distinguish between items for successful retrieval. In free recall performance, the effects of associative attributes such as better memory for highly meaningful information than less meaningful information has been shown before. Similarly, positive effects of discriminative attributes such as unusual orthography have also been reported (Hunt & Elliott, 1980).

If such associative and discriminative attributes influence the search as well as the output processes, then it is reasonable to assume that these attributes may also affect the state of awareness that accompanies this output in recall. That is, the access to specific attributes at recall likely determines the states of awareness that accompanies recall. Thus, Remember and Know responses in free recall may be based on access to specific attributes versus strength of item memory, respectively. Future research is needed to explore these initial ideas about the basis of Remember/Know judgments in free recall.

Here, we address a potential concern regarding the way participants made Remember/Know judgments in our study. Because we found the proportion of Remember judgments to remain constant, one might argue that participants might have felt obliged to choose Know responses some of the time. Although a possibility, we consider this to be unlikely for the following reasons. We gave participants detailed instructions, including a warning, that there is no correct pattern of responding. We explicitly instructed our participants that some people might have all Remember judgments or all Know judgments, or they might have a combination of the two. Further, our instructions were similar to those used in other studies in the literature. Across these studies, different patterns of Remember/Know responses have been observed (Gardiner, 1988; Gardiner et al., 1994; Gardiner & Gregg, 1997; Gardiner & Java, 1990; Gardiner & Parkin, 1990; Gregg & Gardiner, 1994; Jones & Roediger, 1995; Mäntylä & Raudsepp, 1996; Rajaram, 1993; Rajaram & Hamilton, 2001). We observed different patterns of Remembering and Knowing across tasks (as a function of the levels of processing variable) in our study as well, suggesting that our participants used the Remember/Know instructions correctly.

Although the focus of our paper was on Remember judgments we note that in our experiments both Remember and Know judgments show parallel effects as a function of increase in retrieval cues and dissociative effects as function of levels of processing. These simultaneous associative and dissociative pattern of Remember/Know responses have been recently reported in a few other studies as well (Gardiner, Ramponi, & Richardson-Klavehn, 1999; Rajaram & Hamilton, 2001). For instance Gardiner et al. (1999) reported an effect of response deadline (500 ms versus 1500 ms) on both Remember and Know responses, but a levels of processing effect and a generation effect only on Remember responses. Similarly, Rajaram and Hamilton (2001) reported parallel effects of repetition on Remember and Know responses but dissociative effects of levels of processing and divided attention. We also note that these recent associative and dissociative effects have been reported mainly with the recognition memory task. However, our study reports these patterns across other explicit memory tasks as well.

In summary, the main message of our article is that Remember responses provide a purer measure of conscious recollection than the standard measures of explicit memory that are typically used for this purpose, and this conclusion holds not only for recognition memory but also for various recall tasks. We demonstrated in our experiments that the recollective experience could arise from the retrieval of different attributes, conceptual and perceptual across a variety of memory tasks. Certainly, unique attributes along other dimensions may also have a positive influence on Remembering and should be explored in future studies. Our findings provide the empirical basis for the use of different explicit memory tasks in the future study of conscious recollective experience.

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