CHAPTER 11

Remembering and Knowing as States of Consciousness During Retrieval

Suparna Rajaram
State University of New York at Stony Brook
Henry L. Roediger III
Washington University, St. Louis

Consciousness is the most difficult topic that psychologists investigate. Philosophers have debated the meaning of consciousness for thousands of years and experimental psychologists have tried, with mixed success, to study the topic objectively in the last hundred years. The term has many distinct meanings and senses. As Miller put it over 30 years ago, "Consciousness is a word worn smooth by a million tongues" (1962, p. 25). In trying to gain a firmer grasp on the topic, we were driven to the *Macmillan Dictionary of Psychology*, edited by Stuart Sutherland (1991), where we found the following definition:

> **Consciousness.** The having of perceptions, thoughts, and feelings; awareness. The term is impossible to define except in terms that are unintelligible without a grasp of what consciousness means. Many fall into the trap of equating consciousness with self consciousness—to be conscious it is only necessary to be aware of the external world. Consciousness is a fascinating but elusive phenomenon: It is impossible to specify what it is, what it does, or why it evolved. Nothing worth reading has been written on it. (p. 90)

Many psychologists perhaps share Sutherland's gloomy conclusion, although certainly other authors in this volume represent exceptions to the general rule. However, why do most of us perceive that psychologists have made little headway beyond the ruminations of philosophers in understanding consciousness? Early psychologists in the structural school assiduously applied the method of analytic introspection to gain understanding of conscious awareness of the world. As is pointed out in every history of psychology text-

book, current judgment is that the great effort they put into such introspective study came to naught, at least in terms of enhancing our understanding of consciousness. One fundamental problem is that the introspectionists' methods proved unreliable from laboratory to laboratory (and even within people in the same laboratory). Give two people what seems to be exactly the same experience and their list of the basic attributes (the sensations, the images, and the affections, as Titchener would have described them) might be rather different in the two cases. In short, one overarching difficulty in the study of consciousness is that researchers have had great difficulty in producing reliable methods for distinguishing states of awareness.

This chapter aims to help revive a study of states of awareness that accompany the act of retrieval. Essentially, the method described here involves having people determine the nature of conscious experience while they are retrieving previous experiences. Following Tulving (1985) and Gardiner (1988), we believe that subjects can reliably and usefully distinguish at least two conscious states of awareness during recollection: *remembering and knowing*. To try to illustrate the distinction, think back to your most recent trip to a scientific conference. Try to retrieve as much as possible about your travel experience. In performing this exercise, you can retrieve many details of the adventure and (in a sense) mentally reexperience the event from beginning to end, recalling many details along the way. This ability to revive the experience, or to mentally relive it, is referred to as remembering; remembering is this feeling of reexperiencing and of recollecting many details that authenticate the memory.

Next, try to retrieve your travel experience to a scientific conference held, say, 20 years ago. To pick an example, the second author is certain that he attended the Midwestern Psychological Association meeting in 1975 and in fact that he drove from West Lafayette, Indiana, to the conference in Chicago. However, despite knowing that he attended the conference and drove to it, he cannot remember the travel. He can remember no details whatsoever—the weather, the traffic conditions, or even the companions (if any). This latter experience represents knowing an event: We are confident that it happened, but we do not remember it.

The distinction between remembering and knowing in the senses just described was introduced by Tulving (1985). He argued that remembering is a reflection of the episodic memory system (our memory for personal happenings, or autobiographical memory as some call it), whereas knowing reflects output from the semantic memory system (our repository of impersonal, ahistorical knowledge). This distinction is a bit tricky, however, because in the travel example, and in the experiments described later, subjects make judgments of knowing about events in their personal past. The general argument is that we can know about episodes of our lives in an impersonal way, just as amnesic patients may know something but not be able to remember it. In

short, the second author's 1975 trip to the meetings of MPA has the same ahistorical and impersonal character as his knowledge that Abraham Lincoln was the 16th president of the United States. He knows both statements to refer to true facts about the world, but has no personal recollection of the occurrence of either event. Although Tulving (1985) originally introduced knowing this way, more recently others (e.g., Jacoby, Yonelinas, & Jennings, chapter 2, this volume) have conceived the process in terms of familiarity, as one of the two components in recognition memory (as proposed by Mandler, 1980, 1989). This chapter considers other ideas about what the Know state may signal.

REMEMBER AND KNOW JUDGMENTS

Tulving (1985) introduced the distinction between remembering and knowing the past. In his experiment he presented subjects with a categorized list of words and then tested them by various means, with increasing power of retrieval cues across tests. Subjects studied category name–instance pairs (e.g., musical instrument–VIOLA) and then they participated in three successive recall tests. The power of the cues increased at each test from a free recall test to a category cued recall test (e.g., musical instrument–_____), to a category name and letter cued recall test (e.g., musical instrument–V_____). After subjects recalled an item, they made a Remember or Know judgment to it.

The results showed that the proportion of Remember responses declined as the cues provided at test increased in their power. That is, the proportion of Remember responses given to recalled items was greatest in free recall and least in the test with category name and letter cues. Correspondingly, Know responses increased with stronger cues. Furthermore, in a recognition memory experiment, Remember responses declined more with retention interval over an 8-day period relative to overall recognition performance.

Following Tulving's original description of the Remember/Know judgment technique to analyze states of consciousness during a memory test, John Gardiner and his colleagues have employed the test in an extensive series of experiments. Others have also used the paradigm to good effect. Gardiner and Java (1993) have recently reviewed this body of work in an excellent chapter so we will not attempt to review exactly the same evidence. This chapter reviews the representative evidence to date from use of the technique and describes a new approach to explaining these results in light of further evidence carried out mostly in the first author's laboratory. To achieve this goal, the chapter is organized in the following way. First, it delineates the instructions, remarks on the nature of these judgments and the relation between them, and discusses the relations between Remember/Know judgments and the conceptual/perceptual components of recognition and of priming. Second, it describes the influence of conceptual and perceptual manipulations on Re-

member/Know judgments. This section documents three types of dissociations—that is, the influence of the independent variables on Remember but not Know judgments, the opposite influence of the independent variables on Remember and Know judgments, and the influence of the independent variable on Know but not Remember judgments—that initially supported the substantial degree to which conceptual/perceptual processing distinction mapped on to Remember/Know distinction. Third, it reviews evidence that is problematic for the conceptual/perceptual processing distinction and proposes a new framework based on distinctiveness and fluency that accounts for most of the evidence to date. The last section evaluates the Remember/Know paradigm, its usefulness in studying the states of consciousness that accompany retrieval, and comments on the current alternate approaches to the study of conscious recollective states.

REMEMBER/KNOW JUDGMENTS: INSTRUCTIONS AND RELATED REALMS OF RESEARCH

In the experiments reported by Gardiner and his colleagues and by Rajaram, subjects were instructed that if production of a word was "accompanied by a conscious recollection of its prior occurrence in the study list," then they should write *R* for Remember beside the word. Subjects were further told:

> 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 something that happened in the room, or of what you were thinking or doing at the time). In other words, the Remember words 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 the word). On the other hand, 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.

These instructions were taken from those used by Rajaram (1993, p. 102), but they were modeled on previous instructions used by Gardiner (1988). It is important to emphasize that instructions to the subject are absolutely critical and in some cases researchers require subjects to repeat back the instructions in their own words to make sure they understand them before the experiment proceeds. Subjects must be told precisely what judgments are to be made, and must be clear that they can separate the two states of consciousness reliably. Although the technique seems fraught with difficulties, its careful use has produced a reasonably consistent body of evidence.

For example, in one experiment Gardiner (1988, Exp. 1) manipulated lev-

els of processing while subjects studied a long list of words. During study subjects were either led to think about the phonemic property of words, or to make a semantic judgment about the words. This levels of processing manipulation has powerful effects on recall and recognition in most explicit tests (Craik & Lockhart, 1972). Gardiner was interested in whether the effect would be seen in Remember judgments or Know judgments, or both. He gave subjects a recognition test and asked them, after judging a word to be old, to say whether they remembered that the word had appeared in the list or whether they simply knew that it had. A powerful levels of processing effect was obtained in overall recognition. When the effect was decomposed into subjects' Remember and Know judgments, Remember judgments determined the levels of processing effect, whereas judgments of Know were equivalent for the two levels of processing.

Note that Gardiner (1988) followed the convention introduced by Tulving in considering overall recognition to be composed of two types of recollective experiences: Remember and Know. Subjects are asked to judge recognized items on this basis, and the experimenter decomposes overall recognition into the two components. This practice has been criticized by others (Jacoby et al., chapter 2, this volume) for assuming that there is an exclusive relation between the two states of knowledge: Items are either remembered or known, without any possibility of a mix, as would be assumed if the underlying processes were thought to be independent.

This chapter also follows the convention of decomposing recognition responses into the two entities of interest, Remember and Know. We are interested in a first-person account of subjects' states of awareness, and so leave it to them to determine this quality for each item. This is not to say that the processes involved may not somehow overlap, but we leave it to the subject to determine whether recognized items should be judged as Remember or Know based on the predominance of information on which the retrieval experience is based. As is true in all the first-person accounts of states of awareness, we assume the subject is capable of making these judgments and we prefer to trust the categorization of behavior provided by the subject rather than to apply statistical techniques that, at least in the theorist's mind, provides a truer picture of the subject's states of awareness. After all, the hallmark of first-person accounts of the study of consciousness, of which Remember/Know is a clear instance (see Gardiner, 1991), is to rely on the subject's reports. These of course may be faulty in some instances (e.g., Nisbett & Wilson, 1977), but in matters of recollection—an inherently private experience—we must rely on the subject's reports. Therefore, this chapter does so, although others would prefer to make different assumptions and apply different models to structure the data. This issue is considered again later.

Several other variables have an effect similar to levels of processing on Remember and Know judgments, as reviewed by Gardiner and Java (1993). That

is, manipulation of an experimental variable often affects Remember responses, leaving Know responses unaffected. One worry in the face of such a pattern is that Know responses are simply a residual category—just what subjects put down when they think that something might have occurred but cannot really remember it—but do not reflect a special state of consciousness. Although a valid concern, the feeling of familiarity that accompanies the retrieval of many events in the absence of clear and vivid recollection is a common everyday experience. It may also be that Know judgments are simply insensitive to any experimental variation. At least this second charge can be shown to be untrue, because as becomes evident later, experiments have permitted people to dissociate Remember and Know judgments by experimental variables. That is, manipulation of a variable can have opposite effects on Remember and Know judgments, or in some cases have an effect on Know judgments but not on Remember judgments (Rajaram, 1993).

Another potential worry is that Remember/Know judgments simply reflect different degrees of confidence, with Remember responses reflecting high confidence and Know responses reflecting low confidence. If so, Remember/Know judgments would not represent states of consciousness any different from those represented by confidence judgments. Although it is true that Remember judgments are often accompanied by high degrees of confidence (Tulving, 1985), Gardiner and Java (1990), Parkin and Walter (1992), and Rajaram (1993) have shown that these responses are not one and the same. In these studies, independent variables produced different patterns of interactions with Remember/Know judgments compared to those produced with confidence judgments ("sure"/"unsure").

Gardiner's results (already presented), and many other results too, fit comfortably with two other bodies of evidence. This fact has caused researchers to conceive of Know judgments in quite a different way from Tulving's (1985) initial conceptualizations of these as reflecting impersonal knowledge from semantic memory. First, several other researchers have proposed that there are two bases of recognition memory. Mandler (1979, 1980) termed these components integration and elaboration, where integration refers to processing elements of an individual item and elaboration refers to relating an item to others. Jacoby (1983a, 1983b; Jacoby & Dallas, 1981) similarly distinguished between perceptual and conceptual bases of recognition. In some cases, we recognize an event from our past because of perceptual fluency—it "jumps off the page at us"—whereas in other cases we recognize that a test event has a similar meaning to a prior study event. The ideas of Mandler and Jacoby might map on to Remember and Know judgments in a natural way. Remember judgments may reflect elaborative or conceptual processing in those theorists' terms, whereas Know judgments might reflect perceptual fluency or intraitem integration. Putting the same ideas into Jacoby et al.'s (chapter 2, this volume) terms, Remember judgments may reflect conscious recollection,

whereas Know judgments might reflect the automatic influence of past events that bias current experience. However, note that for Jacoby's and Mandler's conceptualizations, Know items provide a warm feeling of familiarity, whereas this attribute seemed absent from Tulving's original conceptualization of Know responses as involving retrieval from semantic memory.

The second realm of research that may be related to Remember/Know judgments is perceptual priming in implicit memory tests (Jacoby, 1983b; Roediger, 1990). These authors have distinguished between perceptual and conceptual bases of priming. In many experiments, such as Gardiner's, a variable affecting subjects' strategies has large effects on Remember judgments but leaves Know judgments unaffected. This same pattern occurs in many perceptual implicit memory tests, with variables such as levels of processing having little or no effect on tests such as perceptual identification (Jacoby & Dallas, 1981), word stem completion (Graf, Mandler, & Haden, 1982), and word fragment completion (Roediger, Weldon, Stadler, & Riegler, 1992). One plausible idea is that the same sorts of factors that affect perceptual priming also drive Know judgments in the Remember/Know paradigm, because Know judgments are also little affected by levels of processing. On the other hand, Remember judgments appear to increase with manipulation of variables, such as levels of processing, that also improve performance on the conceptual explicit memory tasks such as free recall (see Roediger, Weldon, & Challis, 1989). This similarity is explored later, too. However, to presage the conclusion, neither of the simple stories worked out previously turn out to accommodate all the data.

REMEMBER/KNOW JUDGMENTS: EFFECTS OF PERCEPTUAL AND CONCEPTUAL MANIPULATIONS

A selective review of the evidence is presented in this section to demonstrate the similarities and differences in the pattern of results between Remember/Know judgments and explicit/implicit memory tasks. (Note that in this chapter, all discussions of explicit memory tasks pertain specifically to explicit tasks that are conceptual in nature. Similarly, all discussions of implicit memory tasks are only with reference to perceptual priming tasks.) As becomes evident, the initial set of Remember/Know data described here maps onto the conceptual and perceptual processing distinctions in recognition memory very nicely. In addition, our selection of studies also illustrates the three different types of dissociations that validate the Remember/Know distinction, namely, dissociations in which a given variable affects only Remember judgments, affects both Remember and Know judgments in opposite ways, or affects only Know judgments.

The previous section described the results that Gardiner (1988, Exp. 1) ob-

tained by having subjects produce rhyme associates or semantic associates for the study items. Rajaram (1993, Exp. 1) also used this variable in order to replicate Gardiner's findings. These data are presented in Fig. 11.1. Rajaram (1993) replicated the basic levels of processing finding for the overall recognition data and for the Remember judgments. In addition, she found that subjects gave more Know responses to items for which rhyme associates rather than semantic associates were produced at study. Although this reversed levels of processing effect for Know judgments supports the hypothesis that perceptual factors mediate Know judgments, this pattern has not typically been reported with perceptual implicit memory tasks (but see Luo, 1993). As mentioned earlier, the levels of processing manipulation is known to have little effect on implicit memory tasks under most conditions (Roediger & McDermott, 1993). Of course, Gardiner (1988) did not find the reversed levels of processing effect, so further research is warranted.

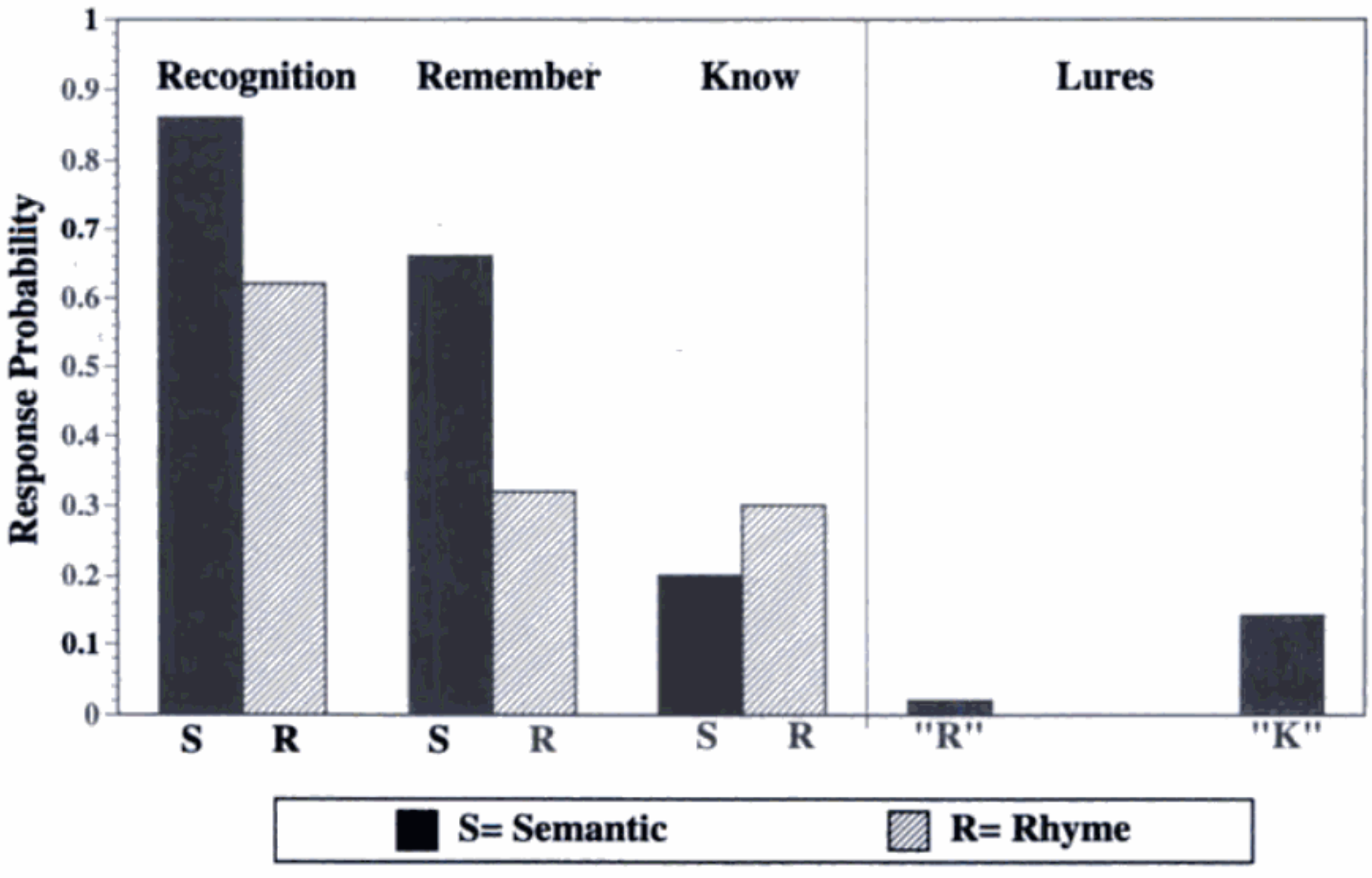

FIG. 11.1. The mean proportion of hits and false alarms shown as a function of the levels of processing manipulation in Rajaram (1993, Exp. 1). Similar to Gardiner's finding, a levels of processing effect—that is, superior performance for semantically processed items compared to phonetically processed items—was obtained in the overall recognition and in Remember judgments. This effect was magnified for the Remember judgments and reversed for the Know judgments. These data support the notion that Remember judgments are enhanced by conceptual processing during study whereas Know judgments increase as a function of perceptual processing. From Rajaram (1993). Copyright 1993 by Psychonomic Society. Adapted with permission.

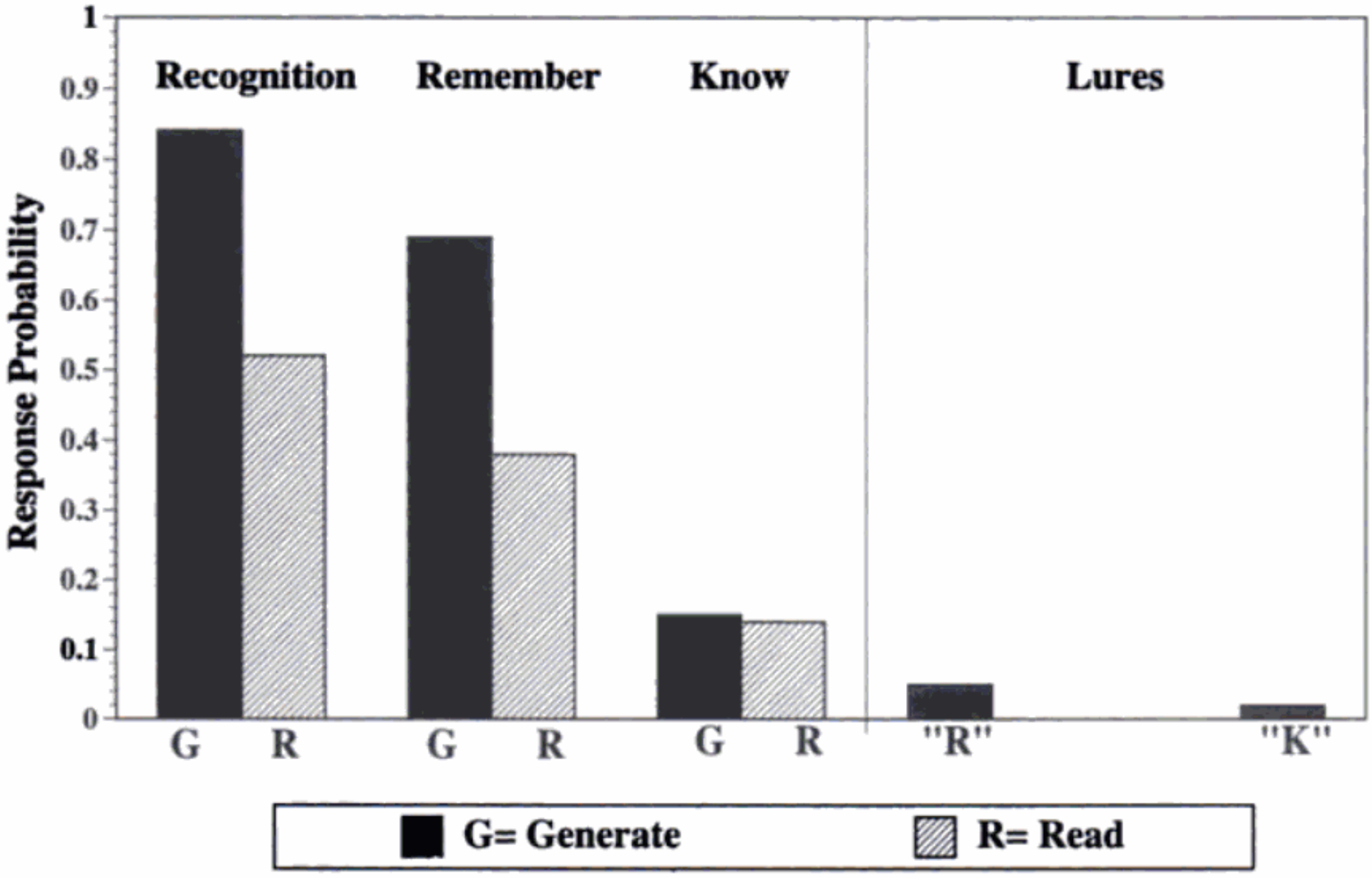

FIG. 11.2. The mean proportion of hits and false alarms shown as a function of the generate–read manipulation at a 1-hour retention interval in Gardiner (1988, Exp. 2). The generation effect, that is, better memory for items generated than read at study, was obtained for recognition and Remember judgments. This variable had no effect on the Know judgments. These data bear a resemblance to the effects of the generate–read manipulation on conceptual explicit memory and perceptual implicit memory tasks respectively, with one difference. In the perceptual implicit memory tasks, the generation effect is typically reversed, unlike the null effects obtained here for the Know judgments. From Gardiner (1988). Copyright 1988 by Psychonomic Society. Adapted with permission.

The generate–read manipulation also produces a similar dissociation between Remember and Know judgments as the one found between explicit and implicit tasks, with one difference. When subjects *generate* the target words at study in response to semantic cues (e.g., generating antonyms given the semantic cue, hot–???) as opposed to simply reading them with context (hot–cold) or without any context (e.g., xxx–cold), performance in explicit memory tasks such as recognition is better for generated items compared to items that were read (Jacoby, 1978; Slamecka & Graf, 1978). This pattern reverses in implicit memory tasks when the items in the *read* condition are presented without the context (i.e., xxx–cold): reading generally produces more priming on perceptual implicit memory tasks than does generating (see Roediger & McDermott, 1993, for a review, and Masson & MacLeod, 1992, for an exception). As shown in Fig. 11.2, when Gardiner (1988, Exp. 2) had subjects

generate or read (with context, i.e., hot–cold) target items and later make Remember and Know judgments to recognized items, subjects gave more Remember responses to generated than to read items. This manipulation had no effect on Know judgments. Furthermore, Java (1994) found that even when study items in the Read condition were presented without context (i.e., xxx–cold, a condition in which the generation effect reverses in the perceptual priming tasks), the generate/read manipulation had no effect on Know judgments. Thus, once again we find that the manipulated variable affects Know judgments and perceptual priming tasks differently. However, with the levels of processing variable, the effect of the independent variable is observed on Know judgments (at least in Rajaram's experiment) but not obtained on perceptual priming tasks, whereas the generate–read manipulation is known to affect perceptual priming but had no effect on Know judgments.

Another variable of interest in this regard is processing of items under full versus divided attention conditions. This manipulation has been reported to have differential effects on explicit and implicit memory tasks (e.g., Jacoby, Woloshyn, & Kelley, 1989; Parkin & Russo, 1989). Explicit memory tasks are adversely affected for information studied under conditions of divided attention compared to the full attention condition. This variable does not seem to influence performance on perceptual implicit memory tasks. Similar dissociations were reported between Remember and Know judgments by Gardiner and Parkin (1990). When subjects studied words under divided attention conditions in which they had to perform a secondary task of tone monitoring, Remember responses declined compared to the full attention condition in which no such secondary task was performed. Know judgments however, remained unaffected. In this study, the pattern of dissociation between Remember and Know judgments bears a close resemblance to that observed between explicit and implicit memory tasks.

One of the concerns in evaluating the psychological distinction between Remember and Know judgments is that single dissociations in which a variable affects Remember but not Know judgments do not establish Know judgments as an independently manipulable entity. To consider Know judgments as different from other forms of memories, opposite effects of an independent variable on Remember and Know judgments should be demonstrated. In addition to the levels of processing manipulation (Rajaram, 1993, Exp. 1) described earlier, two other independent variables have influenced Remember and Know judgments in opposite ways. In one experiment, Rajaram (1993) had subjects study words and pictures and later participate in a recognition memory task in which all the studied and nonstudied items were presented in verbal form. Thus, the perceptual format between study and test varied for half the items (i.e., pictures at study and words at test), whereas it was held constant for the other half (words at study and at test). Sample materials and the design are displayed in Fig. 11.3.

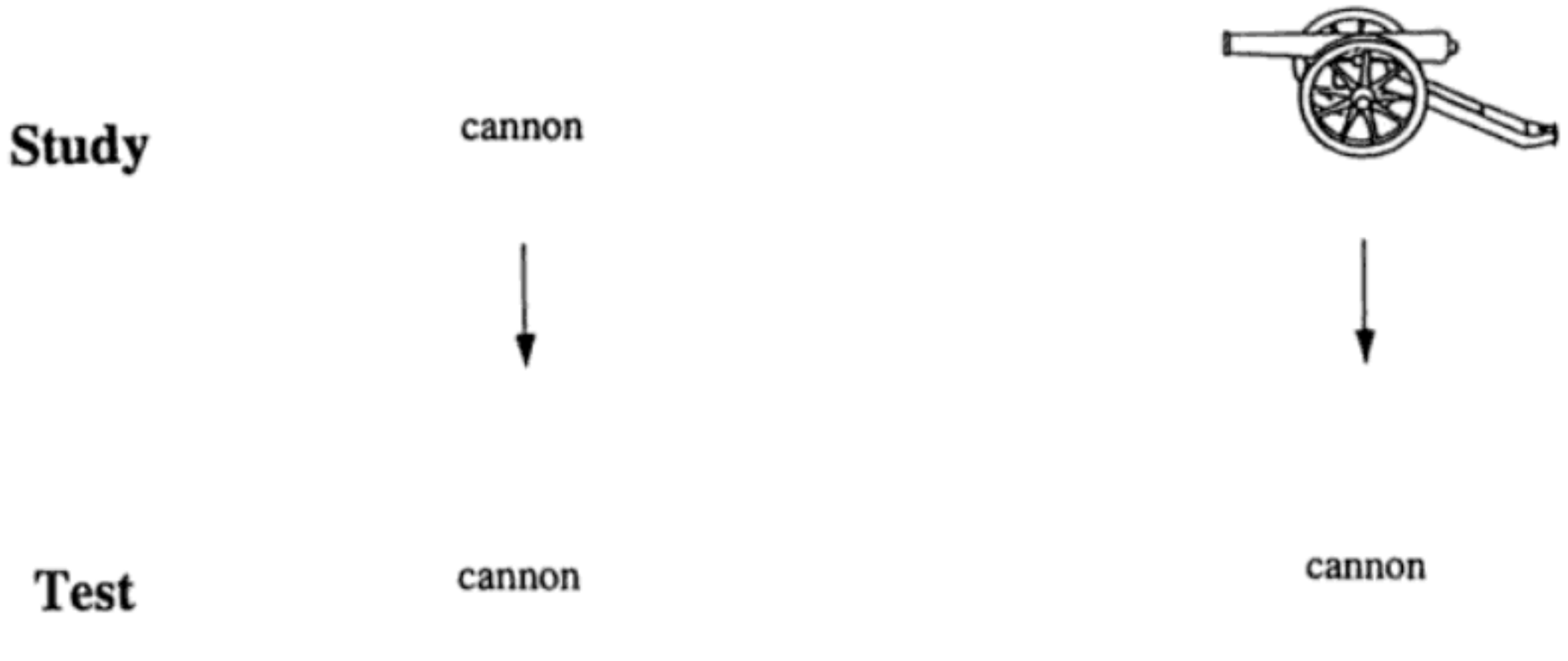

FIG. 11.3. The design and a sample of stimuli used in Rajaram (1993, Exp. 2).

Based on the well-documented findings of the picture superiority effect—better memory for pictures than for words—in most explicit memory tasks (e.g., Madigan, 1983), Rajaram (1993) predicted that a higher proportion of Remember judgments would be given for studied pictures than for studied words. The predictions for Know judgments were derived from Weldon and Roediger's (1987) report that the picture superiority effect reverses in perceptual implicit memory tasks such as word fragment completion. Thus, priming on the word fragment completion task is greater following the study of words (i.e., the names of pictures) rather than following the study of the pictorial counterpart of these items. This is because perceptual implicit memory tasks such as word fragment completion benefit from the perceptual match between the study and test materials, according to the principle of transfer appropriate processing (Roediger et al., 1989). Based on these findings, Rajaram (1993) reasoned that Know judgments should be higher for items in the same format condition compared to items in the different format condition (see Fig. 11.3).

The predictions for Remember and Know judgments were borne out very nicely, as shown in Fig. 11.4. Rajaram (1993) found that a picture superiority effect was obtained for the overall recognition in that the hit rate for pictures was .90 and that for words was .69. When the data were decomposed into Remember and Know, the picture superiority effect was enhanced for Remember judgments (.81 for pictures and .51 for words). Conversely, significantly more Know judgments were given for studied words (.18) than for studied pictures (.09). Once again we find that the patterns of dissociations are very similar between Remember/Know judgments on one hand, and (conceptual) explicit/(perceptual) implicit memory tasks on the other.

Another variable that produces opposite effects on Remember and Know

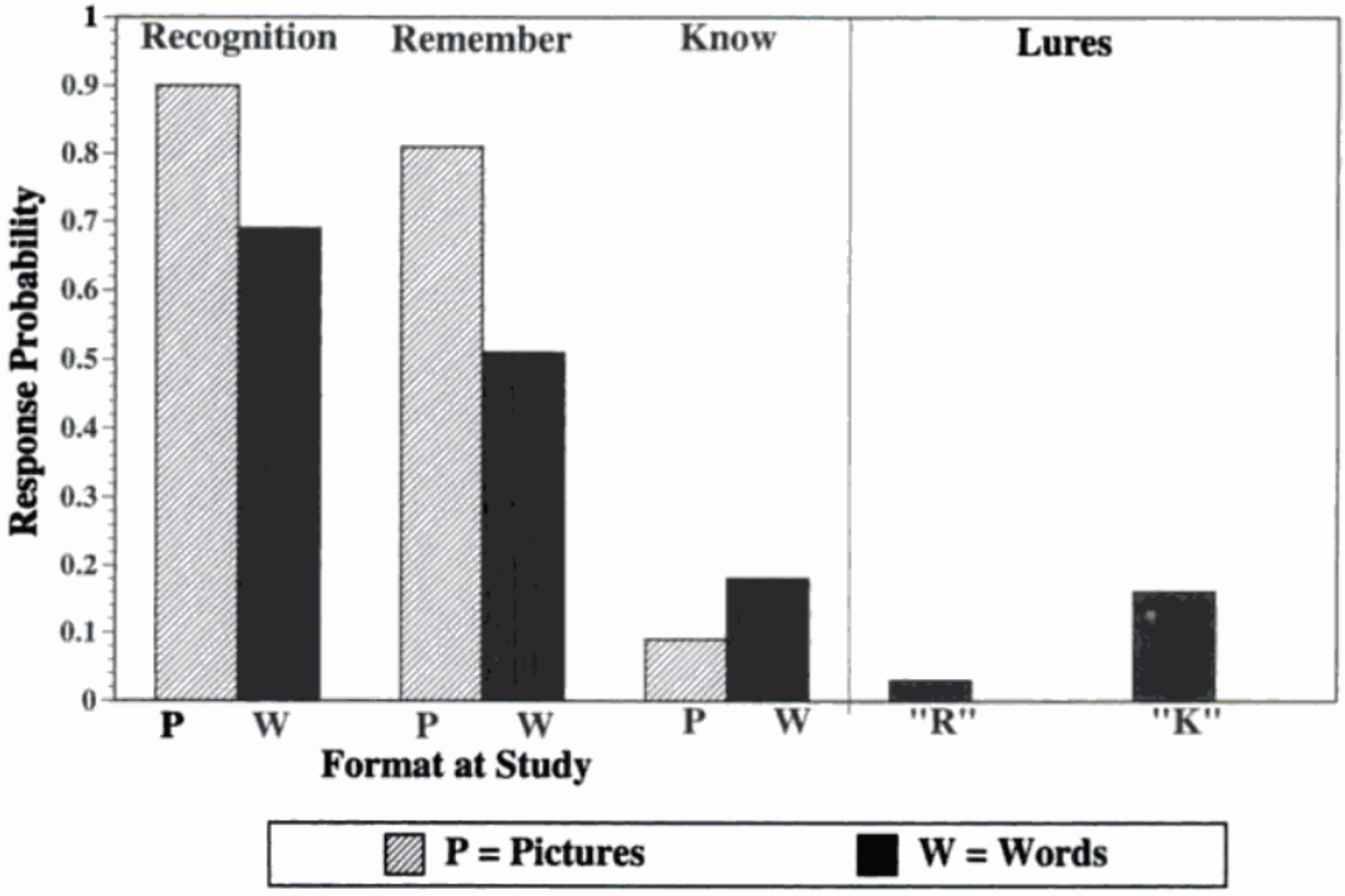

FIG. 11.4. The mean proportion of hits and false alarms obtained by Rajaram (1993, Exp. 2) for studied words and pictures in a word recognition memory task. Subjects studied words and pictures and then took a recognition test requiring recognition of studied and nonstudied items presented in word form. Items studied as pictures were recognized better than those studied as words. This picture superiority effect was magnified when only Remember responses are considered, indicating greater conscious recollection for pictures than for words. However, Know responses were greater for words than for pictures, presumably because Know judgments are driven by the same factors as produce priming on perceptual implicit memory tasks (i.e., the match in perceptual processes between study and test.) From Rajaram (1993). Copyright 1993 by Psychonomic Society. Adapted with permission.

judgments is study and testing of words and nonwords. Gardiner and Java (1990, Exp. 2) found that after studying words and nonwords, subjects gave more Know responses to studied nonwords than to studied words, whereas more Remember judgments were given to studied words than nonwords. Gardiner and Java reasoned that subjects likely engage more in the perceptual analyses of the stimuli that are nonwords (because no conceptual information is available for these items), thereby giving more Know responses to these stimuli. On the other hand, word stimuli are more amenable to conceptual processing, thereby receiving more Remember responses. Like most of the data described so far, this explanation fits well with the conceptual and perceptual bases of recognition proposed by Jacoby and Mandler.

In the studies described so far, variables that influenced Know judgments

TABLE 11.1
The Design and Results for Proportion of Hits and False Alarms for the Masked Repetition Manipulation

Study items (target)—table, plate

	Targets		*Lures*	
	Masked Repetition	*Unrelated Prime*	*Masked Repetition*	*Unrelated Prime*
Mask	XXXXX	XXXXX	XXXXX	XXXXX
Prime	table	scale	glass	chalk
Target	TABLE	PLATE	GLASS	SHIRT
Response Required	"Yes"	"Yes"	"No"	"No"
Recognition Response	"Yes"	"Yes"	"Yes" (FA)	"Yes" (FA)
	.67	.60	.23	.18
Remember Response	.43	.42	.05	.05
Know Response	.24	.18	.18	.13

Note: From Rajaram (1993). Copyright 1993 by Psychonomic Society. Reprinted with permission.

also had an effect on Remember judgments. Rajaram (1993, Exp. 3) reasoned that if Know judgments are dissociable from Remember judgments, they should be *selectively* influenced by independent variables that increase the perceptual fluency with which items are processed. This prediction was based on the findings from previous experiments suggesting that Know judgments are sensitive to variables that enhance perceptual processing of the to-be-recognized stimuli.

Jacoby and Whitehouse (1989) argued that masked repetition of tested items increases the perceptual fluency with which these items are processed. This increased perceptual fluency gives rise to a feeling of familiarity, which in turn improves recognition performance for the studied items and increases false alarms for nonstudied items in a recognition memory task. To test the hypothesis that perceptual factors increase Know responses, Rajaram (1993) presented some of the studied and nonstudied words in the recognition test twice, such that the first presentation of the stimulus was not available for conscious report[1] because it was preceded by a forward mask and followed by its second presentation in uppercase (see Table 11.1 for an example). For the other half of the studied and nonstudied words, the preceding masked words

[1]It should be noted that we are not claiming that these items were presented subliminally. We consider that the masked items were not available for conscious report only in as much as subjects claimed not to see these words and were unable to report them.

were different from the targets. This design is illustrated with an example in the top half of Table 11.1. Based on Jacoby and Whitehouse's (1989) findings, the prediction was that the masked repetition manipulation should only increase Know judgments while leaving the proportion of Remember judgments unaffected, if indeed Know judgments are selectively affected by changes in the perceptual processing of items. The results obtained by Rajaram supported this perceptual fluency hypothesis for Know judgments, as seen in the data presented in the bottom half of Table 11.1.

The results reported here present a generally consistent story with reference to the two comparisons mentioned earlier. The first comparison is drawn between the conceptual explicit and perceptual implicit memory dissociations on one hand, and the Remember and Know dissociations on the other. As has been noted, although there are some differences observed in the results with Remember/Know judgments, it seems that, by and large, Remember judgments capture the processes affecting conceptual explicit memory tests whereas Know judgments are influenced by processes that also determine performance on perceptual implicit memory tasks.

The second comparison was drawn between Remember/Know judgments and conceptual/perceptual bases of recognition memory, respectively. When subjects encode the conceptual, elaborative, and meaningful aspects of the to-be-recognized materials, they are more likely to actually "remember" the event later. Thus, variables such as semantic encoding of the stimuli in the levels of processing manipulation, generating words in the generate–read manipulation, studying pictures versus words, and studying words versus nonwords all benefit recollective processes that preserve the conscious and vivid aspects of memories. Conversely, if the to-be-recognized materials are processed more for their perceptual (surface) characteristics, subjects "know" that the event was encountered before but cannot "remember" the actual occurrence of the event. Thus, phonemic processing of stimuli in the levels of processing manipulation, reading the stimuli in the generate–read manipulation, the perceptual overlap between studied and tested stimuli in the picture–word manipulation, and the presumed enhanced perceptual processing of nonwords relative to words all increase the likelihood of "knowing" that the stimulus was encountered before. In addition, increasing the perceptual fluency of processing by masked repetition of an item selectively increases Know judgments. Some other studies have examined the effects of manipulating certain subject variables and have obtained results consistent with the findings described so far.

Individual Differences in Remember/Know judgments

Remember and Know judgments have been reported to dissociate as a function of normal aging and neurological impairments as well. For instance,

Parkin and Walter (1992) predicted that older adults should produce fewer Remember responses than do young adults because older adults likely benefit less from contextual information (typically associated with episodic memory) compared to younger adults (Craik, L. W. Morris, R. G. Morris, & Loewen, 1990). Further, older adults may rely more on the perceptual fluency of the studied stimuli to recognize them (if conceptual factors are impoverished), which should yield a higher proportion of Know judgments from these subjects compared to younger adults. This was exactly the pattern of results obtained by Parkin and Walter (1992). Once again, this pattern resembles the dissociation obtained between perceptual implicit memory tasks and conceptual explicit memory tasks (e.g., Light & Singh, 1987) as a function of age, because performance on explicit memory tests is found to be impaired in older adults whereas their perceptual priming is comparable to that of young adults.

In another study, Blaxton (in press) tested normal subjects and temporal lobe epileptics (TLEs) for their recognition memory for novel line drawings. TLEs exhibit memory impairments as a function of their neurological condition. In one experiment, normals and TLEs with left temporal lobe damage gave mostly Know judgments to the recognized line drawings, suggesting that these novel figures were presumably processed for perceptual features in the right hemisphere. That is, because the left temporal lobe was damaged, TLEs presumably relied on the right hemisphere processes to support recognition and the right hemisphere is assumed to be largely responsible for perceptual processes involved in object recognition. On the other hand, TLEs with damage to the right temporal lobe gave mostly Remember judgments to correctly recognized stimuli. Based on these results and the fact that left TLEs show deficits in learning meaningful verbal materials, Blaxton (in press) reasoned that the left TLEs presumably show deficits in conceptual processing of information, whereas the right TLEs show perceptual processing deficits. To test this idea, Blaxton had normals, left TLEs, and right TLEs perform semantic or surface encoding of the same novel figures in another experiment. Normal subjects gave more Remember judgments following semantic encoding of the nonverbal materials and more Know judgments following an analysis of the surface features. The left TLEs showed a deficit in conceptual transfer, as indicated by a high proportion of Know judgments even after the semantic encoding of the nonverbal stimuli. On the other hand, the right TLEs produced a high proportion of Remember responses even when the study instructions specified a perceptual analysis of the materials, exhibiting a deficit in perceptual transfer.

Blaxton's (in press) work supports the conceptual/perceptual distinction drawn between Remember and Know judgments, and Parkin and Walter's (1992) study with young and aging adults provides yet another instance of the similarity between explicit and implicit memory tasks and Remember and Know judgments. Thus, based on the evidence presented in this and the pre-

vious sections, it appears that Remember and Know judgments capture the two bases of recognition memory proposed by Jacoby and Dallas (1981) and Mandler (1980). As clear-cut and consistent as these findings may seem, new evidence collected by the first author complicates these conclusions and is discussed next.

EVIDENCE INCONSISTENT WITH PERCEPTUAL BASES OF KNOW JUDGMENTS

There are two different patterns of results where the dissociations between Remember and Know judgments do not seem to map onto conceptual and perceptual factors, respectively. The first set of results documents the failure to obtain an increase in Know judgments in conditions that presumably facilitate perceptual processing. The second set of results demonstrates the effects of perceptual manipulations on Remember judgments. Each of these patterns is discussed in turn.

The first set of results was obtained by manipulating the modality in which the study and test items were presented to the subjects. There are two reports on the effects of preserved or changed modality between study and test on Remember/Know judgments. In one study, Rajaram (1993) had subjects either read words or listen to words before participating in a visual word recognition task. The expected benefit for Know judgments in the perceptual match condition (visual presentation at study and at test) relative to the perceptual mismatch condition (auditory presentation at study and visual presentation at test) was not obtained. The results are shown in Fig. 11.5. One possible reason why Rajaram (1993) failed to obtain an effect of modality match for Know judgments might be that there was no effect of preserved modality on the overall recognition memory performance.

However, the lack of a modality effect in recognition is also problematic for two-component theories of recognition. Modality has substantial effects on perceptual priming tests, with words presented visually producing greater priming than words presented auditorily on visual priming tests (fragment completion, stem completion, etc.; see Roediger & McDermott, 1993, for a review). If recognition memory is partly driven by the same factors that determine perceptual priming, then one would expect an effect of modality on recognition memory. Although some have reported a small effect (Kirsner & Smith, 1974), most researchers have not obtained this effect. For example, in a particularly powerful experiment, Challis et al. (1993) failed to find any modality effect in recognition.

Gregg and Gardiner (1991) also failed to find perceptual effects of modality match on Know judgments. In their study, subjects read words either silently or aloud at study and at test. When the modaiity of presentation was

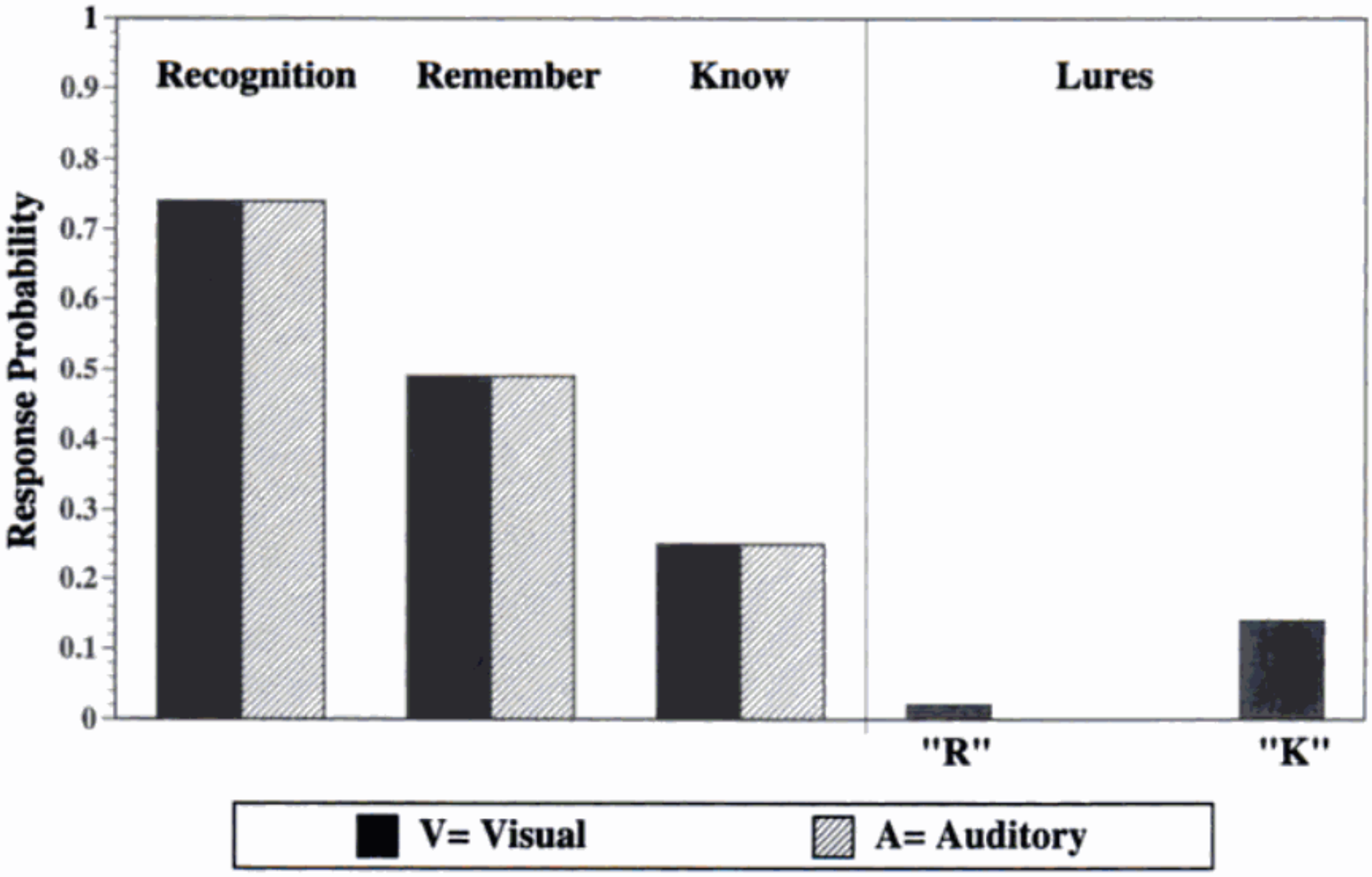

FIG. 11.5. The mean proportion of hits and false alarms obtained by Rajaram (1993, Exp. 1) for items studied in the visual or auditory modality and tested on a recognition task in the visual modality. There was no effect of modality of presentation on any of the response type (Recognition, Remember, or Know). Although a modality match is expected to enhance Recognition and Know judgments, there are no consistent reports of this modality effect reported in the literature for the recognition memory task. From Rajaram (1993). Copyright 1993 by Psychonomic Society. Adapted with permission.

held constant (e.g., reading an item silently at both study and test, or aloud at both study and test), the perceptual match was maximized as opposed to when the modality of presentation was changed (i.e., read silently at study and aloud at test, or vice versa). Based on the idea that perceptual factors drive Know judgments, one would predict that greater proportions of Know judgments would be obtained in the perceptual match rather than the perceptual mismatch conditions. Conversely, more Remember judgments should be obtained in the modality mismatch conditions, because subjects have to rely on information that is relatively conceptual to recognize an item presented in a different modality. In a recent study Gregg and Gardiner (1994) found the effect of modality match on Know judgments using a powerful manipulation. However, in an earlier study (1991), they found that Know judgments did not increase in the modality match conditions, and similar to Rajaram's findings (1993), they also failed to find an effect of modality match on overall recognition. These puzzling findings may be due to the problem that, in general, the modality manipulation has not yielded consistent patterns in conceptual ex-

plicit tasks in the literature. In any case, it is not clear to us why the modality match did not increase Know judgments in Gregg and Gardiner's (1991) and Rajaram's (1993) work. Further work (or a better theory) is needed to resolve this issue.

The second set of findings that is difficult to reconcile with the hypothesis that Remember judgments reflect conceptual processes and Know judgments reflect perceptual processes are those showing effects of perceptual variables on Remember judgments instead of on Know judgments. The first such finding was reported by Gardiner and Java (1990, Exp. 1), who assessed subjects' recognition memory for high and low frequency words. A typical finding in recognition memory tasks is that subjects recognize significantly more low frequency words compared to high frequency words. This superior recognition memory for low frequency words has been explained by assuming that low frequency words are processed with increased perceptual fluency (Jacoby & Dallas, 1981) or familiarity (Mandler, 1980) relative to high frequency words, when they are processed on the test (i.e., a second time.) A straightforward prediction from this reasoning is that better recognition memory for low frequency words should be captured in Know judgments. However, Gardiner and Java (1990) obtained the opposite pattern of results. Subjects gave significantly more Remember judgments to low frequency words than to high frequency words, whereas Know judgments for these two types of words did not differ.

Rajaram (1996; Rajaram & Coslett, 1992, 1993) reported a similar finding with both verbal and pictorial stimuli. In one experiment, subjects studied pictures and words, and were given a recognition task in which all the studied and nonstudied items were presented in the pictorial form. Note that this experiment is the complement to the one reported by Rajaram (1993, Exp. 2), where the study phase was exactly the same as described here but at test, all items were presented in the word form (see Fig. 11.3). In Rajaram's (1993) experiment, the maximal perceptual match was present for items studied and tested in word form and, accordingly, Know judgments in this same format condition were higher than in the different format condition (that is, pictures at study and words at test). Based on these prior results, a higher proportion of Know judgments would be expected for items studied and tested in the pictorial format in Rajaram's (1996) experiment, because the perceptual overlap is greater in this condition than in the different format condition (that is, words at study and pictures at test). However, the results did not bear out this prediction, as shown in Fig. 11.6. Not surprisingly, studied pictures were recognized better than were studied words, and this difference was magnified for the Remember responses. However, rather than showing the same pattern for Know responses, as predicted, the pattern actually reversed. That is, items studied as words received more Know judgments following their judgment of "old" on picture recognition than did items studied as pictures. This outcome

is inconsistent with the idea that Know judgments are driven mostly by perceptual fluency.

Rajaram (1996) manipulated the size and the reflection of the studied and tested pictorial stimuli to determine the effects of such changes in surface features on Remember and Know judgments. In one experiment, subjects studied pictures presented in small or large sizes. At test, these pictures were either presented in the same size as at study (perceptual match condition) or in a different size from study (perceptual mismatch condition). In addition, half of the nonstudied pictures were small and the other half were large in size. The results showed a slight but statistically significant effect of size on overall recognition, with same size pictures at study and test being recognized better than pictures that differed in size on the two occasions. Given that size had an

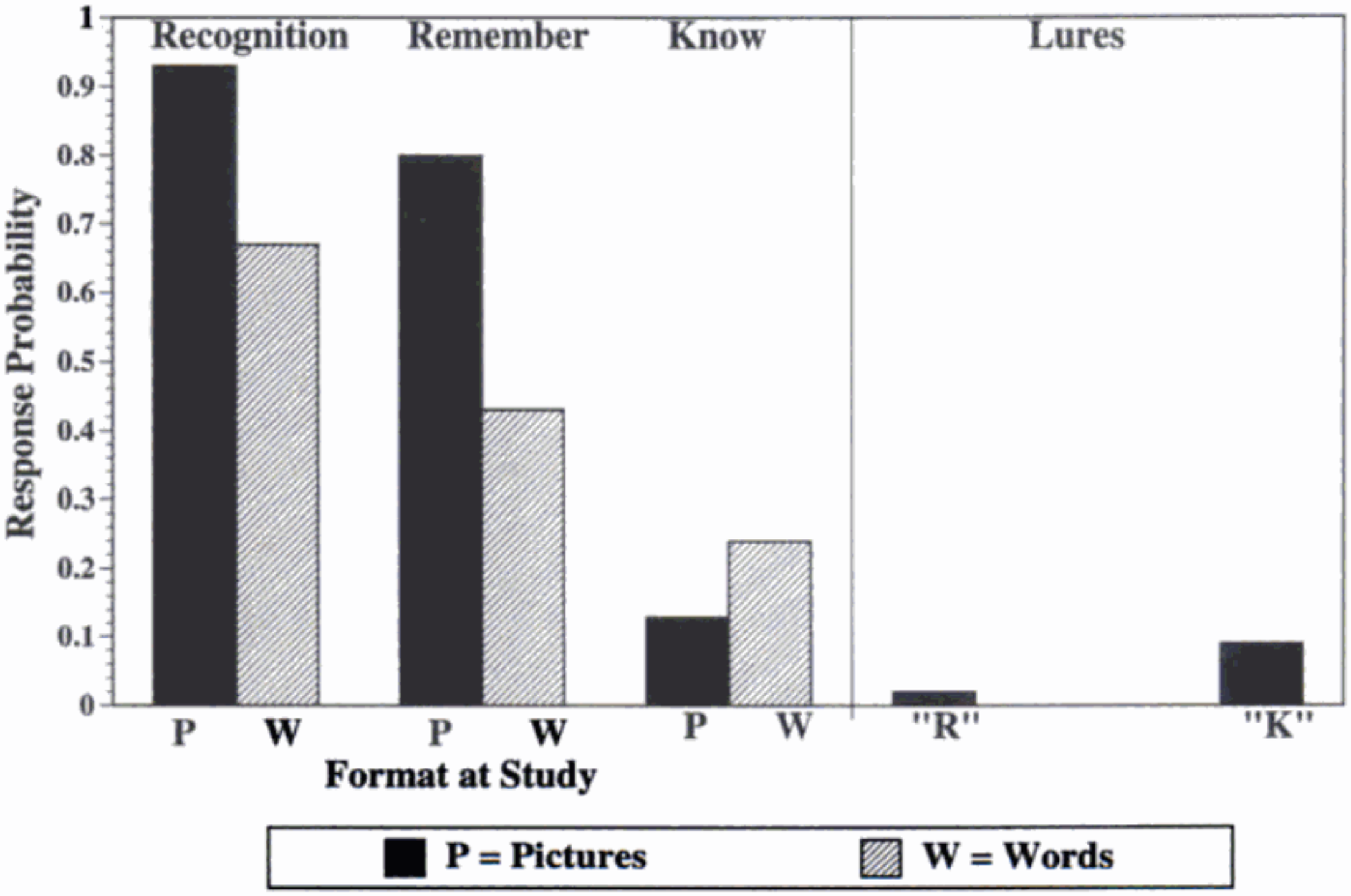

FIG. 11.6. The mean proportion of hits and false alarms obtained by Rajaram (1996) when subjects studied words and pictures and were tested on a picture recognition memory task. Overall recognition was better for items studied and tested in the pictorial form compared to the items studied as words and tested in the pictorial form. This effect was magnified for Remember judgments, whereas a greater proportion of Know judgments were given to items studied as words and tested in the pictorial form compared to the same format condition. These data are problematic for the notion that greater perceptual match increases Know judgments. From Rajaram (1996). Copyright 1996 by American Psychological Association. Adapted with permission.

effect in overall recognition, one might expect that such a perceptual factor would influence Know judgments but not Remember judgments. However, exactly the opposite happened. The effect of size was entirely on the Remember judgments and indeed there was actually a reversal (that approached significance) in Know judgments, such that different sized pictures at study and test produced a greater proportion of Know responses than did same size pictures at study and test.

Rajaram (1996) manipulated another perceptual attribute to determine its effect on Remember and Know judgments: the reflection of pictorial stimuli across study and test. Half the objects presented at study faced right whereas the other half faced left. At test, the reflection for half of studied items was preserved with respect to the study phase and was changed for the other half (such that objects facing right at study now faced left, and vice versa.) Furthermore, half the lures faced left and the other half right. It is reasonable to assume that the perceptual match in the same reflection condition would be greater than the changed reflection condition. Therefore, overall recognition should be greater in the same reflection condition compared to the changed reflection condition and the difference should appear in Know judgments (due to enhanced perceptual fluency). On the other hand, same or changed reflection should not affect Remember judgments. However, the results did not bear out any of these predictions. The effect of preserved or changed reflection was not obtained either for the overall recognition judgments or for the Know judgments. Surprisingly, a significantly greater proportion of Remember judgments were obtained in the same reflection condition relative to the changed reflection condition. Therefore, Rajaram's (1996) results were directly opposite to those predicted by the idea that perceptual fluency drives Know responses.

These effects of size and reflection changes on Remember/Know judgments are clearly problematic for the idea that the conceptual/perceptual processing distinction underlies Remember and Know judgments. It is worth noting that the problematic results obtained in the experiments with size and reflection were conducted under the same conditions, with the same instructions, and with the same general type of subjects that led to the positive results found in the earlier experiments. However, in the context of other experiments, these findings do not seem too surprising, because they are in accord with the evidence reported by Biederman and E. Cooper (1992) and L. Cooper, Schacter, Ballesteros, and Moore (1992) for explicit and implicit memory tasks. Biederman and E. Cooper (1992) manipulated the size of line drawings of common objects in an object naming task (presumably a perceptual implicit task) and a recognition task (presumably a conceptual explicit task). L. Cooper et al. (1992) manipulated size and reflection of novel line drawings (in separate experiments) in an object decision task (presumably a perceptual implicit task) and a recognition task (presumably a more conceptual explicit

task). The performance in the object naming task (Biederman & E. Cooper, 1992) and the object decision task (L. Cooper et al., 1992) was unaffected by changes in the size and reflection of stimuli even though these tasks are presumed to rely on perceptual operations. On the other hand, recognition performance was adversely affected by size and reflection changes across study and test phases in both these studies. That is, recognition was better for objects that were tested in the same size or reflection given at study rather than in a different size or reflection.

In the light of these findings, Rajaram's (1996) results with Remember and Know judgments may not be surprising. Specifically, if Know judgments are presumed to be sensitive to variables that affect perceptual implicit tasks and if size and reflection (for whatever reasons) do not affect priming, then it is no surprise that these variables do not affect Know judgments. In fact, increased Know judgments were produced with size or reflection changes although they were rather small. More importantly, the effects of size and reflection transformations in Rajaram's experiments on Remember judgments were similar to the effects obtained in recognition memory in Biederman and E. Cooper's (1992) and L. Cooper et al.'s (1992) studies. Regardless of this consistency in the pattern of results, the size and reflection effects and the other perceptual effects on Remember judgments reported in this section cannot be accommodated within the currently favored explanation that only conceptual factors affect conscious and vivid aspects of the recollective processes.

How can these findings be explained and what implications do they have for the nature of recollective processes? One obvious conclusion to draw from all these findings is that the conceptual/perceptual processing distinction, although useful up to a point, does not encompass the gamut of variables that influence the two different ways of accessing memories for prior events. Indeed, these data seem highly problematic for dual process theories of recognition.

One way to understand the overall picture painted by these apparently conflicting patterns of data would be to revisit the instructions that subjects are given in the Remember/Know paradigm. The instructions given for making Remember judgments specify not only the associations from the study phase that come to mind (i.e., the conceptual attributes), but also memory for the "aspects of the physical appearance of the words [pictures], . . . or something about its appearance." Further, subjects were told that, "the 'remembered' word [picture] 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." Thus, conscious recollective processes can be influenced by certain perceptual attributes as well (Hunt & Toth, 1990). Then, why were perceptual effects obtained selectively for Know judgments in the early studies?

Perhaps a distinction is necessary between factors that induce fluency of

processing and factors that provide salient or distinctive information about the studied stimulus (Rajaram, 1996). The basic idea is that either fluent processing or encoding of highly distinctive information influences recognition memory. Indeed, many others have proposed that distinctiveness of events greatly affects their recognition (see Hunt & McDaniel, 1993). A further assumption is that whereas fluency affects Know responses, distinctiveness of information against a background of relatively uniform information, as in the von Restorff effect (von Restorff, 1933; also see Wallace, 1965) and related phenomena, aids Remember judgments. Based on these ideas, several specific predictions can be made. For instance, if the independent variable increases the perceptual fluency with which an item is processed, its effects should be observed on Know judgments. ("Fluency" could be gauged by how the variable affects implicit memory tests.) However, if the independent variable increases the salience of the stimulus or consists of stimuli with distinctive attributes, this manipulation would affect the Remember judgments. L. Cooper et al. (1992) also suggested that distinctive information influences episodic memory judgments. This hypothesis about how fluency and distinctiveness affect Remember/Know judgments can be applied not only to perceptual attributes, but to conceptual, temporal, contextual, and spatial attributes as well. For example, inducing *conceptual* fluency of processing should influence Know judgments, and not Remember judgments. These predictions will be tested in future experiments.

The problematic data obtained with the Remember/Know paradigm can be accommodated within the distinctiveness/fluency of processing framework with some reasonable assumptions. For example, low frequency words are likely more distinctive than high frequency words (Gardiner & Java, 1990), leading to better recognition and greater Remember judgments for low frequency words compared to high frequency words. Similarly, studied pictures may be considered more distinctive than studied words, regardless of the test format (Rajaram, 1993, 1996). These assumptions would help explain the results obtained by Rajaram (1993, 1996) for studied pictures and words that were tested in either verbal or pictorial format. Furthermore, if we consider size and reflection of stimuli as attributes that are relevant and distinctive for episodic memory judgments, then Rajaram's (1994) data can also be accommodated within this framework. In fact, L. Cooper et al. (1992) speculated that size and reflection likely constitute distinctive properties of events used by the episodic memory system. Clearly, this section has provided a post hoc analysis of the inconsistent data. However, the explanation outlined here, although a bit tentative, can accommodate both the early and recent evidence (with the exception of modality effects, for which we have no explanation) on the issue, and also provide a framework for conducting future research to test the proposed ideas. In addition, the idea that fluency of processing increases recognition is supported by considerable additional evidence (e.g., Luo, 1993),

although not uniformly so (Watkins & Gibson, 1988). Of course, the same is true for the concept of distinctiveness, because considerable research also shows the usefulness of this construct in explaining a variety of memory phenomena (see Hunt & McDaniel, 1993).

EVALUATION OF THE REMEMBER/KNOW PARADIGM AND CONCLUDING REMARKS

The Remember/Know distinction introduced by Tulving (1985) is a metamemorial judgment, one of a large number of judgments that people are able to make about their own memories. This field of metamemory has grown rapidly since around 1970 (see Nelson, 1992, for a collection of important papers on this topic). Subjects have provided feeling-of-knowing judgments (they know if they can recognize information on a multiple choice test that they could not retrieve on a cued recall test); judgments of a tip-of-the-tongue state (missing information is on the tip of one's tongue or not); judgments of reality monitoring (judging whether something actually occurred in the external world or was imagined by the subject); judgments of confidence of responses (sure or unsure); judgments of learning (whether or not studied information will be recalled later). (References for all these examples can be found in Nelson, 1992.) This list can be extended, but the point would remain the same: The Remember/Know judgment is another in a long series of interesting judgments that psychologists have asked people to make about properties of their own memorial experience. In each of these other cases, the simplest form of the response involves a dichotomous rating (sure or unsure, know or don't know, etc.), although various types of rating scales and other procedures can also be used (Nelson, 1984). The relation of Remember/Know judgments to these other types of judgments awaits future research, but we firmly believe that the Remember/Know judgment is an interesting, reliable, and psychologically meaningful judgment for subjects to make, as attested by the growing body of literature showing generally encouraging and reproducible results. As mentioned previously, the Remember/Know judgment requires even more careful instructions to subjects than is usual, but the dividends seem worth the effort.

As stated earlier, the Remember/Know paradigm provides a viable framework to study the states of awareness that accompany different memories. Remember judgments provide an index of conscious experience as this judgment is given by the subjects to memories for which they are aware how it is they know that they had encountered them on a previous occasion. Alternately, for Know judgments, even though the subjects are fully aware that the memory belongs to their personal past, they are unable to determine the basis of this conscious experience. Of course, the nature of Know judgments is

more complicated because this judgment could either be based on the sort of experience just described or some nonconscious processes may also be articulated as Knowing as long as they give rise to a strong feeling of familiarity. In any case, these two judgments provide a valid measure of the conscious experience during retrieval and take researchers one step further in their attempts to study at least one aspect of consciousness, that is, related to the retrieval process, within a scientific framework.

Our analysis of Remember/Know judgments followed the prior work of Tulving, Gardiner, and others by assuming that overall recognition hit rate could be decomposed into two meaningful entities based on judgments by the subjects. The assumption is that the subjects themselves can divide the recognized items into Remember and Know categories. Jacoby et al. (chapter 2, this volume) have criticized the assumption of an exclusive relation between Remember and Know categories and have advocated treating these responses as statistically independent and applying the same equations as in the process dissociation procedure (Jacoby, 1991). The assumption that subjects can make mutually exclusive responses does not necessarily mean, however, that information driving both types of processes could not be present in the same test event. We prefer to leave it to our subjects (rather than to a mathematical model) to decide which is the predominant source of information that guides their response. In addition, the logic for considering Remember and Know as mutually exclusive would seem to be the same as in most of the other metamemory judgments, in which subjects essentially make dichotomous and mutually exclusive responses (know or don't know, tip of the tongue or not, sure or unsure, etc.). Although information on which these judgments are made may be continuous and overlapping, subjects are always asked to gauge the information by whatever means they have and produce appropriate responses.

Jacoby's (1991) process-dissociation procedure also aims to provide a decomposition of performance into components reflecting conscious recollection and those reflecting a more automatic basis. The logic of opposition on which the procedure is based and the resulting equations represent a mixture of a first-person and a third-person account of conscious experience. This means that subjects' abilities to follow the exclusion and inclusion instructions rely on their first-person judgments; they decide what to include or to exclude. However, the use of the technique to determine how responding is based on conscious recollection and on some more automatic basis resembles more a third-person account, because the data are subjected to a model to determine the outcome. This outcome of the procedure tells the experimenter what subjects were able to consciously control and what influences were automatic, rather than letting the subjects make direct claims for themselves on these matters. Certainly there is no necessary conflict between the application of the Remember/Know procedure and the use of the process-dissociation procedure. Both would seem to have their benefits and weaknesses. As we see

it, the benefit of the Remember/Know distinction is to permit a first-person account in the determination of the *nature* of memories for the retrieved items from a study episode. Jacoby et al. (this volume) argue that the Remember/Know responses should be considered independent and therefore subjected to the process-dissociation procedure. Indeed, they find good agreement between some results produced from the process-dissociation procedure and others from the Remember/Know procedure when it is assumed that Remember and Know judgments are independent. Others have suggested that it makes more sense to consider Remember and Know judgments as redundant; for example, all items recognized might be considered known by the subject, but remembered items have some special additional features that permit them to be consciously recollected. If one assumes a redundancy relation between the measures, then the equations used to arrive at estimates of conscious recollection and automatic influences are different and so are the likely outcomes (Joordens & Merikle, 1993). It will doubtless take considerable theoretical and experimental effort to unravel these complicated issues, but in the meantime we prefer to stick with subjects' judgments, as is the custom in the study of other metamemory phenomena. Nonetheless, it may be that some of the problematic data reviewed toward the end of the empirical part of this chapter would change if the process-dissociation procedure or other measurement assumptions were employed. (On the other hand, some of the supportive data for dual process recognition theories might also evaporate).

One aspect that the Remember/Know procedure and the process-dissociation procedure share is to argue that even explicit memory measures such as recall and recognition involve a mixture of processes. Recognition memory seems to have more than one basis, however it is to be conceptualized (e.g., Jacoby, 1991; Mandler, 1980, 1989). One important offshoot of this point is that a standard application of signal detection theory to recognition memory data is inappropriate, because it assumes that subjects make judgments along a single dimension of strength or familiarity. Because recognition memory has at least two (and maybe multiple) bases, not just judgments of strength, it seems pointless to correct overall recognition data using signal detection to gain estimates of d' and β. Signal detection theory might still be quite useful in analyzing judgments of familiarity, as Jacoby et al. (this volume) advocate. However, the standard use of signal detection theory to analyze recognition memory, at least in some instances, may be inappropriate.

One can conceive of the Remember/Know procedure as a method to "purify" recognition scores (or cued recall, or free recall, for that matter) into two components. The Remember component more accurately reflects the output of an episodic memory system, according to Tulving (1985). A problem for future research is the phenomenological status of Know responses. Tulving (1985) argued that these were output of a semantic memory system that could also be changed by recent events. Others (Gardiner, 1988; Jacoby et al.,

chapter 2, this volume; Rajaram, 1993) have shown that Know responses are driven by perceptual fluency, or familiarity, or some other automatic process. The important issue for future research is to address whether Know responses reflect anything more than a residual category: Perhaps subjects respond positively to test items but then cannot recollect their actual occurrence in the study list and so simply say, "Know." This inarticulateness or blankness of conscious experience associated with Know responses would be consistent with the idea that they are driven by some automatic process that is not under conscious control.

Tulving's (1985) Remember/Know paradigm has produced a considerable body of evidence, showing that it is useful and perhaps telling us important facts about subjective experience during recollection. This section has tried to point to some future directions that might be profitable. Research using this paradigm is just beginning and the unanswered questions seem to loom larger (or at least represent a longer list) than the answered questions. So, future research in this area should pay important dividends in the study of conscious experience.

ACKNOWLEDGMENTS

The authors thank Jonathan Cohen, John Gardiner, Kathleen McDermott, Jonathan Schooler, and Endel Tulving for comments on an earlier draft of this chapter. Preparation of this chapter was supported by the AFOSR Grant F49620-92-J-0437 to Henry L. Roediger III.

REFERENCES

Blaxton, T. A. (in press). The role of the temporal lobes in recognizing nonverbal materials: Remembering versus knowing. *Neuropsychologia.*

Biederman, I., & Cooper, E. E. (1992). Size invariance in visual priming. *Journal of Experimental Psychology: Human Perception and Performance, 18,* 121–133.

Challis, B. H., Chiu, C.-Y., Kerr, S. A., Law, J., Schneider, L., Yonelinas, A., & Tulving, E. (1993). Perceptual and conceptual cueing in implicit and explicit retrieval. *Memory, 1,* 127–151.

Cooper, L. A., Schacter, D. L., Ballesteros, S., & Moore, C. (1992). Priming and recognition of transformed three-dimensional objects: Effects of size and reflection. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18,* 43–57.

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., Morris, L. W., Morris, R. G., & Loewen, E. R. (1990). Relations between source amnesia and frontal lobe functioning in older adults. *Psychology and Aging, 5,* 148–151.

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

Gardiner, J. M. (1991). Memory with and without recollective experience. *Behavioral and Brain Sciences, 14,* 678–679.

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

Gardiner, J. M., & Java, R. I. (1993). Recognizing and remembering. In A. Collins, M. A. Conway, S. E. Gathercole, & P. E. Morris (Eds.), *Theories of memory* (pp. 163–188). Hillsdale, NJ: Lawrence Erlbaum Associates.

Gardiner, J. M., & Parkin, A. J. (1990). Attention and recollective experience in recognition memory. *Memory and Cognition, 18,* 579–583.

Graf, P., Mandler, G., & Haden, P. (1982). Simulating amnesic symptoms in normal subjects. *Science, 218,* 1243–1244.

Gregg, V. H., & Gardiner, J. M. (1991). Components of recollective awareness in a long-term modality effect. *British Journal of Psychology, 82,* 153–162.

Gregg, V. H., & Gardiner, J. M. (1994). Recognition memory and awareness: A large effect of study-test modalities on "know" responses following a highly perceptual task. *European Journal of Cognitive Psychology, 6,* 131–147.

Hunt, R. R., & McDaniel, M. A. (1993). The enigma of organization and distinctiveness. *Journal of Memory and Language, 32,* 421–445.

Hunt, R. R., & Toth, J. P. (1990). Perceptual identification, fragment completion, and Free recall: Concepts and data. *Journal of Experimental Psychology: Learning, memory, and Cognition, 16,* 282–290.

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. (1991). A process dissociation framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language, 30,* 513–541.

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., & 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., 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.

Java, R. I. (1994). States of awareness following word stem completion. *European Journal of Cognitive Psychology, 6,* 77–92.

Joordens, S., & Merikle, P. M. (1993). Independence or redundancy? Two models of conscious and unconscious influences. *Journal of Experimental Psychology: General, 122,* 462–467.

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

Light, L. L., & Singh, A. (1987). Implicit and explicit memory in young and older adults. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 13,* 531–541.

Luo, C. R. (1993). Enhanced feeling of recognition: Effects of identifying and manipulating test items on recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19,* 405–413.

Madigan, S. (1983). Picture memory. In J. C. Yuille (Ed.), *Imagery, memory, and cognition: Essays in honour of Allan Paivio* (pp. 65–89). Hillsdale, NJ: 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* (pp. 293–327). Hillsdale, NJ: Lawrence Erlbaum Associates.

Mandler, G. (1980). Recognizing: The judgment of previous occurrence. *Psychological Review, 87,* 252–271.

Mandler, G. (1989). Memory: Conscious and unconscious. In P. R. Solomon, G. R. Goethals, C. M. Kelley, & B. R. Stephens (Eds.), *Memory: Interdisciplinary approaches* (pp. 84–106). New York: Springer-Verlag.

Masson, M.E.J., & MacLeod, C. M. (1992). Reenacting the route to interpretation: Enhanced perceptual identification without prior perception. *Journal of Experimental Psychology: General, 121,* 145–176.

Miller, G. A. (1962). *Psychology: The science of mental life.* New York: Harper & Row.

Nelson, T. O. (1984). A comparison of current measures of the accuracy of feeling-of-knowing predictions. *Psychological Bulletin, 95,* 109–133.

Nelson, T. O. (1992). *Metacognition: Core readings.* Boston: Allyn & Bacon.

Nisbett, R. E., & Wilson, T. (1977). Telling more than we can know. *Psychological Review, 84,* 231–259.

Parkin, A. J., & Russo, R. (1989). Implicit and explicit memory and the automatic/effortful distinction. *European Journal of Cognitive Psychology, 2*(1), 71–80.

Parkin, A. J., & Walter, B. (1992). Recollective experience, normal aging, and frontal dysfunction. *Psychology and Aging, 7,* 290–298.

Rajaram, S. (1993). Remembering and knowing: Two means of access to the personal past. *Memory and Cognition, 21,* 89–102.

Rajaram, S. (1996). Perceptual effects on Remembering: Recollective processes in picture recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 22,* 365–377.

Rajaram, S., & Coslett, H. B. (1992, November). *Further dissociations between Remember and Know judgments in recognition memory.* Poster presented at the 33rd Annual Meeting of the Psychonomic Society, St. Louis, MO.

Rajaram, S., & Coslett, H. B. (1993, May). *Effects of size and reflection of objects on Remember/Know responses in recognition memory.* Paper presented at the 65th Annual Meeting of the Midwestern Psychological Association, Chicago.

Roediger, H. L. (1990). Implicit memory: Retention without remembering. *American Psychologist, 45,* 1043–1056.

Roediger, H. L., & McDermott, K. B. (1993). Implicit memory in normal human subjects. In F. Boller & J. Grafman (Eds.), *Handbook of Neuropsychology* (Vol. 8, pp. 63–131). Amsterdam: Elsevier.

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, NJ: Lawrence Erlbaum Associates.

Roediger, H. L., Weldon, M. S., Stadler, M. L., & Riegler, G. L. (1992). Direct comparison of two implicit memory tests: Word fragment and word stem completion. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18,* 1251–1269.

Slamecka N. J., & Graf P. (1978). The generation effect: Delineation of a phenomenon. *Journal of Experimental Psychology: Human Learning and Memory, 4,* 592–604.

Sutherland, S. (1991). *Macmillan dictionary of psychology.* London: Macmillan.

Tulving, E. (1985). Memory and consciousness. *Canadian Psychologist, 26,* 1–12.

von Restorff, H. (1933). Uber die Wirkung von Bereichsbildungen im spurenfeld [On the effects of organization in the trace field]. *Psychologie Forschung, 18,* 299–342.

Wallace, W. P. (1965). Review of the historical, empirical, and theoretical status of the von Restorff phenomenon. *Psychological Bulletin, 63,* 410–424.

Watkins, M. J., & Gibson, J. M. (1988). On the relation between perceptual priming and recognition memory. *Journal of Experimental Psychology: Human Learning and Memory, 14,* 477–483.

Weldon, M. S., & Roediger, H. L. (1987). Altering retrieval demands reverses the picture superiority effect. *Memory and Cognition, 15,* 269–280.