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When False Recognition Meets Metacognition: The Distinctiveness Heuristic

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We investigated the contribution of a distinctiveness heuristic to rejecting false memories. Individuals studied words, pictures, or both types of items and then completed a recognition test on which the studied items appeared once, whereas the new words appeared twice. Participants who had studied pictures were less likely to falsely recognize repeated new words than were participants who had studied words. We argue that studying pictures provides a basis for using a distinctiveness heuristic during the recognition test; participants infer from the absence of memory for expected picture information that a test item is "new." These experiments also investigated the influence of two variables—diagnosticity and metacognitive control—on the use of the distinctiveness heuristic. We examined the role of diagnostic information in eliciting the heuristic by varying the proportion of studied items that appeared as pictures. Compared to a word encoding condition, participants successfully rejected repeated new words after studying 50, 25, and 33% of the items as pictures in Experiments 1, 2, and 3, respectively. Thus, the distinctive information need not be completely diagnostic (i.e., perfectly predictive of an item's oldness) for participants to use the heuristic. We also show that the distinctiveness heuristic is under metacognitive control such that it can be turned on or off depending on participants' expectations about its usefulness for reducing memory errors. © 2002 Elsevier Science (USA)

Key Words: false recognition, metacognition, distinctiveness heuristic, and false memory.

Although memory is often durable and accurate, it is also subject to various types of forgetting and distortion (Schacter, 1999, 2001). During the past several years, increasing experimental and theoretical attention has focused on misattribution errors that occur when some form of memory is present but is attributed to an incorrect time, place, or source (for reviews, see Johnson, Hashtroudi, & Lindsay, 1993; Roediger, 1996; Schacter, Norman, & Koutstaal, 1998). Demonstrations of errors and distortions in remembering raise a question with important theoretical and practical implications: How can memory misattributions be reduced or avoided? Several studies have shown that a number of encoding and retrieval manipulations can produce reliable reductions in memory errors such as false recall and false recognition (e.g., Gallo, Roberts, & Seamon, 1997; Hicks & Marsh, 1999; Kensinger & Schacter, 1999; Koutstaal, Schacter, Galluccio, & Stofer, 1999; Mather, Henkel, & Johnson, 1997; McDermott, 1996; McDermott & Roediger, 1998; Schacter, Verfaellie, Anes, & Racine, 1998).

We recently suggested one mechanism for reducing misattribution errors that we call the *distinctiveness heuristic* (Dodson & Schacter, 2001; Schacter, Cendan, Dodson, & Clifford, in press; Schacter, Israel, & Racine, 1999), a mode of responding in which people expect to remember vivid details of an experience and make recognition decisions based on this metacognitive expectation. When a novel event or item lacks the expected distinctive information, people can use this absence of critical evidence to reject the item.

We provided evidence for the operation of the distinctiveness heuristic in three sets of experiments using a procedure originally developed by Deese (1959) and later refined and extended by Roediger and McDermott (1995). In the Deese/Roediger-McDermott (DRM) paradigm, participants hear lists of words (e.g., *candy, sour, sugar*) that all are semantic associates of a non-

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presented theme or lure word (e.g., *sweet*). When later given an old–new recognition test that contains studied words (e.g., *sour*), new unrelated words (e.g., *point*), and new related lure words (e.g., *sweet*), participants frequently and confidently claim that they previously studied the related lures. This robust false recognition effect has been documented and explored in various laboratories (e.g., Gallo et al., 1997; Mather et al., 1997; Norman & Schacter, 1997; Payne, Elie, Blackwell, & Neuschatz, 1996; Schacter, Verfaellie, & Pradere, 1996; Smith & Hunt, 1998).

Schacter et al. (1999; see also Israel & Schacter, 1997) modified the DRM procedure by presenting each word in an associated list auditorily along with a picture of the item. Compared to a condition in which participants studied only words (in both visual and auditory modalities), false recognition of related lures was reduced dramatically following pictorial encoding. Schacter et al. (1999) argued that the reduction in false recognition was attributable to participants' metacognitive expectation that they should be able to remember the distinctive pictorial information. Thus, the *absence* of memory for this distinctive information provides evidence that the test item is new (cf. Rotello, 1999; Strack & Bless, 1994). By contrast, participants who studied words would not expect detailed recollections of studied items and, hence, would not base recognition decisions on the presence or absence of memory for such distinctive information.

Dodson and Schacter (2001) reported a similar reduction in false recognition of related lures after participants said aloud target words on study lists compared to when they heard the target items (participants also saw the studied words in both conditions). Dodson and Schacter noted that earlier studies provide evidence that people expect to remember information that they have generated themselves (Conway & Gathercole, 1987; Foley, Johnson, & Raye, 1983; Hashtroudi, Johnson, & Chrosniak, 1989; Johnson, Raye, Foley, & Foley, 1981; Kelley, Jacoby, & Hollingshead, 1989). They suggested that in the DRM procedure, participants who said words at study employed a distinctiveness heuristic during the recognition test; they demanded access to the distinctive "say" information in order to judge an item as "old." Because related lure words were never said, the distinctiveness heuristic helped participants to avoid falsely recognizing them.

Although our previous studies provide evidence consistent with the operation of a distinctiveness heuristic, they leave open a fundamental question: What are the necessary conditions for eliciting or "turning on" the distinctiveness heuristic? Schacter et al. (1999) reported reduced false recognition after pictorial encoding compared to word encoding in a between-subjects design. However, they observed no evidence of reduced false recognition for picture lists compared to word lists in a within-subjects design where some associate lists were studied as pictures and others were studied as words. Dodson and Schacter (2001) reported an identical pattern—reduced false recognition for said lists compared to heard lists in a between-subjects design but not in a within-subjects design.

As noted by Schacter et al. (1999) and Dodson and Schacter (2001), in a between-subjects design, distinctive information is perfectly predictive or *diagnostic* of prior study. If participants remember having seen a picture or having said a word aloud, then they can be certain that the item appeared on the study list. Conversely, the absence of the expected distinctive information provides diagnostic evidence that the item did not appear in the list. In a within-subjects design, by contrast, distinctive information is no longer diagnostic of prior study. Because participants studied some lists as pictures and others as words (Schacter et al., 1999) or said aloud some lists and heard others (Dodson & Schacter, 2001), not remembering distinctive information about a test item does not necessarily mean that the item is novel; it might mean only that the item was from one of the lists presented as words. Thus, the contrasting patterns of false recognition in between- and within-subjects designs can be taken as support for the idea that participants rely on the distinctiveness heuristic only when distinctive information is diagnostic of prior study and abandon the heuristic when distinctive information is not diagnostic of prior study.

However, there is a confounding feature of the DRM procedure that creates two different interpretations of the aforementioned findings of no difference between the false recognition rates for the picture and word lists in the within-subjects design. As we just noted, one interpretation is that participants abandon the distinctiveness heuristic because it is no longer diagnostic. Alternatively, participants may be attempting, but failing, to apply the distinctiveness heuristic selectively to the test items from the lists presented as pictures. Consider, for example, a participant who studies pictures corresponding to the heard words *butter*, *dough*, *milk*, and so forth and then encounters the related lure word *bread* on the recognition test. To avoid making a false alarm to *bread* because of the absence of expected pictorial information, the participant would have to be able to remember that *butter*, *dough*, *milk*, and other associates appeared with pictures in the study list. However, if the participant cannot remember the presentation mode of the study list—and, thus, cannot remember which of the lists for which the heuristic would be useful—then he or she may apply the heuristic globally to all of the test items. This global use of the distinctiveness heuristic would produce the finding of no difference in false recognition rates to lures associated to the picture and word lists.

This latter point is important theoretically because it implies that failure to observe reduced false recognition for pictures or said words in the within-subjects version of the DRM paradigm might not provide evidence supporting the importance of diagnostic information in turning on the distinctiveness heuristic. Instead, these data may speak to the difficulty of remembering mode of list presentation when making recognition judgments about related lure words. Indeed, Dodson and Schacter (2001) noted evidence from their experiments and those of Schacter et al. (1999) suggesting that participants might have been trying to use the distinctiveness heuristic in the within-subjects version of the DRM paradigm, even though the distinctive information was not diagnostic of prior study. They observed that in the within-subjects paradigm, levels of false recognition in all conditions were suppressed compared to the "standard" or nondistinctive condition in the between-subjects design (i.e., the word-only presentation in Schacter et al., 1999, and the heard condition in Dodson & Schacter, 2001). This cross-experiment observation has been confirmed by Schacter et al. (in press), who produced in a single experiment the trends obtained in separate experiments by Schacter et al. (1999) and Dodson and Schacter (2001). The fact that no additional suppression was found for pictures or said words in the within-subjects condition may be attributable to the memory limitations noted above rather than to the fact that distinctive information was no longer diagnostic of prior study. Thus, data from the DRM paradigm cannot speak conclusively to the importance of diagnosticity for the distinctiveness heuristic.

In the experiments reported here, we examine the role of diagnostic information in eliciting the heuristic. The current experiments also address the more general question of the relationship between the distinctiveness heuristic and familiarity and recollection of source or specific item information. The distinctiveness heuristic is one instance of a general class of retrieval strategies that participants use to assess remembered information. (we further consider the distinctiveness heuristic in relation to similar retrieval strategies later in the General Discussion). As a retrieval strategy for evaluating remembered information, our view of the distinctiveness heuristic is very much consistent with the source-monitoring framework of Johnson et al. (1993) and the constructive memory framework of Schacter, Norman, and Koutstaal (1998), both of which emphasize the importance of evaluative mechanisms for memory accuracy. However, in the context of dual process models of memory, the distinctiveness heuristic conceptually differs from the processes of familiarity and recollection. Specifically, in most models, familiarity is based on a unidimensional variable that is produced by a variety of factors such as the overall similarity of the familiar item to other items in memory (e.g., Gillund & Shiffrin, 1984; Hintzman, 1988; Humphreys, Bain, & Pike, 1989; Murdock, 1982), the frequency of prior exposure of the familiar item (e.g., Atkinson & Juola, 1974; Underwood, 1972), and the fluency of processing the recognized item (e.g., Jacoby & Dallas, 1981). Recollection is thought to involve memory for more specific item or source information, such as multiple features of an event, or a remembered event and the context in which it occurred (e.g., Anderson & Bower, 1972, 1974; Gillund & Shiffrin, 1984; Humphreys et al., 1989; Johnson et al., 1993; Mandler, 1980). There is sometimes an opposition relationship between familiarity and memory for more specific item information (Jacoby, 1991) such as when familiar items can be rejected when more specific information is remembered (cf. Dodson & Johnson, 1996). In this article, we provide evidence that the distinctiveness heuristic constitutes a separate process that contributes to performance when people confront a familiar test item but fail to remember expected source information about it.

To address the aforementioned questions, we use a repetition lag paradigm that was introduced by Underwood and Freund (1970) and modified by Jennings and Jacoby (1997; see also Fischler & Juola, 1971; Koriat, Ben-Zur, & Sheffer, 1988). In the repetition lag paradigm, participants study a list of words and then complete a recognition test in which the studied words appear once but the new words appear two or more different times. Underwood and Freund (1970) used a forced choice recognition test in which each studied word was paired with a new word that either occurred for the first time or was repeated. Recognition performance was substantially lower when studied words were paired with repeated new words than when they were paired with once-presented new words. Jennings and Jacoby (1997) changed the paradigm in two ways. First, all test words were presented individually, and a judgment of “old” or “new” was made for each. Second, the lag between the first occurrence of a new word and its repetition was systematically varied. Jennings and Jacoby observed that even though participants were specifically instructed to say “old” only to words from the study list and not to new words that are repeated, after sufficiently long lags, some participants (especially older adults) made false alarms to repeated new words (for similar results with the same paradigm, see Dywan, Segalowitz, & Webster, 1998). As Jennings and Jacoby (1997) argued, familiarity and recollection of more specific item information exhibit an opposition relationship when it comes to responding to new words that repeat at different lag intervals. When a new word repeats after just a few test items (i.e., a short lag), the repeated new word’s familiarity can be counteracted by recollecting that the new word was seen earlier on the test—a clear sign that the test item must be new because only the new words repeat. By contrast, at the longer lag intervals, there is an increasing likelihood that participants fail to recollect that the repeated new word was encountered before and mistake its familiarity—derived from previous exposure on the test—for prior presentation in the *study* phase.

EXPERIMENT 1

We began by asking whether studying target items as pictures, rather than words, would allow participants to invoke a distinctiveness heuristic on the recognition test and, thus, avoid making false alarms to repeated new words. The general idea is that after studying pictures, participants would expect to remember this information during the recognition test. Because repeated new words lack this expected information, by relying on the distinctiveness heuristic, participants should be able to greatly reduce false alarms to repeated new words. If such an outcome were observed, it would provide evidence for the generality of the distinctiveness heuristic by demonstrating its operation beyond the DRM paradigm used in previous studies. We replicated the procedure of Jennings and Jacoby (1997) by presenting the words visually only, whereas the pictures were accompanied by the auditory presentations of their names. Because any effects of distinctive encoding could be a result of either the picture or the auditory information, we refer to the picture/auditory encoding condition as the *distinctive encoding* condition.

We also examined the role of diagnostic information in turning on the distinctiveness heuristic. Consider a situation where participants study a list in which half the items are pictures and half are words (i.e., 50% distinctive condition) and are then given a recognition test comprised of all words, with new words repeating at varying lags. Because the test item might have appeared as a word at study, failing to remember distinctive information is no longer diagnostic of prior study, as was the case in the within-subjects version of the DRM paradigm used by Schacter et al. (1999). However, the repetition lag paradigm provides a more direct test of the role of diagnostic information in eliciting the distinctiveness heuristic than does the DRM paradigm because the former procedure is not confounded by the "memory for mode of list" presentation issue that blurs interpretation of results from the latter procedure. That is, in the repetition lag procedure, repeated new words are not associated with any specific items from the study list in the same sense that related lure words are linked to specific study lists in the DRM procedure. After studying both pictures and words, it seems reasonable to expect that participants will not heavily weight the absence of memory for distinctive information when making recognition judgments. Therefore, they should fail to reduce false recognition rates of repeated new words relative to participants in the 100% distinctive encoding condition. These results would clearly support the importance of diagnosticity in turning on the distinctiveness heuristic.

Method

Participants. A total of 48 paid volunteers were recruited from the student population at Harvard University. There were 16 participants in each of the three conditions: word encoding, 100% distinctive encoding, and 50% distinctive encoding.

Design and materials. The stimuli consisted of 120 Snodgrass and Vanderwart (1980) pictures and their corresponding verbal labels. A total of 60 items were studied and also served as the old items on the test. The remaining 60 items were the new items on the test. Each new item repeated at either Lag 4, Lag 12, Lag 24, or Lag 48. The 120 stimuli were divided into eight groups of 15 items. The groups were balanced so that they had similar mean ratings for picture familiarity (range = 3.5–3.6), picture complexity (range = 2.6–2.7), and word frequency (range = 34.2–34.9). Four groups of items were presented at study, and four groups were presented as new items on the test at the four lag intervals. Eight different counterbalancing formats rotated the groups of items so that across participants, each group appeared at study and also was presented as a new word in each of the lag conditions at test. This rotation also guaranteed that across participants in the 50% distinctive condition, each group of items was presented as a word and picture at study.

An Apple G3 computer presented all of the stimuli in the center of the screen. The pictures were approximately the same size and fit within a 6- × 6-in. area of the screen. Each picture was also accompanied by the auditory presentation of its name. The words appeared in lowercase letters in size 48-point Geneva font. For each study item, the phrase "How many syllables?" appeared at the bottom of the screen. After a response, the screen cleared and was followed by a 1-s delay before the presentation of the next study item. The 60 study items were randomly intermixed with the restriction that each third of the study list contained an equivalent number of items from each group.

The test items were visual words only that either corresponded to the names of the previously studied pictures or exactly matched the previously studied words. Each test item appeared in the center of the screen in lowercase letters in size 48-point Geneva font. The phrase "Old or new?" appeared 1.5 cm beneath each test item. The order of the test items was random, with the restriction that no more than 3 old or new items could occur consecutively. All new words repeated after either 4, 12, 24, or 48 items separated the initial occurrence of the new word from its repetition. In total, the test was 180 items long: 60 study items and 60 new items that repeated at one of the lag intervals.

Procedure. Participants were assigned to one of three different study conditions: the word condition, the 100% distinctive condition, or the 50% distinctive condition. In contrast to the procedure of Jennings and Jacoby (1997) and Underwood and Freund (1970), our participants were given incidental instructions and were told that they would have to enter as quickly as possible the number of syllables in the study item. No mention was made of a later memory test. The people in the 50% distinctive condition were told that they would see items presented either as pictures or as words. Both these individuals and the participants in the 100% distinctive condition were told that they would hear the name of each picture.

Immediately after the study phase, everyone received the test instructions. They were told that the test was based on their memory for all of the studied items. The participants who studied pictures were informed that the test would contain names of the picture study items. In addition, all of the participants were instructed that the test would contain new words and that these new words would repeat so that they would appear two different times. They were instructed to respond "old" to the studied items only and "new" to the new items by pressing the "a" and ";" keys, respectively. We emphasized to participants that they should respond "new" to the repeated new words. They were warned not to mistake repeated new words for studied items.

Results and Discussion

Table 1 displays the probabilities of responding "old" in the three different encoding conditions to studied items, new words, and repeated new words at the four lag intervals. There are two notable patterns in these results. First, hit rates to studied items and false alarm rates to once-presented new words were comparable across the different conditions, indicating similar overall item recognition. Second, compared to the false alarm rates to new words on their first occurrence (hereafter referred to as baseline false alarm rates), participants in the word study condition greatly increased their "old" responses to repeated new words across the four lag intervals (i.e., 16% baseline false alarm rate vs 32% false alarm rate at Lag 48). By contrast, participants in the 100% and 50% distinctive encoding conditions were more successful at rejecting the repeated new words.

For item recognition, we examined hit rates to studied items, baseline false alarm rates to new words, and corrected recognition scores (i.e., hits minus baseline false alarms). Analyses of variance (ANOVAs) confirmed that there were no differences between the conditions on any of these measures, all Fs $(2, 45) < 1.09$. We also conducted signal detection analyses of the hit rates and baseline false alarm rates with d' as a measure of sensitivity and C as a measure of bias. There were no significant differences between the conditions on either of these measures, Fs < 1.00. Thus, overall old–new discrimination and bias were comparable across the conditions. Within the 50% distinctive condition, however, recognition rates were higher for test items earlier studied as pictures than for test items earlier studied as words (78% vs 61%, respectively), $F(1, 15) = 27.59$, $MSe = .008$, $p < .0001$.

Figure 1 presents the corrected false recognition rates of the *repeated* new words in the three different conditions. These scores represent false recognition rates to repeated new words

TABLE 1

Probabilities of Responding "Old" to Studied Items, New Words, and Repeated New Words at Each of the Lag Intervals in Experiment 1

					Repeated new words			
Study condition	Studied	New	d'	C	Lag 4	Lag 12	Lag 24	Lag 48
Word	.72	.16	1.77	.27	.18	.22	.26	.32
100% distinctive	.71	.11	1.88	.37	.08	.12	.11	.16
50% distinctive	.70	.15	1.70	.32	.14	.17	.17	.22

Note. The "new" column contains false alarm rates to the first presentations of the new words. The signal detection measures, d' (discrimination) and C (bias), are derived from the "old" responses to studied and once-presented new items. "Distinctive" refers to conditions in which participants have studied pictures, with the percentages referring to the proportions of pictured studied items.

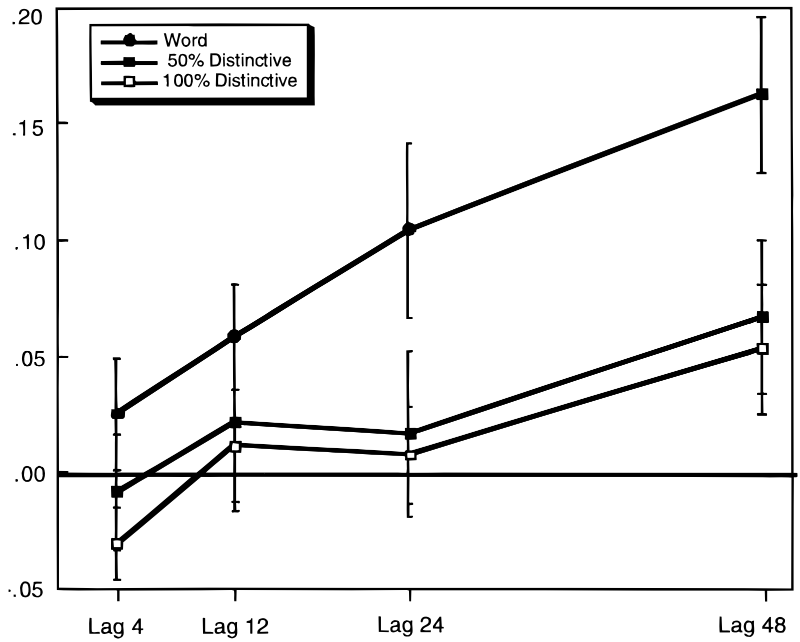

FIG. 1. Corrected false recognition rates in the three study conditions to the repeated new words at each of the four lag intervals in Experiment 1. Lag refers to the number of test items separating the initial occurrence of the new word from its repetition. Vertical lines depict standard errors of the means.

after subtracting out the false recognition rate to new words on their first occurrence. The line at zero, for example, is the point at which there is no difference between the false alarm rate for repeated new words and the baseline false alarm rate. As expected, participants in the word encoding condition were likely to falsely recognize repeated new words, especially those that repeated at the longer lags. Participants in the 100% and 50% distinctive encoding groups, by contrast, show considerably lower false recognition rates to repeated new words. We examined the corrected false recognition rates with a 3 (Condition) × 4 (Lag) ANOVA that yielded a significant effect of condition, $F(2, 45) = 3.55$, $MSe = .031$, $p < .05$; a significant effect of lag, $F(3, 135) = 10.40$, $MSe = .005$, $p < .001$; and no significant interaction. Planned comparisons confirmed the pattern in Fig. 1; corrected false recognition rates were higher in the word encoding condition than in either the 100% distinctive encoding condition, $F(1, 45) = 6.23$, $p < .05$, or the 50% distinctive encoding condition, $F(1, 45) = 4.23$, $p < .05$. There were no differences between the 100% distinctive encoding and 50% distinctive encoding conditions, $F(1, 45) < 1.00$. The significant effect of lag reflects the greater probability of falsely recognizing the repeated new words at the longer lag intervals. As Jennings and Jacoby (1997) discussed, at the longer lag intervals, there is a heightened probability that participants will fail to recollect that the repeated new word was encountered before and will mistake its familiarity for prior presentation in the study phase. By contrast, at the short lags, such as Lag 4 and Lag 12, the repeated new word's familiarity can be countered by recollecting that the new word was seen earlier in the test. Because only the new words repeat, such recollection is a marker that the test item must be new.

There are two important results from this experiment. First, our finding of lower corrected false recognition rates in the 100% distinctive encoding condition than in the word encoding condition conceptually replicates the results of Schacter et al. (1999) and Dodson and Schacter (2001) in the DRM paradigm. As we argued in the DRM paradigm, studying all of the items as pictures reduces the tendency to falsely recognize repeated new words because it provides a basis for invoking the distinctiveness heuristic. Participants in the distinctive encoding condition expect to remember distinctive information about studied items. When these individuals confront a test item that is familiar (e.g., a repeated new word) but that fails to elicit memory for pictorial information, they infer that the test item is new. However, as we will discuss in greater detail later, the distinctiveness heuristic appears to be used primarily for new words that repeat at the longer lags, when participants are likely to fail to recollect encountering the words earlier in the test. The second important result is that participants still use the distinctiveness heuristic to successfully identify repeated new words as "new" in the 50% distinctive encoding condition even though the heuristic is no longer perfectly diagnostic of the items' oldness. That is, participants persist in using the heuristic even when it is not a reliable indicator that an item is new.

It might appear surprising, in light of the well-known picture superiority effect, that we found no difference in item recognition (i.e., hit rates and false alarm rates) between the 100% distinctive and word encoding groups. However, to our knowledge, there is only one other study that has examined recognition memory for pictures and words using a between-groups design and a verbal test. Jenkins, Neale and Deno (1967) observed no difference in recognition memory between participants who had studied pictures and participants who had studied words (i.e., the names of the pictures). By contrast, many studies have found more accurate recognition memory for pictures than for words on a verbal test when the pictures and words were studied together in a single list such as our 50% distinctive condition (e.g., Dewhurst & Conway, 1994; Madigan, 1983; Rajaram, 1993; Scarborough, Gerard, & Cortese, 1979). Similar findings of comparable memory for two classes of materials when the stimuli are presented in a between-subjects manner, but not in a within-subjects manner, have been found by many researchers examining free recall performance (e.g., McDaniel, DeLosh, & Merritt, 2000).

With respect to the distinctiveness heuristic, however, the lack of overall difference in old–new discrimination between the word and distinctive encoding conditions indicates that the reduced corrected false recognition rates for repeated new words in the 100% and 50% distinctive encoding conditions is not a byproduct of generally increased memory. Moreover, the lower corrected false recognition rates in the two distinctive conditions cannot be a result of a more conservative response bias in these conditions, as compared to the word encoding condition, because the bias (*C*) scores did not differ among the three conditions.

EXPERIMENT 2

Experiment 1 has demonstrated that the use of a distinctiveness heuristic produces reduced false recognition responses to repeated new words, even when the distinctive information is not completely diagnostic of the items' oldness; participants seem to ignore the base rate of the distinctive information. These results naturally lead us to question the role of diagnosticity in activating the distinctiveness heuristic. At what level of unreliability will participants abandon the distinctiveness heuristic as a strategy for responding to test items? More concretely, how many of the studied items need to be distinctive before the heuristic is invoked?

We address this question in Experiment 2. We used the same basic procedure as in Experiment 1 except that we varied the number of studied items that appeared as pictures. There were three different groups of participants in this experiment. As in Experiment 1, one group studied only words—an exact replication of the word encoding condition in Experiment 1. We also included two other groups of participants that studied a mixture of pictures and words. Some participants saw 25% of the studied items as pictures, and others saw 10% of the items as pictures. These latter two conditions were designed to reveal the point at which individuals would abandon the distinctiveness heuristic, thus producing false recognition rates to the repeated new words that are similar to those rates in the word encoding condition.

Method

Participants. A total of 48 paid volunteers from the Harvard University student population participated in this experiment. There were 16 participants in each of the three conditions.

Design and materials. The stimuli were identical to those used in Experiment 1. The 120 stimuli were divided into eight groups of 15 items. Four of the groups of items were presented at study, and four groups served as new items that repeated at the different lag intervals. The word encoding condition was identical to the corresponding condition in Experiment 1; participants were presented with 60 words during the study phase. In the 25% distinctive condition, one of the four study groups was presented as pictures and the rest as words (i.e., 15 pictures and 45 words). In the 10% distinctive condition, 6 items were randomly selected from the four study groups of items to appear as pictures with the constraint that no more than 2 items could come from the same group. As in Experiment 1, each picture was accompanied with the auditory presentation of its name.

The study lists and test lists were constructed in the same manner as in Experiment 1. However, in the 10% distinctive condition, there were no pictures within the first or last five study positions because primacy/recency effects might increase the salience of the item.

Procedure. We used the same study and test instructions that we used in Experiment 1. The people in the 25% and 10% distinctive conditions were told that they would see either pictures or words. No mention was made about the relative proportion of picture and word study items.

Results and Discussion

Because the word encoding condition is an exact replication (i.e., identical stimuli and procedure) of this condition in Experiment 1, we first compared performance in these two conditions with the goal of combining them. The word encoding conditions in Experiments 1 and 2 are characterized by similar hit rates to studied items, false alarm rates to new words, corrected recognition rates, and corrected false recognition rates to the repeated new words, all Fs $<$ 1.40. To increase our power of detecting differences between conditions in Experiment 2, we merged the two word encoding conditions from Experiments 1 and 2 into a single word encoding condition.

Table 2 presents the probabilities of responding “old” to the different test items (i.e., studied, new, or repeated new) in the three different conditions. We observed a large increase in false recognition responses to the repeated new words, relative to the baseline false alarm rate, in both the word and 10% distinctive study conditions. Interestingly, the false recognition rate to repeated new words was suppressed in the 25% distinctive condition.

In terms of overall item recognition, an ANOVA performed on the hit rates to the studied items yielded a significant effect, $F(2, 61) = 4.16$, $MSe = .025$, $p < .05$. A Newman–Keuls test determined that hit rates were significantly higher in the word encoding condition than in

TABLE 2

Probabilities of Responding “Old” to Studied Items, New Words, and Repeated New Words at Each of the Lag Intervals in Experiment 2

					Repeated new words			
Study condition	Studied	New	d'	C	Lag 4	Lag 12	Lag 24	Lag 48
Word	.72	.19	1.64	.20	.21	.23	.27	.32
25% distinctive	.58	.11	1.61	.58	.13	.13	.10	.18
10% distinctive	.63	.17	1.42	.35	.18	.23	.20	.30

Note. The “word” condition includes data from the identical condition in Experiment 1. The “new” column contains false alarm rates to the first presentations of the new words. The signal detection measures, d' (discrimination) and C (bias), are derived from the “old” responses to studied and once-presented new items. “Distinctive” refers to conditions in which participants have studied pictures, with the percentages referring to the proportions of pictured studied items.

the 25% distinctive encoding condition. No other comparisons attained significance. There were no differences between the conditions in either the baseline false alarm rates to the new words or the corrected recognition rates, $Fs(2, 61) < 1.62$. In addition, there were no differences in the d' (discrimination) scores, $F(2, 61) = 1.02$. However, an analysis of the bias (C) scores yielded a significant effect, $F(2, 61) = 3.48$, $MSe = .223$, $p < .05$. Participants in the 25% distinctive condition were more conservative than were participants in the word condition, as determined by a Newman–Keuls test. No other comparisons were significantly different.

For item recognition in the 25% and 10% distinctive conditions, participants recognized more test items studied previously as pictures than as words. This pattern was confirmed by a 2 (Condition: 25% vs 10%) × 2 (Item: picture vs word) ANOVA of the recognition rates of the picture and word study items in the 25% and 10% picture conditions. There was no significant effect of condition; a main effect of item, $F(1, 30) = 33.22$, $MSe = .013$, $p < .0001$; and a marginally significant interaction, $F(1, 30) = 3.96$, $p < .06$. Although picture study items were recognized more often than word study items, the difference in the recognition rates of these two types of items was larger in the 25% picture condition (75% hit rate for picture study items vs 53% hit rate for word study items) than in the 10% distinctive condition (73% hit rate for picture study items vs 62% hit rate for word study items).

Figure 2 presents the corrected false recognition rates of the repeated new words at each of the lag intervals. A 3 (Condition) × 4 (Lag) ANOVA of the corrected false recognition rates yielded a significant effect of lag, $F(3, 183) = 10.77$, $MSe = .009$, $p < .01$, and no other significant effects. Planned comparisons determined that false recognition of repeated new words did not differ between participants who had studied words only and participants in the 10% distinctive encoding group, $F(1, 61) <$

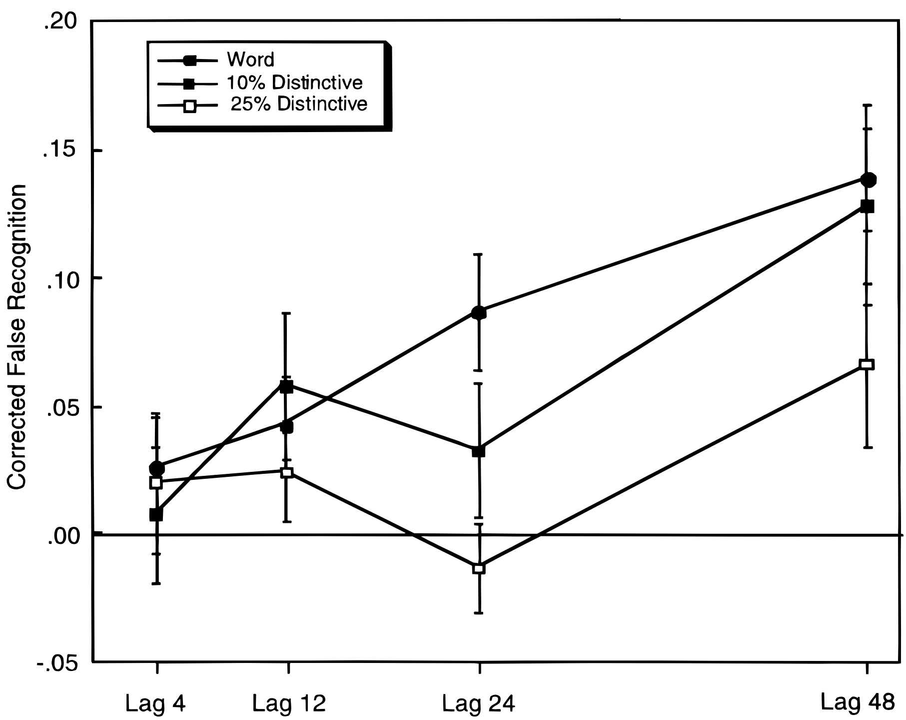

FIG. 2. Corrected false recognition rates in the three study conditions to the repeated new words at each of the four lag intervals in Experiment 2. Lag refers to the number of test items separating the initial occurrence of the new word from its repetition. Vertical lines depict standard errors of the means.

1.00. However, participants in the word encoding condition exhibited higher corrected false recognition rates than did participants in the 25% distinctive encoding condition, $F(1, 61) = 4.28$, $MSe = .024$, $p < .05$.

These results indicate that participants do not require a high degree of predictability to use the distinctiveness heuristic. That is, only a relatively small amount of distinctive study information (25% pictures) seems to be required to “turn on” this heuristic. After encoding some distinctive information, participants appear to weight heavily its presence or absence when making subsequent old–new judgments.

EXPERIMENT 3

The previous experiments have documented that studying 25% or more of target items as pictures produces a reduction in false recognition responses to repeated new words. We have interpreted these results as reflecting the use of a metacognitive heuristic. Specifically, we argue that people infer from the absence of remembering distinctive information about a test item that the item is novel. However, it is possible that this reduction in false recognition rates does not reflect the use of a strategic metacognitive heuristic. Instead, the reduction might reflect a relatively automatic consequence of encoding pictorial information; perhaps encoding pictures simply renders old and new items more discriminable, thereby producing a reduction in false alarms to repeated new items (we consider this issue at greater length later in the General Discussion). If this were so, then there would be no need to postulate the involvement of metacognitive or heuristic processes during retrieval.

A fundamental question, then, is whether the distinctiveness heuristic is characterized by the properties of a metacognitive mechanism (e.g., Barnes, Nelson, Dunlosky, Mazzoni, & Narens, 1999; Nelson & Narens, 1990, 1994). For instance, one essential attribute of a retrieval strategy is that it is susceptible to cognitive control (e.g., Dodson & Johnson, 1996). If the distinctiveness heuristic is a metacognitive mechanism, then there should be situations in which people can turn this strategy on or off based solely on their expectations regarding the kinds of information they believe they should remember.

To assess this possibility, we developed an experimental design in which the critical comparison holds the nature of the study and test stimuli constant and varies only participants’ metacognitive expectations. During the study phase, we used the identical instructions and procedure as in the previous experiments. However, in contrast to the preceding experiments, we tested participants’ memory for only a subset of the study items. As with the prior experiments, the studied items appeared once and the new words appeared twice at either Lag 24 or Lag 48. We did not use the two shorter lags from previous experiments because the earlier results indicated that at the relatively short lags participants often recollected having seen the new word earlier on the test and, thus, would have no reason to use a distinctiveness heuristic.

There were four different conditions in Experiment 3. One group of participants studied only words. Results from this *word encoding* group should replicate our prior findings; false recognition of repeated new words should significantly exceed the baseline false recognition rate. A second group of participants studied 33% of the items as pictures and was tested on both picture and word study items. This *standard distinctive* group should also replicate prior findings and exhibit a lower corrected false recognition rate to the repeated new words as compared to the word encoding group. The remaining two groups were critical for answering our question about metacognitive control and were identical in every respect except for the test instructions. Both groups studied 33% of the items as pictures but were tested on the word study items only; the test contained no items that had been seen earlier as pictures. Participants in the *uninformed distinctive* group received standard test instructions; they were told that their memories would be tested for *all* of the study items. By contrast, participants in the *informed distinctive* group were told that the test included only the word study items; these individuals were told that they would not be asked about the picture study items on the recognition test.

The primary comparison in this experiment, then, is between the two conditions—informed distinctive and uninformed distinctive—in which participants studied 33% of the items as pictures and then either are or are not informed that the test includes the word study items only. If the suppression effect is entirely attributable to studying a sufficient number of pictures and does *not* reflect a strategic process, then participants in both of these conditions should perform similarly to each other and to the standard 33% distinctive study condition; test instructions should have no effect on performance. All of these distinctive study groups should exhibit reduced false recognition rates to the repeated new words relative to the word encoding condition. On the other hand, if the test instruction manipulation abolishes false recognition suppression in the informed distinctive group—the group that does not expect to be tested on picture study items—then this would be powerful evidence that participants are using a mechanism that is under metacognitive control. Thus, we predicted that false recognition rates to repeated new words would be higher when participants do not expect to be tested on items that appeared as pictures during the study phase (the informed distinctive group) than when participants do expect to be tested on the picture study items (uninformed distinctive group).

Method

Participants. A total of 75 paid volunteers were recruited from the Harvard University student population. There were 15 participants in the word encoding condition and 20 participants in each of the standard distinctive, uninformed distinctive, and informed distinctive conditions.

Design and materials. The stimuli were 125 Snodgrass and Vanderwart (1980) pictures and their corresponding names. The stimuli were divided into five groups of 25 items. The groups of items had similar mean ratings for picture familiarity (range = 3.5–3.7), picture complexity (range = 2.6–2.7), and word frequency (32 for each group). Three groups of items were randomly intermixed and constituted the study list. The remaining two groups of items served as new items on the test that repeated at either Lag 24 or Lag 48. In the standard distinctive, uninformed distinctive, and informed distinctive groups, one of the three groups of items was presented at study as pictures and the remaining two groups were presented as words. All three groups of items were presented as words in the word encoding condition. The groups of items were counterbalanced across participants so that each group was presented at study as a picture and word and as a new word that repeated at each of the two lag intervals during the test.

Participants studied 75 items but were tested on only 50 of them. Specifically, in the standard distinctive condition, the test contained 25 items studied as pictures and 25 items studied as words. The test contained 50 items studied as words in the remaining three conditions (word encoding, uninformed picture, and informed picture). In all of the conditions, the test also contained 50 new words that repeated at either Lag 24 or Lag 48. Across participants, the particular subset of studied items that were subsequently tested was counterbalanced. Overall, the lengths of the study and test lists were identical across all conditions.

Procedure. The study and test instructions were the same as those used in the previous experiments. Individuals in the word encoding, standard distinctive, and uninformed distinctive conditions were told that the test would be based on memory for *all* of the studied items. Participants in the informed distinctive condition were instructed that their memories would be tested for only the items seen as words; they would not have to remember the picture study items. In addition, everyone was informed that the test would contain new words and that the new words would repeat. We emphasized that they should press the “old” key for the studied items and the “new” key for the new words. As in the previous experiments, the participants were warned not to mistake repeated new words for old words; they should call the repeated new words “new.”

Results and Discussion

Table 3 presents the proportions of “old” responses to the different items in the four different conditions. Item recognition was comparable across the conditions; there were no differences in hit rates to studied items, baseline false alarm rates to new words, or d' and C

TABLE 3

Probabilities of Responding "Old" to Studied Items, New Words, and Repeated New Words at Each of the Lag Intervals in Experiment 3

					Repeated new words	
Condition	Studied	New	d'	C	Lag 24	Lag 48
Word encoding	.63	.28	1.01	.14	.35	.44
Standard distinctive	.63	.23	1.15	.21	.26	.23
Uninformed distinctive	.55	.21	1.00	.36	.20	.22
Informed distinctive	.57	.21	1.07	.35	.31	.31

Note. The "new" column contains false alarm rates to the first presentations of the new words. The signal detection measures, d' (discrimination) and C (bias), are derived from the "old" responses to studied and new items. In the standard distinctive condition, participants study 33% of the items as pictures and are tested on both picture and word study items. In the uninformed and informed distinctive conditions, participants study 33% of the items as pictures but are tested on the word study items only. The uninformed group was incorrectly told that the test was based on both picture and word study items, whereas the informed group was told the true nature of the test.

scores. As in the previous experiments, participants in the word encoding condition falsely recognized more repeated new words than did participants in the standard distinctive condition. There was, however, a dramatic effect of test instructions on the false recognition rate to the repeated new words. As predicted, participants in the informed distinctive condition showed higher false recognition rates to repeated new words than did participants in the uninformed distinctive condition.

Overall item recognition was similar in the various conditions; there were no differences in either the hit rate to studied items, the baseline false alarm rate to new words, or the corrected recognition rates, all $Fs(3, 71) < 1.52$. In addition, there were no differences between the conditions in d' (discrimination) or C (bias) scores, $Fs(3, 71) < 1.25$.

Figure 3 presents corrected false recognition rates to the repeated new words. Corrected false recognition rates were considerably lower in the standard distinctive condition than in the word encoding condition. Critically for the issue of metacognitive control, corrected false recognition rates were higher in the informed distinctive condition than in the uninformed distinctive condition. A 4 (Condition) × 2 (Lag) ANOVA produced a significant effect of condition, $F(3, 71) = 6.17$, $MSe = .021$, $p < .001$, and no other significant effects. Because of the large number of pairwise comparisons, we used Newman–Keuls tests to analyze the effect of condition. These tests indicated that corrected false recognition rates in the informed distinctive condition did not differ from those in the word encoding condition. However, participants in both of these conditions exhibited significantly higher false recognition rates than did participants in either the standard distinctive condition or the uninformed distinctive condition; these latter two conditions did not differ from each other. Thus, we replicated previous results in that individuals falsely recognized more repeated new words in the word encoding condition than in the standard distinctive condition. Importantly, participants falsely recognized more repeated new words when they were informed that they would not be tested on the picture study items compared to the otherwise identical condition in which participants were informed that they would be tested on all of the studied items.

Although participants in the informed distinctive condition falsely recognized the repeated new words at comparable levels as participants in the word encoding condition, the informed distinctive participants did not exhibit an effect of lag (i.e., higher false recognition rates to new words repeating at Lag 48 than at Lag 24) that is typically observed in the word encoding condition. We have no ready explanation for this apparent anomaly and will explore the issue further in future experiments.

Overall, the data from Experiment 3 indicate that the distinctiveness heuristic is a strategic mechanism that participants can turn on or off

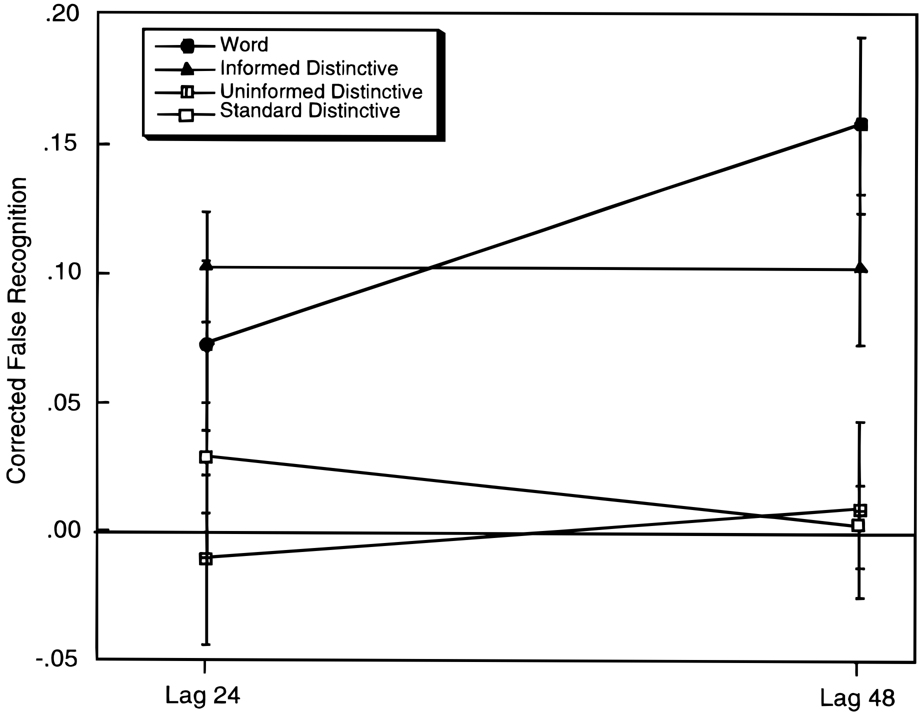

FIG. 3. Corrected false recognition rates to the repeated new words at the two lag intervals in Experiment 3. Lag refers to the number of test items separating the initial occurrence of the new word from its repetition. Vertical lines depict standard errors of the means.

depending on their expectations of whether they will or will not be tested on the picture study items. Because all features of the two key experimental conditions were held constant except for the test instructions, we can be confident that the distinctiveness heuristic operates under metacognitive control and, consequently, that false recognition suppression is not an automatic consequence of encoding pictures during the study phase. Studying pictures creates a basis for invoking the distinctiveness heuristic, but only when test instructions indicate that it is appropriate to activate the heuristic.

EXPERIMENT 4

We have suggested that memory for pictorial information drives the use of the distinctiveness heuristic under appropriate test conditions. As we mentioned earlier, however, this conclusion is not entirely clear-cut because participants who studied pictures also heard the name of each picture. Thus, it is possible that memory for auditory information, rather than pictorial information, underlies the distinctiveness heuristic. To address this issue, we tested three different groups. One group studied only words, one studied pictures and heard the name of each picture, and one studied words and also heard the name of each word. If auditory information is critical for activating the distinctiveness heuristic, then this latter word + sound group should perform similarly to the basic picture encoding group. However, if auditory information is not critical for activating the distinctiveness heuristic, then the word + sound group should behave like the word encoding condition.

Method

Participants. A total of 48 paid volunteers from the Harvard University student population participated in this experiment, with 16 participants in each of the three groups.

Design and materials. The stimuli consisted of 120 Snodgrass and Vanderwart (1980) pictures and their verbal labels. As in Experiments 1 and 2, participants studied 60 items. The remaining 60 items were presented as new items on the test that repeated at either Lag 24 or Lag 48. The stimuli were divided into four groups of 30 items. The groups had similar mean ratings for picture familiarity (range = 3.5–3.6), picture complexity (range = 2.6–2.8), and word frequency (33 for each list). Four different counterbalancing formats rotated the groups of items so that across participants, each list was presented at study and also was presented as a new item at each of the lag intervals. There were three different study conditions. The word encoding and picture encoding conditions were identical to those conditions in Experiment 1. In the word + sound encoding condition, people heard the name of each word and saw the visual form of the word on the screen.

Procedure. The study instructions were the same as those used in the prior experiments. In the word + sound encoding condition, participants were informed that they would hear the name of each word that appeared on the screen. The test instructions were identical to those in the earlier experiments. Participants were informed that the test would contain old items and new items that would repeat.

Results and Discussion

Table 4 presents the probabilities of responding “old” to the studied, new, and repeated new words in the three different conditions. Item recognition rates were similar across conditions. There were no differences in hit rates to studied items, $F(2, 45) < 1.00$; baseline false alarm rates to new words, $F(2, 45) = 1.82$; or corrected recognition rates, $F(2, 45) < 1.00$. In addition, there were no differences between the conditions in either d' scores, $F(2, 45) = 1.62$, or C scores, $F(2, 45) = 1.05$.

Table 4 also shows that the false recognition rates to the repeated new words at Lag 24 and Lag 48 are similar in the word and word + sound encoding conditions. A 2 (Lag) × 3 (Condition) ANOVA of the corrected false recognition rates produced a significant effect of lag, $F(1, 45) = 13.42$, $MSe = .006$, $p < .001$; a marginally significant effect of condition, $F(2, 45) = 2.58$, $MSe = .026$, $p < .09$; and no significant interaction. Participants exhibited higher false recognition rates to the new words that repeated at Lag 48 than to those that repeated at Lag 24. Planned comparisons confirmed that corrected false recognition rates were lower in the picture encoding condition than in either the word encoding condition, $F(1, 45) = 3.97$, $MSe = .026$, $p = .05$, or the word + sound encoding condition, $F(1, 45) = 3.76$, $MSe = .026$, $p < .06$. False recognition rates did not differ in the latter two conditions, $F(1, 45) < 1.00$. The high false recognition rates in the word + sound condition demonstrate that the distinctiveness heuristic is not based on auditory information about the studied items. Instead, the heuristic is activated only after participants have studied pictorial information. However, we must note one qualification to this conclusion. In the DRM paradigm, we have shown that saying words aloud at study, rather than hearing the words, is sufficient to activate the distinctiveness heuristic because there is a lower false recognition rate to

TABLE 4

Probabilities of Responding “Old” to Studied Items, New Words, and Repeated New Words at Each of the Lag Intervals in Experiment 4

					Repeated new words	
Study condition	Studied	New	d'	C	Lag 24	Lag 48
Word	.62	.18	1.30	.34	.27	.30
Word + sound	.61	.17	1.31	.34	.24	.31
Picture	.62	.12	1.64	.49	.11	.18

Note. The “new” column contains false alarm rates to the first presentations of the new words. The signal detection measures, d' (discrimination) and C (bias), are derived from the “old” responses to studied and once-presented new items.

the critical lures in the say encoding condition than in the hear encoding condition (for results and discussion, see Dodson & Schacter, 2001). Thus, auditory information does not drive the distinctiveness heuristic when it has been passively heard, rather than self-generated, during the study task.

GENERAL DISCUSSION

In four experiments, we examined the distinctiveness heuristic with a repetition lag paradigm. Participants studied words, pictures, or a mixture of both and then completed a recognition test in which studied items appeared once and new items appeared twice. All of the experiments demonstrated that participants in the word encoding condition were vulnerable to falsely recognizing the repeated new words, especially when the words repeated at one of the longer lag intervals such as Lag 24 or Lag 48. Studying pictures, however, produced a reduction in false recognition rates to the repeated new words. This finding conceptually replicates the results of Dodson and Schacter (2001) and Schacter et al. (1999) in the DRM paradigm. We interpret this suppression effect as the outcome of a metacognitive heuristic in which individuals infer that a test item is novel from the absence of memory for expected distinctive information. These experiments also investigated the influence of two variables—diagnosticity and metacognitive control—on the use of the distinctiveness heuristic.

Consider first the role of diagnostic information, which we examined by varying the proportion of studied items that appeared as pictures. Compared to a word encoding condition, participants successfully rejected repeated new words after studying 50%, 25%, and 33% of the items as pictures in Experiments 1, 2, and 3, respectively. Thus, the distinctive information need not be completely diagnostic—(i.e., perfectly predictive of an item's oldness) for participants to use the heuristic. Instead, a relatively small amount of distinctive study information appears to be sufficient to "turn on" this heuristic.

The second critical issue we examined is whether or not individuals exert metacognitive control over the distinctiveness heuristic. We investigated this issue by manipulating participants' expectations about whether or not the test would contain items studied as pictures. We compared two different conditions that were identical in every respect except for the particular test instructions; participants in both conditions studied a mixture of pictures and words but were tested only on the items studied as words. When participants were informed that they would not be tested on the picture study items, they did not engage the distinctiveness heuristic and, consequently, falsely recognized a number of the repeated new words. By contrast, when they were (incorrectly) informed that the test was based on all of the studied items, participants used the heuristic and rejected the repeated new words. These results indicate that the distinctiveness heuristic is under metacognitive control such that it can be turned on or off depending on participants' expectations about its usefulness for reducing memory errors.

These results are consistent with other results from our lab showing that participants exert some degree of control over the use of the distinctiveness heuristic (Schacter et al., in press). In that study, we used the DRM paradigm and found that participants could turn the distinctiveness heuristic on or off depending on the demands of the retrieval test. With a standard old–new recognition test, we replicated previous results and found that false recognition rates to semantically related lure words were lower after picture encoding than after word encoding. However, this suppression effect after picture encoding was nearly eliminated with a "meaning" recognition test on which participants were instructed to respond "old" to any test items that matched the theme or gist of studied items (Brainerd & Reyna, 1998). Under this latter condition, there is no reason for participants to consider whether test items possess distinctive properties that are characteristic of studied items. Thus, these results indicate that suppression of "old" responses to related lures is not an automatic consequence of encoding pictorial information. Instead, the effect depends critically on retrieval conditions that do or do not elicit the strategy that we call the distinctiveness heuristic.

One further intriguing feature of our results concerns whether or not there are costs to using the distinctiveness heuristic. If individuals respond on the basis of the absence of memory for pictorial information about a test item, then one might expect that using such a criterion would lower recognition rates of test items that were studied as words because memories for the word items would not contain the critical pictorial information (at least not to the same extent as would memories for the picture study items). Specifically, one reasonable prediction would be that participants who used the distinctiveness heuristic would exhibit lower hit rates to the items studied as words than would participants who did not use the heuristic. To examine this issue, we focused on the two conditions from Experiment 3—the informed distinctive and uninformed distinctive groups—that were identical in every respect except that participants in one condition were informed that the test includes only word study items and participants in the other condition were not so informed. Although participants in the informed condition did not use the heuristic and showed significantly higher corrected false recognition rates than did participants in the uninformed condition, the two conditions yielded highly similar responses to the word study items. As seen in Table 3, hit rates (.57 vs .55) and baseline false alarm rates (.21 vs .21) were nearly identical in both conditions. These data suggest that there is no cost to using the distinctiveness heuristic.

The apparent lack of a cost in item recognition from using the distinctiveness heuristic provides one explanation of why people persist in applying the heuristic even when it is not highly diagnostic of an item's oldness (e.g., when 25% or 33% of the studied items appeared as pictures). On the one hand, it might seem counterproductive to use the distinctiveness heuristic, and thus heavily weigh memory for pictorial information, when only 25% of the studied items were seen as pictures. On the other hand, if there is no cost to invoking the heuristic then it might indeed be reasonable to apply it even when distinctive information is not highly diagnostic because false alarms to repeated new words are reduced with no cost to hit rates. These results suggest that participants can use the distinctiveness heuristic in a relatively specific or targeted manner that does not merely result in a generally more conservative response bias.

Consider next the distinctiveness heuristic in relation to issues concerning familiarity and recollection of source information. The repetition lag paradigm illustrates the separate contributions of familiarity, recollecting source-specifying information, and the distinctiveness heuristic. Familiarity contributes to the correct recognition of earlier studied items. But it also leads to the incorrect acceptance of repeated new words when participants fail to recollect specific item information about encountering the new words earlier in the test and do not invoke the distinctiveness heuristic. Recollecting item-specific information, of course, contributes to the correct recognition of studied items. It also can underlie a "recall-to-reject" process in which participants correctly reject repeated new words because they recollect seeing the new word earlier on the test list (for discussion of recall-to-reject processes, see Clark & Gronlund, 1996; Rotello & Heit, 1999; Rotello, Macmillan, & Van Tassel, 2000). This recall-to-reject process probably occurs frequently for new words that repeat at one of the shorter lags such as Lag 4 or Lag 12. Use of the recall-to-reject process can account for the finding that in all conditions, the false recognition rate for the new words that repeat at Lag 4 or Lag 12 is not significantly different from the baseline false recognition rate. The new words that repeat at the longer lags, however, are falsely recognized significantly above the baseline rate (when the distinctiveness heuristic is not invoked) because participants fail to recollect encountering the new words earlier on the test list (i.e., are not able to use a recall-to-reject process). Participants, therefore, misattribute the new words' familiarity to their having been studied. Thus, the lag effect in the word encoding conditions—that is, greater corrected false recognition rates to new words repeating at long lags rather than at short lags—is primarily attributable to failures in recollecting that the new words were seen earlier in the test. According to this account, any inconsistencies in the magnitude of this lag effect across experiments are attributable to differences in the use of this recall-to-reject process.

Finally, participants activate the distinctiveness heuristic when they encounter a familiar test word (e.g., a repeated new word), have studied distinctive information, and believe that it is useful to invoke the heuristic. It is in this situation that participants infer that the failure to recall expected distinctive information signifies that the test item is new. Importantly, the activation of the distinctiveness heuristic is contingent on failing to recollect item-specific information about seeing the new word earlier in the test or during the study phase.

From the above description of the distinctiveness heuristic, our account predicts that the false alarm rates to once-presented new items (i.e., the baseline false alarm rates) will be lower after picture encoding than after word encoding. That is, because new test items will not evoke memory for pictorial information, even though they will occasionally pass a familiarity criterion, this absence of expected distinctive information should be used to reject the new test items. Evidence for this effect, however, is mixed. In conditions in which participants studied all pictures (i.e., the 100% distinctive [picture] encoding conditions in Experiments 1 and 4), the baseline false alarm rate is lower than in the corresponding word encoding conditions. However, when participants studied a mixture of pictures and words, the results are inconsistent; sometimes there is a lower baseline false recognition rate after picture encoding than after word encoding, such as performance in the 25% distinctive condition in Experiment 2, and sometimes there is no difference in the baseline false alarm rate as a function of the encoding condition, such as the 50% distinctive condition in Experiment 1. This inconsistency might be attributable to a floor effect in the baseline false alarm rates that mask differences between encoding conditions. Nonetheless, further research is needed to examine the issue.

One potential problem with using the term *distinctiveness heuristic* is that it is difficult to predict a priori what participants will view as distinctive or subjectively memorable. Alternatively, it might be preferable to refer to a *picture heuristic* and avoid the potential pitfalls with the concept of “distinctiveness.” However, we have previously found that patterns of false recognition reduction observed after pictorial encoding are also seen with another type of distinctive information (saying words aloud vs hearing them) (Dodson & Schacter, 2001). Therefore, it seems needlessly narrow to use a label such as the *picture heuristic* for a strategy that appears to operate the same way with different kinds of distinctive information. Thus, we believe that the distinctiveness heuristic captures the generality of processing that occurs after studying different kinds of distinctive material.

We believe that the data from these experiments and others from our lab are best explained by a distinctiveness heuristic. Are there alternative accounts that could also explain the observed findings? For instance, can “memory strength” differences between the items studied as pictures and those studied as words account for our finding lower corrected false recognition rates after picture encoding than after word encoding? If the items studied as pictures are more familiar than the items studied as words, then there should be a similar effect on false recognition rates to new items—a mirror effect—so that there are lower false recognition rates to new items after studying pictures than after studying words (e.g., Glanzer, Kim, & Adams, 1998). The main problem with this account is that although false alarm rates to the once-presented new words (baseline false alarm rates) were lower after studying all pictures than after studying all words, there were no differences in hit rates, nor were there differences in overall discriminability, as measured by d' or corrected recognition scores. Hence, use of the distinctiveness heuristic does not appear to depend on strength differences because overall item recognition did not vary across conditions in which people either suppressed or did not suppress false recognition responses to the repeated new words. An alternative possibility is that participants are generally more conservative after studying pictures, or a mixture of pictures and words, than after studying all words. Except for the 25% condition in Experiment 2, false recognition suppression did not correspond with use of a more conservative criterion. In short, neither strength nor criterion shift accounts can readily explain our results.

Our view of the distinctiveness heuristic fits well with a basic assumption of Johnson et al.'s (1993) source monitoring framework that participants can recruit a variety of different decision strategies when making memory judgments. A number of studies have documented that people use a strategy, comparable to the distinctiveness heuristic, when they attribute test items to a particular source (e.g., Anderson, 1984; Foley et al., 1983; Hashtroudi et al., 1989; Hicks & Marsh, 1999; Johnson et al., 1981; Kelley et al., 1989). For instance, Johnson et al. (1981) observed that individuals who had generated some words and heard an experimenter present others during the study phase displayed a marked bias on a later test when they identified the origin of various test items (i.e., were they new words or were they previously generated or heard?). Participants who falsely recognized new words were nearly three times more likely to respond that the items had been previously heard spoken by the experimenter than that they had been previously generated by the participant—what Johnson et al. referred to as the "It had to be you" effect. This decision bias appears to reflect participants' metamemorial beliefs that self-generated information is more memorable than heard information (Johnson & Raye, 1981). Therefore, familiar test items that fail to evoke any source-identifying information are more likely to be judged as heard than judged as generated given the expectation that if the items had been generated, they would certainly be remembered as such.

Hicks and Marsh (1999) demonstrated that a similar metacognitive strategy reduces the recall of false memories in the DRM false memory paradigm (e.g., Roediger & McDermott, 1995). They observed that participants who had studied lists of related words (e.g., *tired*, *bed*, *dream*) from two different sources, such as generating words from anagrams and hearing words, were less likely to falsely recall a critical lure word (e.g., *sleep*) than were participants who had studied the lists of words from the same source (e.g., hearing all of the words). Hicks and Marsh (1999) argued that studying items from different sources reduces false recall when participants' recall judgments are contingent on remembering source information about the items. That is, participants are able to reject false memories that lack expected source information such as memory for having generated the items from an anagram during the study phase. Thus, both Hicks and Marsh's proposal and our notion of a distinctiveness heuristic depend on decision rules in which the failure to retrieve particular information about an event is diagnostic of the event's nonoccurrence.

The distinctiveness heuristic is also similar to a metacognitive heuristic, referred to as the "lack of knowledge" inference by Collins and colleagues, that contributes to how people answer questions (e.g., Collins, Warnock, Aiello, & Miller, 1975; Gentner & Collins, 1981). For example, most people can confidently answer that they have never shaken hands with Richard Nixon because they would expect to remember meeting someone so well known. The lack of knowledge about what is assumed to be such a memorable event is used as evidence that the event did not occur. A similar metamemorial inference, based on the perceived memorability of test items, affects participants' tendencies to falsely recognize new words (e.g., Brown, Lewis, & Monk, 1977; Strack & Bless, 1994; cf. Rotello, 1999; Wixted, 1992). That is, new words that are judged as particularly salient or memorable, such as a participant's name, are more often correctly rejected than are less salient or memorable new words (for an analogous "I would have seen it if it had been there" strategy with memory for visual scenes, see also Brewer & Treyens, 1981). In sum, the results from these different paradigms point to the existence of a fundamental metacognitive inference process that is based on the absence of memory for expected distinctive information.

The present experiments, in combination with other results from our lab, indicate that a strategic retrieval process that we refer to as the distinctiveness heuristic represents a third factor affecting recognition performance in addition to familiarity and recollection of item-specific information. The central findings of the present experiments—that the distinctiveness heuristic is used even when distinctive information is not perfectly diagnostic of an item's oldness, that the heuristic reflects the operation of expectations that are under metacognitive control, and that using the heuristic appears to entail little cost—raise questions concerning the properties of the "it had to be you" heuristic described by Johnson et al., (1981) and the lack of knowledge inference described by Collins (e.g., Collins et al., 1975) and others. Do these heuristics, like the distinctiveness heuristic, operate under conditions of imperfect diagnosticity? Are they, too, susceptible to metacognitive control? And do these heuristics have few costs associated with them, in line with our findings regarding the distinctiveness heuristic? We think that these are promising questions that merit investigations in future studies that examine the relation between metacognition and false recognition.

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