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Why distinctive information reduces false memories: Evidence for both impoverished relational-encoding and distinctiveness heuristic accounts

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<t>Why Distinctive Information Reduces False Memories: Evidence for Both Impoverished Relational-Encoding and Distinctiveness Heuristic Accounts

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<abs>Two accounts explain why studying pictures reduces false memories within the Deese–Roediger–McDermott paradigm (Deese, 1959; Roediger & McDermott, 1995). The impoverished relational-encoding account suggests that studying pictures interferes with the encoding of relational information, which is the primary basis for false memories in this paradigm. Alternatively, the distinctiveness heuristic assumes that critical lures are actively withheld by the use of a retrieval strategy. When participants were given inclusion recall instructions to report studied items as well as related items, they still reported critical lures less often after picture encoding than they did after word encoding. As the impoverished relational-encoding account suggests, critical lures appear less likely to come to mind after picture encoding than they do after word encoding. However, the results from a post-recall recognition test provide evidence in favor of the distinctiveness heuristic.

<txt>During the past several years, there has been a growing interest in mechanisms that minimize the occurrence of false memories (see Dodson, Koutstaal, & Schacter, 2000; Schacter, Norman, & Koutstaal, 1998, for reviews). In part, this interest has been fueled by a paradigm

developed by Deese (1959) and modified by Roediger and McDermott (1995; see also Read, 1996) that generates robust false memories. In the Deese–Roediger–McDermott (DRM) paradigm, individuals study lists of words that are all semantically related to a nonpresented lure word. On subsequent recall or recognition tests, participants usually show high levels of false memory for the nonpresented lure word. For example, the false-recognition rate of the related-lure words is so high that it is typically equivalent to the correct-recognition rate of studied words (e.g., Dodson & Schacter, 2001; Mather, Henkel, & Johnson, 1997; Norman & Schacter, 1997; Payne, Elie, Blackwell, & Neuschatz, 1996; Roediger & McDermott, 1995; Schacter, Verfaellie, & Pradere, 1996).

<p>However, a variety of researchers have shown that different encoding manipulations can reduce the occurrence of false memories in the DRM and other paradigms (e.g., Arndt & Reder, 2003; Dodson & Schacter, 2001; 2002a; Marsh & Hicks, 1998; Schacter, Israel & Racine, 1999; Smith & Hunt, 1998). For example, studying items as pictures or saying words aloud reduces false-recognition errors in the DRM and repetition-lag paradigms (e.g., Dodson & Schacter, 2001; 2002a; 2002b; Israel & Schacter, 1997; Schacter, Cendan, Dodson, & Clifford, 2001; Schacter et al., 1999). Although there are many different mechanisms that could explain these reduced false memories, we focus on retrieval and encoding accounts that stem from studying distinctive information.

<p>One mechanism that we have proposed to explain the reduction in false memories is a retrieval strategy called the *distinctiveness heuristic* (e.g., Dodson & Schacter, 2001, 2002a, 2002b; Schacter et al., 1999; see also Ghetti, 2003; Johnson, Hashtroudi, & Lindsay, 1993; Hicks & Marsh, 2001; Marsh & Hicks, 1998, and Strack & Bless, 1994, for related views). This retrieval strategy refers to a decision rule whereby the absence of memory for expected information is taken as evidence for an event's nonoccurrence. For example, when an individual has studied pictures and later confronts a related-lure item on a recognition test, even though this item may evoke a strong feeling of familiarity, the individual should correctly reject it, because it fails to elicit memory for expected pictorial information. According to this metacognitive retrieval mechanism, individuals will deliberately withhold endorsing or reporting the critical lure based on the absence of memory for expected information. By contrast, participants who studied words would not expect detailed recollections of studied items and, hence, would not base recognition decisions on the absence of memory for such distinctive information.

<p>In contrast with our retrieval account, there are a variety of encoding explanations, depending on the theoretical approach, that could account for the reduction in false memories in the DRM paradigm when participants study distinctive information. All of these encoding accounts, however, share the notion that studying distinctive information—or processing information in a distinctive manner—decreases memorial information that is elicited by the related-lure item. According to Hunt and colleagues' distinction between item-specific and relational information (Einstein & Hunt, 1980; Hunt & Einstein, 1981; Hunt & McDaniel, 1993; Smith & Hunt, 1998; see also Arndt & Reder, 2003), studying distinctive information may increase memory for item-specific information at the expense of memory for relational information. As the nonpresented lure is related to many studied items, decreased memory for relational information would decrease responses to the critical lure. In terms of Roediger and colleagues' activation–monitoring framework, reduced false memories could occur because studying distinctive information decreases the spread of activation from the studied items to the related lure (e.g., Roediger, Balota, & Watson, 2001; Roediger, Watson, McDermott, & Gallo, 2001; see also McEvoy, Nelson, & Komatsu, 1999, for a related view). Similarly, according to

Brainerd and Reyna's fuzzy trace theory (Brainerd & Reyna, 1996; 1998), studying distinctive information might decrease the occurrence or reliance on gist representations, which are the primary basis for falsely remembering related items (e.g., Brainerd, Wright, Reyna, & Payne, 2002). In sum, a variety of different theoretical frameworks can all explain reduced false memories in terms of the related-lure item evoking less memorial information after one studies distinctive information. Therefore, based on these foregoing frameworks, we define the impoverished relational-encoding account as the notion that studying distinctive information interferes with the encoding of relational or associative information.

<p>Both the distinctiveness heuristic and the impoverished relational-encoding accounts are sensible, and yet very different, explanations of reduced false memories following the encoding of distinctive information. The central difference between the two accounts is that the impoverished relational-encoding account predicts that critical lures evoke less memorial information after picture encoding than they do after word encoding. By contrast, the distinctiveness heuristic predicts that critical lures evoke similar amounts of memorial information after the two encoding conditions. However, picture encoding allows participants to deliberately suppress false recognition of the critical lures by invoking a retrieval strategy whereby the absence of memory for expected distinctive information is indicative of an event's nonoccurrence.

<p>There is conflicting evidence in favor of both the distinctiveness heuristic and impoverished relational-encoding accounts as explanations of reduced false memories within the DRM paradigm (e.g., Arndt & Reder, 2003; Schacter et al., 2001). In testing the distinctiveness heuristic, Schacter et al. reasoned that if participants received inclusion recognition instructions to endorse both studied items as well as related items that matched the theme of previously studied items, there should be no need to invoke the distinctiveness heuristic, because the related lures should be recognized as “old.” Consequently, these inclusion instructions should reduce or eliminate the difference in false-recognition rates to the critical lures that is typically observed after picture encoding relative to word encoding. This is, in fact, what Schacter et al. observed: When participants received standard recognition instructions, fewer critical lures were falsely recognized after picture encoding than were falsely recognized after word encoding. However, with inclusion instructions, there were no significant differences between the two encoding conditions in responses to critical lures. This pattern of data indicates that a retrieval strategy underlies this false-recognition suppression effect, because it is essentially turned on and off with a retrieval manipulation.

<p>However, Arndt and Reder (2003) provided evidence in favor of the impoverished relational-encoding account as an explanation for reduced false-recognition rates of critical lures in the DRM paradigm. Arndt and Reder presented items in distinctive and unusual-looking fonts. Some of the DRM lists (i.e., the correlated lists) were presented with the same unusual font for all of the items within the list—that is, the font was correlated with the list. For other DRM lists (i.e., the unique lists), however, each item was presented in a different and unique font. After studying both correlated and unique lists, participants falsely recognized fewer critical lures that were related to the unique lists than they did critical lures that were related to the correlated lists. Arndt and Reder suggest that presenting the items in unique fonts encourages item-specific processing at the expense of relational processing. Consequently, reduced relational information would produce lower false-recognition rates of the lures that are related to the unique lists. These results are inconsistent with the distinctiveness heuristic, which would predict a global reduction in false-recognition rates to all critical lures on the test rather than the observed selective reduction to the critical lures related to the items presented in the unique fonts.

<p>In the following experiments, we used a combination of recall and recognition tests to examine the following possibilities: Does studying distinctive information decrease the likelihood that critical lures will come to mind? Or is it that the critical lures come to participants' minds, but they use a distinctiveness heuristic to withhold reporting them? Or, perhaps, both of the foregoing scenarios are at work.

<h1>Experiment 1

<txt>To test the predictions of the distinctiveness heuristic and impoverished relational-encoding accounts, we contrasted word encoding with picture encoding, which has reliably decreased false-recognition rates in the DRM paradigm (e.g., Schacter et al., 1999, 2001). However, instead of using a recognition test, we used a recall test. Recently, Seamon et al. (2003) showed that encoding items in an item-specific manner, such as writing the word or writing the second letter of the word, reduced subsequent false-recall (and false-recognition) rates of the critical lures (see also Kellogg, 2001; Smith & Hunt, 1998). Based on this evidence and on the predictions of the distinctiveness heuristic and impoverished relational-encoding accounts, there should be lower false-recall rates of the critical lures after picture encoding than there are after word encoding.

<p>However, in order to discriminate between the distinctiveness heuristic and impoverished relational-encoding accounts, we gave participants inclusion instructions to recall both studied items and other items that were related to what was studied, a procedure that was inspired by the work of Jacoby (1991), as well as by that of Brainerd and Reyna (1998; Brainerd et al., 2002; see also Schacter et al., 2001). Inclusion recall seems more effective than inclusion

recognition at testing whether critical lures are less likely to come to mind following the encoding of distinctive information. Inclusion recognition of a critical lure could be produced for a variety of reasons: (a) it evokes a sufficient amount of familiarity or other memorial information to justify an *old* response; or (b) participants use a test strategy to endorse related items, even though these items may not elicit any familiarity. For example, after studying *tired*, *bed*, *dream*, and so on, participants could endorse *sleep* on an inclusion recognition test, not because *sleep* evokes a strong sense of familiarity, but because participants are aware that *sleep* is related to what was studied. This test strategy would allow participants to recognize critical lures even though the lures themselves evoke little familiarity or memorial information. By contrast, recall tests with inclusion instructions cannot be, or are less likely to be, influenced by this particular strategy. Instead, they should provide a measure of whether encoding distinctive information reduces the likelihood of critical lures coming to mind, as the impoverished relational-encoding account would predict.

<p>The inclusion recall instructions should disable the distinctiveness heuristic, as there is no need to withhold reporting critical lures. In fact, the critical lures should be reported under these instructions, because the lures are obviously related to the studied items. Specifically, the distinctiveness heuristic account predicts that the inclusion instructions will produce similar patterns of recall of critical lures after picture and word encoding, assuming comparable recall rates of studied items after these two encoding conditions. By contrast, the impoverished relational-encoding account predicts that, even with the inclusion instructions, picture encoding, relative to word encoding, will produce lower recall rates of the critical lures.

<p>As an additional test of these two hypotheses, following the inclusion recall test, participants were directed to go through their recalled items and to recognize by placing a check next to those items that were actually presented during the encoding phase. The impoverished relational-encoding and distinctiveness heuristic accounts predict different patterns of performance on this post-recall recognition test. According to the distinctiveness heuristic, participants who studied pictures should falsely recognize a smaller proportion of critical lures that were recalled via the inclusion instructions than participants who studied words. The absence of memory for pictorial information should be used as a clue to exclude (i.e., not recognize) critical lures. By contrast, the impoverished relational-encoding account predicts that the two encoding conditions will show similar false-recognition rates of the critical lures that had been reported on the preceding recall test. It is important to emphasize that the to-be-recognized items have all passed a threshold of having been reported on the inclusion recall test. With this in mind, the impoverished relational-encoding account offers no retrieval mechanism that would allow for the selective rejection of critical lures on the recognition test. In other words, this account assumes that participants in both encoding conditions will use similar retrieval strategies and therefore should falsely recognize similar proportions of critical lures.

<h3>*Method*

<h4>*Participants*. **<smtxt>**Forty-two University of Virginia undergraduate students (16 women and 26 men) participated in this study. There were 21 participants in each condition, and each participant received course credit for his or her participation.

<h4>*Design and materials*. **<smtxt>**The stimuli consisted of 72 pictures (created by Israel & Schacter, 1997) and their corresponding names, which are based on the lists used by Roediger and McDermott (1995) as well as on Russell and Jenkins's (1954) word-association norms. The stimuli were divided into six lists, each of which contained 12 semantically related items that were presented in order of decreasing associative strength to the non-presented critical lure. The order of the lists was randomized, and the same order was presented to all participants.

<p>In the picture-encoding condition, each study item was presented as an auditory word with a corresponding picture; in the word-encoding condition, each study item was presented as an auditory word and as a visual word. The picture stimuli were black-and-white line drawings that varied in size (all pictures were smaller than 12 x 12 cm). All drawings contained similar amounts of detail. Word stimuli were presented in lowercase 48-point Geneva type font. All stimuli were presented on Apple iMAC computers.

<h4>*Procedure*. <smtxt>Participants were randomly assigned to one of two conditions: word encoding or picture encoding. Each participant was tested individually and was told to pay close attention to the items that he or she would see and hear because a memory test would follow the study phase. In the word-encoding condition, participants were told that they would hear the item being spoken (e.g., “butter”) and see the word printed on the computer screen. In the picture-encoding condition, participants were told that they would hear the item being spoken (e.g., “butter”) and see a picture of the item on the computer screen.

<p>All of the 72 study items appeared on the computer monitor at a rate of 1 item every 3 s. No breaks were given between the six lists; each list immediately followed presentation of the previous list (e.g., Smith & Hunt, 1998, Experiment 1; Toglia, Neuschatz, & Goodwin, 1999, Experiment 2). Following the study phase, participants completed a 5-min distractor task that involved writing down the names of as many U.S. presidents and politicians as they could remember.

<p>At the end of the 5-min delay, participants were given the instructions for the free-recall test and were asked not only to report as many studied items as they were able but also to

report any items related to the studied items that came to mind (see Brainerd & Reyna, 1998). In addition, after the recall test, participants were instructed to place a check mark next to those reported items that were actually presented during the encoding phase.

<h3>*Results and Discussion*

<txt>Figure 1**<fgc>** displays the probabilities of recalling studied items and critical lures after encoding either pictures or words. Whereas recall rates of studied items were comparable in the two encoding conditions, recall rates of critical lures were significantly lower after picture encoding than they were after word encoding. A 2 (encoding condition: picture vs. word) x 2 (item type: studied items vs. critical lures) analysis of variance (ANOVA) produced significant main effects of item type, $F(1, 40) = 25.51$, $MSE = 0.02$, $p < .01$, and encoding condition, $F(1, 40) = 14.98$, $MSE = 0.05$, $p < .01$, and a significant Encoding Condition × Item-Type interaction, $F(1, 40) = 13.57$, $MSE = 0.02$, $p < .01$. Consistent with the predictions of the impoverished relational-encoding account, the central finding is the sharp decrease in recall rates of critical lures in the picture-encoding condition (34%) as compared with the word-encoding condition (66%), $t(40) = 4.17$, $p < .01$. Recall rates of studied items were slightly higher after word encoding than they were after picture encoding, $t(40) = 1.90$, $p = .06$. An additional striking pattern in this figure is the dramatic increase in recall rates of critical lures, relative to studied items, after word encoding. This pattern in the word-encoding condition replicates the findings of **<cr3>**Brainerd, Payne, Wright, and Reyna (2003), who also observed, with inclusion instructions, a much higher recall rate of critical lures than of studied items. Lastly, participants were more likely to report *noncritical* intrusions (i.e., nonstudied, noncritical items) after word encoding (32 items on average) than they were after picture encoding (16 items on average), $t(40) = 1.92$, $p = .06$.

<p>With respect to the proportion of recalled items that were subsequently recognized as actually having been studied, a 2 (encoding: picture vs. word) × 2 (item type: studied vs. critical lure) ANOVA yielded a significant effect of item type, $F(1, 40) = 79.45$, $MSE = 0.07$, $p < .01$, and a marginally significant interaction, $F(1, 40) = 3.10$, $MSE = 0.07$, $p < .09$. Participants in both encoding conditions recognized studied items at similar rates (.86 after picture encoding and .81 after word encoding), $t(40) = 1.58$, $p = .12$. However, participants who studied pictures falsely recognized fewer critical lures (.24) than did participants who studied words (.40), although this difference was not significant, $t(40) = 1.47$, $p < .15$. Finally, false-recognition rates of noncritical intrusions were no different across the two encoding conditions (picture encoding = .13 and word encoding = .08), $t(40) = 0.95$.

<p>The foregoing results support the impoverished relational-encoding account. Participants who studied words reported nearly twice as many critical lures on an inclusion recall test as did those who studied pictures. Studying the items as pictures appears to interfere with participants' ability to activate and/or to acquire inter-item relational information. This decrement in relational information after picture encoding would impair participants' ability to generate related items on the recall test. In short, critical lures are less likely to come to mind after picture encoding than they are after word encoding.

<p>These data provide little support for the distinctiveness heuristic. Although participants who studied pictures falsely recognized fewer critical lures on the post-recall recognition test than did those who studied words (i.e., 24% vs. 40%), this difference was not significant. We sought to replicate and extend these results before considering their possible ramifications.

<h1>Experiment 2

<txt>Experiment 1 is somewhat damaging for the distinctiveness heuristic and suggests that the impoverished relational-encoding hypothesis is the primary mechanism explaining differences in the occurrence of false memories after picture versus word encoding, at least on recall tests. Given the importance of these results for disconfirming the distinctiveness heuristic hypothesis, in Experiment 2, we contrasted standard recall instructions with inclusion recall instructions in order to examine three predictions that follow from the distinctiveness heuristic and impoverished relational-encoding accounts.

<p>As discussed earlier, the distinctiveness heuristic assumes that picture encoding, and not word encoding, enables participants to use a retrieval strategy to withhold reporting items that lack expected memorial information. Two predictions follow from the distinctiveness heuristic account. First, analyses of recall rates of the critical lures should show an interaction between encoding condition and retrieval condition. That is, we should conceptually replicate the recognition findings of Schacter et al. (2001). Specifically, the distinctiveness heuristic account predicts a larger difference between the two encoding conditions in the recall rates of the critical lures under the standard instructions (i.e., to recall only the studied items) than under the inclusion instructions (i.e., to recall both studied items and related items). This pattern emerges if participants use a retrieval strategy after studying the items as pictures to edit out and withhold reporting the critical lures under the standard instructions. Under the inclusion instructions, however, the participants who studied the items as pictures should now report the critical lures, because they are clearly related to what was studied. Consequently, the expected difference in false-recall rates of the critical lures after picture encoding versus word encoding under the standard test instructions should be reduced or eliminated under the inclusion recall instructions. Because there is no need to invoke the distinctiveness heuristic under the inclusion instructions, participants should respond by retrieving available relational information following either picture or word encoding.

<p>If, on the other hand, reduced false-recall reflects the impoverished encoding of relational information in the picture-encoding condition as compared with the word-encoding condition, then parallel results should be observed with both recall instructions. If participants encode less relational information after picture encoding, then the retrieval instructions should make little difference in the rate at which critical lures are reported if these lures do not come to mind in the first place.

<p>The second prediction that discriminates between these two accounts involves the proportion of studied items and critical lures recalled under the inclusion instructions that are subsequently recognized as having been presented during the encoding phase. As noted earlier, the distinctiveness heuristic predicts that a smaller proportion of critical lures will be falsely recognized by participants who studied pictures than will be falsely recognized by those who studied words.

<p>Lastly, the impoverished relational-encoding account makes an additional prediction about recall rates of studied items under standard instructions and under inclusion instructions. Specifically, participants who study words should report greater numbers of studied items under the inclusion instructions than they report under the exclusion instructions, replicating the findings of Brainerd et al. (2003). As Brainerd et al. report, two mechanisms contribute to the recall of studied items under the inclusion instructions: First, participants may recollect studying the item earlier, and second, participants may generate the studied item based on their memory for relational information—their knowledge that the studied items shared similar meanings. Under the standard instructions to recall only studied items, however, only the first mechanism is

likely to contribute to recall. Therefore, after word encoding, the foregoing imbalance across the two instructions should produce higher recall rates of studied items under the inclusion than they do under the standard instructions. The impoverished relational-encoding account predicts that, in contrast with the word encoding condition, picture encoding should produce comparable recall rates of studied items under both instructions. In other words, if picture encoding reduces relational information, then recollection should be the primary contribution to recall rates of the studied items under both instructions. In sum, the impoverished relational-encoding account predicts an interaction between the encoding conditions and the retrieval instructions with respect to the rates at which studied items are recalled. To test the foregoing predictions, in Experiment 2, we replicated and extended the methodology of Experiment 1 such that encoding condition (picture vs. word) and recall instruction (standard vs. inclusion) were manipulated between subjects.

<h3>*Method*

<h4>*Participants.* **<smtxt>**Eighty-four University of Virginia undergraduate students (58 women and 26 men) participated in this study. There were 21 participants in each condition, and each participant received course credit or $5 for his or her participation.

<h4>*Design and materials.* **<smtxt>**The materials and design used in Experiment 2 were identical to those used in Experiment 1.

<h4>*Procedure.* **<smtxt>**Half of the participants studied pictures, whereas the other half studied words. In addition, half of the participants received standard recall instructions and were asked to recall as many studied items as they were able. The remaining participants received inclusion recall instructions and were asked to recall studied items as well as any items related to the studied items that came to mind. After the participants in the inclusion-instructions condition completed the recall task, they were directed to go through their reported items and put a check next to those items that were actually presented during the study phase.

<h3>_Results and Discussion_

<txt>Figure 2**<fgc>** presents the probabilities of recalling studied items, and Figure 3**<fgc>** shows the probabilities of recalling critical lures. With respect to our predictions, we began by examining recall rates of studied items under the standard instructions and inclusion instructions, as shown in Figure 2. A 2 (encoding condition: picture vs. word) x 2 (test instructions: standard vs. inclusion) ANOVA of the rates at which studied items were recalled yielded a marginally significant effect of test instructions, $F(1, 80) = 3.35$, $MSE = 0.01$, $p = .07$, and a significant interaction, $F(1, 80) = 6.60$, $MSE = 0.01$, $p = .01$. Participants who studied words reported significantly more studied items under the inclusion than under the standard instructions, $t(40) = 3.24$, $p < .01$. By contrast, participants who studied pictures reported studied items at comparable rates under both instructions, $t(40) < 1$. This pattern exactly fits the predictions of the impoverished relational-encoding account. The acquisition of relational information during word encoding contributes to the greater reporting of studied items under the inclusion instructions than under the standard instructions. The impaired acquisition of this information during picture encoding explains the comparable recall rates of studied items under both instructions.

<p>Figure 3 presents the rates at which critical lures were reported under both retrieval instructions. A 2 (encoding condition: picture vs. word) × 2 (test instructions: standard vs. inclusion) ANOVA of the rate at which the critical lures were recalled yielded significant main effects of encoding, $F(1, 80) = 13.89$, $MSE = 0.04$, $p < .01$, and test instructions, $F(1, 80) = 62.86$, $MSE = 0.04$, $p < .01$. Many more critical lures were recalled by participants who studied words than were recalled by those who studied pictures. In addition, more critical lures were reported under the inclusion instructions than were reported under the standard instructions. In contrast with the prediction of the distinctiveness heuristic, there was no significant interaction between encoding and retrieval conditions ($F < 1$). The retrieval instructions did not affect the magnitude of the difference in recall rates of the critical lures between the two encoding conditions. This pattern, however, fits the predictions of the impoverished relational-encoding account and indicates that critical lures are less likely to come to mind after picture encoding than they are after word encoding.

<p>With respect to the average frequency with which noncritical intrusions were reported under the two retrieval instructions, there were no differences between the two encoding conditions. Specifically, under the inclusion recall instructions, the average frequency of noncritical intrusions was 30.4 in the picture-encoding condition and 27.2 in the word-encoding condition, $t(40) < 0.35$. Under the standard recall instructions, picture encoding and word encoding yielded average noncritical report rates of 1.3 and 0.7 items per person, respectively, $t(40) = 1.39$.

<p>Our remaining prediction from these two accounts concerns the proportion of studied items and critical lures, reported under the inclusion instructions, that were subsequently recognized as having been presented during the encoding phase. Because the inclusion instruction condition is a replication of this condition in Experiment 1, we compared performance across these two experiments with the goal of combining them and, thus, increasing our power of detecting an effect. Specifically, we conducted a 2 (Experiment 1 vs. Experiment 2) x 2 (encoding condition: picture vs. word) x 2 (item type: studied items vs. critical lures) ANOVA on the proportion of studied items and critical lures that were reported under the inclusion instructions and then endorsed as having been presented during the encoding phase, as presented in Figure 4.**<fgc>** This ANOVA determined that there was a marginally significant main effect of experiment, $F(1, 80) = 3.39$, $MSE = 0.06$, $p < .07$, such that endorsement rates tended to be higher overall during Experiment 2 than they were during Experiment 1, but it is important to note that this factor did not interact with either of the other variables, all Fs(1, 80) < 1. Therefore, we continued with the analysis of the combined data from identical conditions in Experiments 1 and 2.

<p>The preceding ANOVA yielded a marginally significant effect of encoding, $F(1, 80) = 3.55$, $MSE = 0.06$, $p = .06$; a significant effect of item type, $F(1, 80) = 140.89$, $MSE = 0.07$, $p < .01$; and a significant Encoding x Item Type interaction, $F(1, 80) = 4.59$, $MSE = 0.07$, $p < .05$. As shown in Figure 4, the Encoding x Item Type interaction fits the predictions of the distinctiveness heuristic. That is, there were significantly fewer critical lures falsely recognized by participants who studied pictures (29%) than by those who studied words (45%), $t(82) = 2.11$, $p < .05$. Yet there were nearly identical correct-recognition rates of studied items by participants in both encoding conditions (86% vs. 85%). Finally, false-recognition rates of the noncritical intrusions were comparable after picture encoding (10%) and word encoding (8.6%), $t(82) < 0.50$.

<p>In sum, Experiment 2 replicates the observations from Experiment 1 and provides evidence that both the impoverished relational-encoding and distinctiveness heuristic accounts contribute to the reduction in false memories after picture encoding. However, the evidence for the contributions of the distinctiveness heuristic comes solely from the post-recall recognition test. The distinctiveness heuristic does not appear to reduce false memories under free-recall conditions. However, consider an alternative account of the recognition data that does not require a distinctiveness heuristic. The impoverished relational-encoding account could explain the false-recognition suppression effect by assuming that, on average, the recalled critical lures have a lower level of activation or familiarity after picture encoding than they do after word encoding. This difference in overall familiarity–activation, therefore, would account for lower false-recognition rates after picture encoding. This explanation awaits further tests.

<p>Finally, it may appear surprising, given the picture-superiority (PS) effect, that we did not observe better recall of the pictures than of the words with the standard recall test (e.g., Paivio, 1986). However, this effect is typically observed when participants have studied a list containing a mixture of pictures and words, in contrast with our between-subjects manipulation of encoding (see Dodson & Schacter, 2002b, for a fuller discussion). Moreover, our results suggest an additional reason for the absence of a PS effect. Assuming that, all things being equal, related items are generally recalled at higher rates than unrelated items (although see Hunt & McDaniel, 1993), then there is an important reason why we would not expect a PS effect with related items, such as the ones from the DRM paradigm. Our experiments show that presenting related items as pictures appears to impair the spontaneous encoding of relational information and thus appears to nullify whatever improvement naturally occurs after studying related materials. Therefore, we may not have observed a PS effect because the impoverished encoding of relational information after studying pictures counteracts the normally greater recall of pictures than of words.

<h1>General Discussion

<txt>In Experiments 1 and 2, we examined two different accounts of why studying pictures reduces false memories within the DRM paradigm. The impoverished relational-encoding account suggests that reduced false memories are produced because the critical lures elicit less familiarity and other memorial information after picture encoding than they do after word encoding. By contrast, the distinctiveness heuristic assumes that studying pictures does not reduce memorial information for the critical lures. Instead, the critical lures are actively withheld from being reported or endorsed by the use of a retrieval strategy whereby the absence of memory for expected distinctive information is taken as diagnostic of an event's nonoccurrence. The recall results from both experiments support the impoverished relational-encoding account and do not support the distinctiveness heuristic. Participants who studied pictures reported critical lures less often than did participants who studied words, even when participants were given inclusion instructions to report studied items as well as related items. Therefore, it appears that critical lures are less likely to come to mind after picture encoding than they are after word encoding, as the impoverished relational-encoding account suggests. However, the recognition results support the distinctiveness heuristic account. Participants were less likely to falsely recognize critical lures after picture encoding than they were after word encoding. In sum, in this article, we demonstrate the contributions of both false-memory suppression mechanisms in the DRM paradigm.

<p>The present results, in combination with extant data, point toward both retrieval processes and encoding processes as contributing to the reduction in false memories. At retrieval, there are a variety of inferential strategies, such as the distinctiveness heuristic, that may be invoked when an individual fails to remember sufficient information about a past event (e.g., Dodson & Schacter, 2001, 2002a; see Dodson & Johnson, 1996, for a different retrieval strategy). This view of retrieval as, in part, an inferential process is consistent with the source-monitoring framework (e.g., Johnson et al., 1993). The distinctiveness heuristic depends on an individual's metamemorial beliefs about what ought to be remembered about past events. Failing to remember expected information about an event is taken as a sign of its never having occurred. This retrieval strategy has proven effective at reducing false-recognition responses in a variety of paradigms (e.g., Dodson & Schacter, 2002a; Schacter et al., 1999). Moreover, this heuristic is very similar to Collins and colleagues' "lack of knowledge inference" (Collins, Warnock, Aiello, & Miller, 1975, p. 397), whereby individuals ruled out the occurrence of past events (e.g., Did you ever shake Bill Clinton's hand?) based on the lack of expected knowledge for this event (Collins et al., 1975; Gentner & Collins, 1981). Other researchers have proposed similar metacognitive strategies for ruling out events on the basis of the absence of expected memorial information (e.g., Brewer & Treyens, 1981; Brown, Buchanan, & Cabeza, 2000; Brown, Lewis & Monk, 1977; Hicks & Marsh, 1999; Strack & Bless, 1994; cf. Rotello, 1999; Wixted, 1992).

<p>More broadly, the distinctiveness heuristic is consistent with retrieval strategies that are involved in attributing items to a particular source (e.g., Johnson et al., 1993). Specifically, there is a variety of decision biases that depend on participants' metamemorial beliefs about the relative memorability of events from different sources (e.g., Anderson, 1984; Foley, Johnson, & Raye, 1983; Hashtroudi, Johnson & Chrosniak, 1989; Hicks & Marsh, 1999; Johnson, Raye, Foley, & Foley, 1981; Kelley, Jacoby, & Hollingshead, 1989). For example, the "it had to be you" effect refers to a retrieval bias whereby falsely recognized new words are more likely to be attributed to an external source than to an internal source. This bias reflects the metamemorial belief that self-generated information is usually more memorable than heard (externally provided) information (Johnson & Raye, 1981). Therefore, attributing a familiar item to an external source is based on the reasoning that the absence of memory for expected information about generating the item suggests that the item must have been heard (i.e., "it had to be you").

In sum, the distinctiveness heuristic and the other foregoing metacognitive retrieval strategies guide behavior on the basis of the absence of memory for expected information.

<p>By contrast, a retrieval mechanism known as recall-to-reject or recollection-rejection suppresses false memories on the basis of remembering specific prior events (e.g., Brainerd et al., 2002; Hintzman, Curran, & Oppy, 1992; Jennings & Jacoby, 1997; Rotello & Heit, 1999). For example, Brainerd and Reyna show that individuals can correctly reject familiar but incorrect test items when they remember specific verbatim traces about an earlier event (e.g., a person might correctly reject *spaniel* when she remembers that she studied the word *poodle*). Similarly, Benjamin (2001) showed that participants were less likely to falsely recognize related lures in the DRM paradigm when the lures were related to lists that had been studied three times, as opposed to one time. With repetition, participants may recall more accurately the exact items that were presented on a particular list; this, in turn, allows them to note that a related-lure word was not presented previously (e.g., Benjamin, 2001; Kensinger & Schacter, 1999; McDermott, 1996). In sum, the foregoing retrieval processes edit out and actively suppress the occurrence of false memories based on either the absence of expected memorial information (e.g., the distinctiveness heuristic) or the presence of specific memorial information (e.g., recall-to-reject).

<p>In contrast to these retrieval suppression mechanisms, there are encoding processes that reduce false memories by decreasing their availability or likelihood of coming to mind at retrieval. Our results suggest that false memories in the DRM paradigm can be reduced because of the impoverished encoding of relational or associative information. As stated earlier, other frameworks could also explain the picture-encoding results in terms of decreased activation of the related lure (e.g., Roediger, Balota, & Watson, 2001; Roediger, Watson, McDermott, & Gallo, 2001) or decreased gist representations (e.g., Brainerd, Wright, et al., 2002).

<p>The question remains why the distinctiveness heuristic is used during recognition but does not seem to be used during recall. The different task demands at recall and at recognition may explain why the distinctiveness heuristic is not used at recall. On recognition tests, invoking the distinctiveness heuristic means that test items are evaluated in terms of the absence of memory for expected distinctive information. At recall, however, items first must be generated and then maintained in working memory while the distinctiveness criterion is applied to them. Although, theoretically, it should be possible for participants to use the distinctiveness heuristic at recall, it may not be used spontaneously because of the demands of this two-stage process, especially since the first stage (i.e., generating items) completes the nominal demands of the recall test. Perhaps the distinctiveness heuristic would be applied at recall if participants were given different test instructions that emphasized only reporting items that elicited pictorial information. This remains an avenue for future research.

<p>Our results have implications for extant research that has used encoding manipulations and has attributed reduced false memories within the DRM paradigm to the use of a retrieval strategy. First, our findings suggest that reduced false memories on a recall test are likely the result of impoverished encoding of associative information rather than the by-product of a retrieval strategy. Second, even on recognition tests, it is difficult to unambiguously explain reductions in false memories in terms of a retrieval strategy, unless a retrieval manipulation, such as responding under time pressure, is used. Therefore, the DRM paradigm may not be the optimal paradigm for examining strategic retrieval processes that are caused by encoding distinctive information. Instead, the repetition lag paradigm is an alternative for examining strategic retrieval processes that is not vulnerable to the same aforementioned interpretive problems (see Dodson & Schacter, 2002b for a fuller discussion).

<p>In conclusion, our results indicate that when examining the influence of a study manipulation, such as encoding distinctive information, on false memories within the DRM paradigm, there are two very different mechanisms that can explain reductions in false memories:(a) Reduced false memories can be caused by the impoverished encoding of relational information; and (b) Reduced false memories can be caused by strategic retrieval processes such as the distinctiveness heuristic.

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<fig>*Figure 1.* Probabilities of recalling studied items and critical lures under inclusion instructions after studying words or pictures in Experiment 1. Vertical bars indicate the standard error of the mean.

<fig>*Figure 2.* Probabilities of recalling studied items under standard and inclusion instructions after studying words or pictures in Experiment 2. Vertical bars indicate the standard error of the mean.

<fig>*Figure 3.* Probabilities of recalling critical lures under standard and inclusion instructions after studying words or pictures in Experiment 2. Vertical bars indicate the standard error of the mean.

<fig>*Figure 4.* True recognition rates of studied items and false-recognition rates of critical lures on the postrecall recognition test, collapsed across Experiments 1 and 2. Vertical bars indicate the standard error of the mean.

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