NIH Public Access
Author Manuscript
J Mem Lang. Author manuscript; available in PMC 2012 November 1.

Published in final edited form as:
J Mem Lang. 2011 November 1; 65(4): 378–389. doi:10.1016/j.jml.2011.06.003.

How Does Distinctive Processing Reduce False Recall?

R. Reed Hunt, **Rebekah E. Smith**, and **Kathryn R. Dunlap**
Department of Psychology, The University of Texas at San Antonio

Abstract

False memories arising from associatively related lists are a robust phenomenon that resists many efforts to prevent it. However, a few variables have been shown to reduce this form of false memory. Explanations for how the reduction is accomplished have focused on either output monitoring processes or constraints on access, but neither idea alone is sufficient to explain extant data. Our research was driven by a framework that distinguishes item-based and event-based distinctive processing to account for the effects of different variables on both correct recall of study list items and false recall. We report the results of three experiments examining the effect of a deep orienting task and the effect of visual presentation of study items, both of which have been shown to reduce false recall. The experiments replicate those previous findings and add important new information about the effect of the variables on a recall test that eliminates the need for monitoring. The results clearly indicate that both post-access monitoring and constraints on access contribute to reductions in false memories. The results also showed that the manipulations of study modality and orienting task had different effects on correct and false recall, a pattern that was predicted by the item-based/event-based distinctive processing framework.

Roediger and McDermott's (1995) resurrection of Deese's (1959) preparation instigated a flood of studies on false memory (see Gallo, 2006, for a thorough review). In the Deese (DRM) paradigm, the participant is asked to remember a list of words. All of the presented words are related to a single word, which is not presented in the list. All things equal, the non-presented word is remembered at about the same level as the presented words and with the same degree of confidence in both recognition and recall tests (e.g., Payne, Elie, Blackwell, & Neuschatz, 1996; Roediger & McDermott, 1995). Although false memories can be difficult to prevent (e.g., Gallo, Roediger, & McDermott, 2001; Kimball & Bjork,

---

Correspondence should be addressed to R. Reed Hunt, Department of Psychology, The University of Texas at San Antonio, San Antonio, TX 78249. reed.hunt@utsa.edu.

[1]We also examined the number of non-critical intrusions; however, given that these intrusions were infrequent, the interpretation of results was complicated in some cases by floor effects. Nonetheless, we provide a brief summary of the results for non-critical intrusions here. In Experiment 1, the number of other intrusions was significantly affected by study condition, $F(2,174) = 20.38$, $MSE = 3.98$, $p < .001$, $\eta_p^2 = .19$, (vowel counting: $M = 2.80$, $SEM = .39$; pleasantness rating: $M = .81$, $SEM = .19$; intentional study condition: $M = .78$, $SEM = .16$) and the main effect of test type was also significant, $F(1,174) = 8.40$, $MSE = 3.98$, $p = .004$, $\eta_p^2 = .05$ (inclusion test: $M = 1.89$, $SEM = .27$; standard recall test: $M = 1.03$, $SEM = .19$), but the two variables did not interact, $F(2,174) = 2.06$, $MSE = 3.98$, $p > .13$. In Experiment 2, the number of other intrusions, was significantly affected by the type of test, $F(1,118) = 8.34$, $MSE = 6.37$, $p = .005$, $\eta_p^2 = .09$ (inclusion test: $M = 1.93$, $SEM = .45$; standard recall test: $M = .61$, $SEM = .10$), but the effect of orienting task was not significant and the two variables did not interact, Fs < 1, ps > .66. Finally, in Experiment 3, the number of other intrusions was significantly affected by study modality, $F(1,272) = 6.97$, $MSE = 1.91$, $p = .009$, $\eta_p^2 = .03$ (visual study: $M = .60$, $SEM = .13$; auditory study: $M = 1.04$, $SEM = .11$) and by test type, $F(1,272) = 6.97$, $MSE = 1.91$, $p = .009$, $\eta_p^2 = .03$ (inclusion test: $M = 1.04$, $SEM = .15$; standard recall test: $M = .60$, $SEM = .07$), but neither the effect of orienting task nor any of the interactions reached significance, Fs < 1.81, ps > .18.

2002; McConnell & Hunt, 2007; Neuschatz, Lynn, Benoit, & Payne, 2003), research has uncovered some variables that reduce, if not eliminate, false memory.

One set of such variables is the mode of study list presentation. For example, Schacter and his colleagues (e.g., Schacter, Cendan, Dodson, & Clifford, 2001; Schacter, Israel, & Racine, 1999) found that false memory is reduced if pictures accompany the auditory presentation of list words relative to presentation of the visual word along with the auditory word. Likewise, fewer false memories occur when associated word lists are seen as opposed heard (Cleary & Greene, 2002; Gallo, McDermott, Percer, & Roediger, 2001; Kellogg, 2001; Smith & Engle, 2011; Smith & Hunt, 1998; Smith, Hunt, & Gallagher, 2008; Smith, Lozito, & Bayen, 2005). Another prominent set of variables that reduces false memory is the activity performed on the study list. For instance, Smith and Hunt (1998) found that rating the pleasantness of each list item reduced false memory relative to intentional memory instructions. McCabe, Presmanes, Robertson, and Smith (2004) showed that pleasantness rating reduced false memory relative to a sorting tak. Dodson and Schacter (2001) required participants to read each study word aloud, which reduced false memory compared to reading the words silently, and Seamon et al. (2003) found that writing the words as they are heard reduces false memory relative to just hearing the words. The purpose of the research reported here is to examine the output processes that mediate the effects of variables that reduce false memory.

Output Processes: Early Selection or Late Correction?

The issue of output processes mediating false memory is framed nicely by Jacoby, Kelley, and McElree (1999) who distinguished between early selection and late correction. They argue that memory accuracy can be controlled either by editing what comes to mind (late correction) or alternatively restricting what comes to mind in response to a cue (early selection). Both types of control have been proposed to account for the reductions in false memory. The better known of these positions is post-access monitoring in which the products of retrieval are edited for accuracy before output.

Late Correction: The Distinctiveness Heuristic—The distinctiveness heuristic (Schacter et al., 1999) is the predominant example of post-access monitoring. The distinctiveness heuristic is a strategy adopted at the time of a memory test. On the meta-memorial belief that some feature shared by all of the target items will be particularly memorable, all accessed items are strategically monitored at test for evidence of that original processing. The information believed to be memorable is said to be “distinctive”, hence the distinctiveness heuristic. The absence of evidence for the distinctive processing is evidence for the absence of the item in the original experience (Schacter et al.). The distinctiveness heuristic has received substantial support in prior research. (e.g., Dodson & Schacter, 2002; Gallo, Meadow, Johnson, & Foster, 2008; Gallo, Weiss, & Schacter, 2004; Schacter et al., 2001).

Early Selection: Impoverished Relational Processing—Prior research has also produced evidence supporting the early selection approach to explaining the beneficial effect of certain variables on false memory. Using the DRM paradigm, Arndt and Reder (2003) varied the font in which study words were presented such that all of the words from an associative theme appeared in the same font or all words appeared in different fonts. False recognition of critical lures was reduced in the unique font condition, and this effect occurred regardless of whether the font manipulation was within- or between-subjects. Arndt and Reder proposed an access-based explanation for their data that appeals to the distinction between relational and item-specific processing (e.g., Hunt & Einstein, 1981). Relational processing is the processing of information shared by all of the elements of an event. Item-specific processing is the processing of information unique to an item in the list. An obvious dimension of relationship among the items of a DRM list is the information corresponding to the critical, non-presented item to which all other items are related. Arndt and Reder suggested that their font manipulation affected the relative balance of relational and item-specific information. When each item is in a different font, study processing is directed toward item-specific features and away from relational attributes thus reducing the probability of activation of the critical item. Thus, the critical item is less likely to come to mind at test.

The access interpretation was directly tested by Hege and Dodson (2004), who used the picture-word manipulation to reduce false memory of critical DRM list items. The focal variable in this study was the type of instructions given at test, either standard or inclusion instructions. Standard test instructions were to recall the items shown at study. Inclusion instructions were to recall the items from study as well as other related items that come to mind. A version of these instructions were first used in DRM studies by Brainerd and Reyna (1998), who found that more critical items are recalled under inclusion than under standard instructions, as would be expected if post-access monitoring were part of retrieval. Inclusion instructions should disengage post-access monitoring allowing more critical intrusions in the inclusion test than in the standard test. On this reasoning, Hege and Dodson predicted that the normal reduction in false recall following picture + word study should disappear in the inclusion condition. To the contrary, their results showed a comparable reduction of false recall under inclusion and standard recall instructions. Hege and Dodson interpreted their data in line with the reduction in relational processing proposed by Arndt and Reder (2003). That is, the beneficial effect of picture presentation at study is the result of encoding processes that reduce the probability of the critical item coming to mind and subsequently being remembered. In sum, the explanations proposed by Arndt and Reder (2003) and Hege and Dodson (2004) converge on the conclusion that the reduction in false memory was due to a deficit in relational processing at study.

An Alternative View

In contrast to Arndt and Reder (2003) and Hege and Dodson (2004), we presume that the constraint on false memory imposed by the variables we investigate is not due to impoverished relational processing, but instead we propose an explanation in which item-specific and relational processing work in concert, resulting in distinctive processing that can reduce false memories. However, our conceptualization of distinctive processing is unlike that of the distinctiveness heuristic. Distinctive processing will be defined as the processing of difference in the context of similarity, a position that grew out of the research surrounding the distinction between item-specific and relational processing (Hunt & Einstein, 1981; see Hunt and McDaniel, 1993, for a review of this research). Relational processing encodes some dimension(s) of similarity among a set of items, e.g., spatial/temporal and semantic, whereas item-specific processing entails information specific to individual items. If difference (item-specific) is encoded in the context of similarity and that difference processing is reinstated at retrieval, i.e., distinctive processing is reinstated at retrieval, precise memory for the studied items will occur.

Distinctive processing has been invoked to explain the effect of encoding operations on false memory. Dobbins, Kroll, Yonelinas, and Liu (1998) and Gruppuso, Lindsay, & Kelly (1997) reported experiments in which subjects were shown two separate lists of words and then asked to remember the items only from the second list. Memory was better when different orienting tasks were performed on the two lists compared to the same task on both lists, and the difference was due entirely to fewer false memories of first list items following the different orienting tasks. The effect was attributed to distinctive processing but contrary to the foregoing description of distinctive processing, there was no effect on studied items. To reconcile the two accounts, Hunt (2003) noted that the preparation used by Dobbins et al. and Gruppuso et al. did not vary distinctive processing within the target study list (i.e., all items in the list received distinctive processing). Consequently, one would not predict an effect on hits from distinctive processing. However, the effect on false alarms can be explained in terms of distinctive processing if one assumed that the unit to which that distinctive processing applied is the unit of the lists. That is, the two lists appeared in a similar spatial/temporal context but within that encoding context similarity, a different orienting task was applied to each list. Thus, two different orienting tasks promoted distinctive processing, not at the level of studied items, but at the level of the lists.

Event-based and Item-based Distinctiveness—To capture the difference between item and list processing, Hunt (2003) proposed a distinction between item-based distinctive processing and event-based distinctive processing. In both cases distinctive processing is defined as processing difference in the context of similarity, but in one case the difference occurs at the level of the individual items within the target list and in the other it refers to difference between two lists. As discussed in greater detail in the discussion section, the definition of items and events will be determined largely by the way in which memory is probed or cued. In the two list paradigm, the individual list words constitute the items and each list constitutes an event. Within a list, each item can receive processing that differentiates that item from the other items in the list, resulting in item-based distinctive processing. If the two lists are processed in different ways (for instance one receives pleasantness ratings while the other is sorted into categories), this provides for differentiation of the two lists within the shared context of the overall study episode. In other words, processing the two lists in different ways allows for event-based distinctiveness with each list constituting an event. Hunt (2003) demonstrated that manipulations of item-based and event-based distinctive processing exerted independent effects on memory for target items and on false alarms.

Applied to false memory in the DRM paradigm (Table 1), the study list constitutes the event and the words within the list constitute the items. Event-based distinctive processing presumes that differences in processing the DRM target list and the critical item will reduce false memory of the critical item. At one level, processing of targets and the critical item is always different in that the critical item is not subject to perceptual processing. This distinction alone is sufficient to support accurate responses to some critical items; we are unaware of any study reporting false responses to100% of the critical items. Beyond that difference, various manipulations exaggerate processing differences between list items and critical items. The two manipulations that we shall study here are orienting tasks and modality of study presentation. Semantic orienting tasks and visual study presentations have been shown to reduce critical false alarms relative to auditory study presentations under intentional memory study, and we argue that this is due to event-based distinctiveness. Semantic orienting tasks have also been shown to improve correct recall, a finding that we attribute to item-based distinctiveness. Thus, as considered in greater detail in the general discussion, the theory of event-based and item-based distinctive processing described above will be shown to be useful for predicting the effects of these manipulations on false recall as well as correct responses.

Comparing Standard and Inclusion Recall Tests

The primary purpose of the current experiments is to investigate control processes at output by comparing performance on the inclusion test used by Hege and Dodson (2004) with standard free recall. In other words, we will apply the inclusion test to evaluate whether the effects of event-based and item-based distinctiveness in the DRM paradigm occur through early-selection, late correction, or some combination of the two. The first two experiments will feature manipulations of orienting tasks. The third experiment will manipulate both orienting task and modality of study presentation.

Experiment 1

The first experiment examined the effects of orienting tasks at study on false recall of DRM lists as a function of the type of recall instructions. The three encoding conditions were intentional memory, a deep orienting task (pleasantness rating), and a shallow orienting task (vowel counting). Test instructions were either standard free recall instructions or inclusion instructions. The latter explicitly allowed recall of items related to the list items, even if the related items had not been in the study list.

Previous research has found a reduction in false recall following a deep orienting task at study relative to intentional memory instructions (Smith & Hunt, 1998). Thus, we predicted that for the standard recall test, pleasantness rating would reduce false recall relative to intentional study. The particular deep processing task used in this experiment, pleasantness rating, encourages both item-specific and event-based processing. Therefore, the deep processing condition will show an increased level of correct recall, as well as a reduction in false recall, relative to the intentional memory condition.

The shallow orienting task was included in the first experiment to allow us to address a second issue. In contrast to Smith and Hunt (1998), several studies have reported that deep orienting tasks produce more false memories for DRM lists (e.g., Rhodes & Anastasi, 2000; Thapar & McDermott, 2001; Toglia, Neuschatz & Goodwin, 1999). All of these studies have compared the effect of deep tasks to shallow tasks whereas Smith and Hunt used intentional memory study instructions as the comparison on the assumption that Roediger and McDermott's (1995) procedures were the standard against which reductions in false memory for DRM lists should be judged. This experiment is the first study to simultaneously compare the three conditions in a single experiment.

As Gallo et al. (2008) noted, the increase in false memory following a deep orienting task compared to a shallow task is not surprising in the DRM paradigm because false memory results from comprehension of the list items. Shallow processing focuses on non-semantic attributes of the list items and consequently is less likely to entail activation of the representation of the critical item, whether it be by reducing the activation of that representation or by eliminating the gist processing that represents the item. In short, the shallow task limits access to the critical false item as well as to the list items because of impoverished relational processing of the list items at study. Based upon the previous studies, we also predicted that false recall on the standard recall test would be reduced following vowel counting relative to pleasantness rating.

In addition, the first experiment was conducted to determine if the same reduction patterns would occur under inclusion test instructions. From the standpoint of post-access monitoring, any reduction of false recall following the deep orienting task under standard test instructions should disappear under inclusion instructions. Alternatively deep processing could be the basis for constraining access to the targeted list items. If so, deep processing should reduce false recall in the inclusion recall condition as well as the standard test condition. A third possibility is that both retrieval mechanisms are in play. There is no reason to assume that they are mutually exclusive. In that event, more false items would be recalled under inclusion test instructions than under standard recall instructions in all study conditions, but the deep orienting task would continue to show a reduced level of false recall relative to the intentional study condition.

Method

Participants and design—One hundred and eighty introductory psychology students from the University of Texas at San Antonio participated for course credit. All were native English speakers. Participants were randomly assigned to one of three study tasks: intentional memory instructions, pleasantness rating (deep processing), or vowel counting (shallow processing). Half of the people in each study condition were assigned randomly to either the standard recall test or an inclusion recall test conditions. Thus, 6 groups of participants were established based on the orthogonal combination of study condition and test instructions.

Materials—The study lists were composed from the same six associatively related lists that were used by Roediger and McDermott (1995, Experiment 1). Those lists were chosen because they elicited high levels of false memory. For each of those 6 lists, the study items were the 12 highest associates, which were presented blocked by associative category in decreasing order of associative relation to the critical item. Each of the 72 study items was shown for 3 seconds on individual computer monitors.

Procedure—Participants completed the experiment in groups of up to six people per session. Once the participant was seated at their testing station, informed consent was obtained and then study instructions were given. Everyone was told that they would see a list of words presented individually on the monitor and that their memory for these words would be tested. The intentional memory group simply was instructed to pay attention to each word and try to remember it. The pleasantness rating (PR) group was asked to rate each word on a scale from 1–5 for perceived pleasantness. The vowel counting (VC) condition was instructed to count the number of vowels in each word. Responses to the orienting tasks for the PR and VC conditions were entered on the number pad of the keyboard during the 3 second presentation period. Immediately following the study list, recall instructions were given. Standard recall instructions were to write all of the words that could be remembered with encouragement to be reasonably sure that the word had been seen before including it in their response. Inclusion instructions followed those of Hege and Dodson (2004): participants were instructed to recall all of the list words that could be remembered and to also write down any related words that came to mind when trying to remember the list items. Three minutes were allocated for the recall tests.

Results

Two dependent measures were analyzed: false recall of critical intrusions, where the critical intrusions were the non-presented associates of the items in the study lists, and correct recall of studied items. All analyses reported as reliable reached at the .05 alpha level.

False recall of Critical intrusions—The proportion of non-presented critical items produced on the recall test is shown in Table 2. An analysis of variance of the critical intrusions as a function of study condition and test type yielded a reliable effect of study condition, $F(2,174) = 27.36$, $MSE = .02$, $p < .001$, $\eta_p^2 = .24$. The intentional study condition had the highest rate of critical intrusions, $M = .25$, $SEM = .02$, a rate that was significantly higher than in the pleasantness rating condition, $M = .17$, $SEM = .02$, $t(118) = 2.48$, $p = .015$, $d = .42$, which in turn was significantly higher than the rate of critical intrusions in the vowel counting condition, $M = .06$, $SEM = .01$, $t(115) = 4.51$, $p < .001$, $d = .75$. The main effect of test type also reached significance with participants producing more critical intrusions in the inclusion test condition, $M = .21$, $SEM = .02$, than in the standard free recall condition, $M = .11$, $SEM = .01$. $F(1,174) = 22.64$, $MSE = .02$, $p < .001$, $\eta_p^2 = .12$. The two variables did not interact, $F(2,174) = 1.21$, $p > .30$.

Because the non-significant interaction in this analysis speaks to the issue of whether post-access monitoring underlies the effects of orienting task, we conducted a power analysis using GPower 3.1.2 (Faul, Erdfelder, Lang, & Buchner, 2007). The power analysis revealed that our power to detect medium size interactions ($f = .25$) was .85; furthermore, over one thousand participants would be required to reach the same level of power for detecting an effect as small as that observed for the interaction ($f = .10$). Nonetheless, additional comparisons were carried out to specifically address whether study task condition would affect false recall on the inclusion test. Under inclusion test instructions, PR study reduced intrusions of critical items relative to intentional study, $t(58) = 2.28$, $p = .03$, and VC study reduced false recall below that in the PR study condition, $t(58) = 3.27$, $p = .002$

Additional analyses were conducted to evaluate our specific predictions regarding false recall in the standard test condition. One-tailed test were used to evaluate these a priori predictions. Specifically, we predicted that we would replicate the findings reported in Smith and Hunt (1998) showing a reduction in false recall following PR study relative to intentional study. The PR study condition produced fewer false recall responses relative to the intentional study condition, $t(58) = 1.71$, $p < 05$. We also expected to replicate previous studies showing a reduction in shallow processing conditions relative to deep processing conditions (e.g., Rhodes & Anastasi, 2000; Thapar & McDermott, 2001; Toglia et al., 1999). As expected, false recall was further reduced in the VC study condition relative to the PR study condition, $t(61) = 5.40$, $p < .001$.

Correct recall—The proportion of studied items that were correctly recalled (Table 2) was affected by study condition, $F(1,174) = 140.63$, $MSE = .01$, $p < .001$, $\eta_p^2 = .62$. Correct recall in the pleasantness rating condition, $M = .30$, $SEM = .01$, was higher than in the intentional study condition, $M = .27$, $SEM = .01$, $t(118) = 2.08$, $p = .04$, $d = .35$, which in turn was higher than correct recall in the vowel counting condition, $M = .08$, $SEM = .01$, $t(121) = 14.17$, $p < .001$, $d = 2.47$. Neither the effect of test type, $F(1,174) = 1.04$, $MSE = .01$, $p > .30$, nor the interaction between study condition and test type reached significance, $F < 1$, $p = .98$.

Discussion

Performing a PR orienting task reduced the production of non-presented critical items (i.e., false recall) relative to intentional memory instructions at study, a finding that replicates previous results (Smith & Hunt, 1998). The novel finding in the current experiment is that the reduction in false recall also was present on the inclusion test. Such an outcome would not be expected if post-access monitoring of the retrieved items were the only mechanism for editing memory. One aspect of the data however suggests that post-access monitoring was part of the output process. The number of intrusions in the inclusion test condition increased substantially over the number in the standard recall conditions. The inclusion instructions disengage the editing of related non-presented items, producing more false recall of critical items than was found with standard recall instructions. In other words, post-access monitoring does play a role in standard recall tests; however, this occurs for all study conditions and because the overall pattern of false recall reduction is the same in the two types of tests, the post-access monitoring proposal cannot explain completely the effects of orienting task on false recall.

A second issue addressed in the first experiment concerned a contradiction in the literature, namely that some studies report reduced false memory following a deep processing task (e.g., Smith & Hunt, 1998) while others report an increase in false memory following a deep processing task (e.g., Rhodes & Anastasi, 2000; Thapar & McDermott, 2001; Toglia, et al., 1999). A major difference in these studies is the comparison condition. In the case of reported reductions in false memory, the deep task is compared to intentional memory instructions whereas in the case of increases in false memory, the comparison task is a shallow orienting task. Both of the previously reported patterns are replicated in our data. Thus, the effect of a deep orienting task on false recall of a DRM list depends on the comparison task, fewer false memories occur relative to an intentional task and more false memories occur relative to a shallow orienting task.

The overall pattern in the current experiment suggests that the reductions in false memory produced by deep and shallow orienting tasks have different causes. The purpose of a shallow orienting task is of course to reduce or eliminate meaningful processing of the study words. To the extent that this purpose is achieved, correct recall will be quite low, as it was here, due to impoverished semantic processing of the list words (e.g., Craik & Lockhart, 1972). Impoverished semantic processing also would discourage the processing of the critical, non-presented associate in a DRM list. That is, the item is less likely to come to mind at study and consequently would be a less likely candidate for retrieval at test. As Gallo et al. (2008) point out, reduction in false memory following a shallow task relative to a deep task probably is due to the simple fact that the deep task encourages processing of the non-presented item and the shallow task discourages that processing at study. However, the reduction of false memory following the deep task relative to intentional memory obviously cannot be attributed to impoverished processing at study. If anything, the deep task is more likely to bring the critical item to mind than the intentional instructions, nonetheless recall of critical items is reduced relative to the intentional instructions. We believe that the comparison of deep orienting tasks with intentional memory instructions is pertinent because intentional study instructions were used to establish the false memory phenomenon with DRM lists (e.g., Deese, 1959; Roediger & McDermott, 1995). Thus, Experiments 2 and 3 do not include the shallow orienting task and instead focus on the comparison of the deep processing condition with intentional memory instructions in the second and third experiments.

Experiment 2

The second experiment was a close replication of the comparison of the PR and IS conditions from Experiment 1, except that we changed the modality of study list presentation. Visual presentation was used for all items in the first experiment, but visual presentation itself has been shown to reduce false memory in the DRM paradigm (Cleary & Green, 2002; Gallo et al., 2001; Smith & Hunt, 1998). To examine the effect of deep orienting tasks on false memory divorced from the effect of visual presentation, the words were presented auditorially in the second experiment. Auditory presentation has been the standard in the DRM literature, used by every study published prior to Smith and Hunt (1998). Based upon the results of Experiment 1 and Smith and Hunt, we predicted that deep processing would reduce false memory relative to the intentional memory condition. Based upon Experiment 1 we also predicted that this pattern would emerge for both the standard recall test and the inclusion test.

Method

Participants and design—One hundred twenty-two introductory to psychology students from the University of Texas at San Antonio volunteered for course credit. The participants were assigned randomly to either intentional memory or PR orienting task at study. Half of each of study condition was assigned randomly to standard free recall test and the other half to an inclusion recall test.

Materials and procedure—The same six DRM lists that were used in Experiment 1 were used in Experiment 2. The lists were recorded in a female voice and presented to the subjects over headphones. The procedure was the same as in Experiment 1 except for the modality of study presentation.

Results

False recall of critical items—False recall of critical items is shown in Table 2 as a function of study condition and type of test. Intentional memory instructions, $M = .33$, $SEM = .03$, led to significantly greater false recall than the PR orienting task, $M = .20$, $SEM = .02$, $F(1,118) = 14.64$, $MSE = .04$, $p < .001$, $\eta_p^2 = 11$. There was a trend for false recall to be higher in the inclusion test condition, $M = .30$, $SEM = .02$, than in the standard free recall condition, $M = .23$, $SEM = .03$, $F(1,118) = 3.45$, $MSE = .04$, $p < .07$, $\eta_p^2 = 03$. As in Experiment 1, the two variables did not interact, $F(1,118) = 1.12$, $MSE = .04$, $p = .29$. We had a power of .85 to detect medium effects ($f = .25$) and nearly one thousand participants would be required to reach a power level of .85 for detecting the observed effect size for the interaction ($f = .09$). Nonetheless, additional analyses were conducted to separately test our predictions for the standard and inclusion recall tests. One tailed tests were used to test these a priori predictions. In the case of the inclusion test, there was a reduction in false recall following PR study relative to intentional study, $t(58) = 1.95$, $p = .03$. Also as predicted, PR study reduced false memory relative to intentional study instructions for the standard recall test, $t(60) = 3.47$, $p < .001$ for this one-tailed test.

Correct recall—Correct recall is shown in Table 2 as a function of study condition and type of test. Correct responding was affected reliably by study condition, $F(1,118) = 15.67$, $MSE = .01$, $p < .001$, $\eta_p^2 = .12$. Participants recalled more of the study list items following PR, $M = .30$, $SEM = .01$, than following intentional memory instructions, $M = .24$, $SEM = .01$.The effect of test type on correct recall was not significant and the two variables did not interact, *F*s < 1, *p*s > .46

Discussion

The results of Experiment 2 replicate the findings from comparable conditions in Experiment 1. The PR orienting task reduced false recall of critical items in both the standard free recall and the inclusion test. As in the first experiment, the parallel reductions in false memory on the two types of test are inconsistent with the post-access monitoring explanation of the effects of deep processing on false memory. On the other hand, there was a trend toward more intrusions on the inclusion test than on the standard test, an outcome consistent with predictions from post-access monitoring.

Distinctive processing can account for the effects of orienting task on both correct and false memory in our experiments. Correct recall was higher for the PR study condition than for intentional study in the first two experiments. Because each item's meaning is different, the deep orienting task supports item-based distinctive processing of items on the study list, which in turn enhances correct recall (Hunt, 2003). As first suggested by Smith and Hunt (1998), the deep orienting task also provides a better basis for event-based distinctive processing than intentional study because the list items are subjected to processing not required of non-list items, just as would be the case if the list items all had to be spoken or written. The third experiment will serve to replicate this pattern of results and to extend the application of the item-based and event-based distinctive processing view to both false and correct memory.

Experiment 3

In the third experiment, modality of study presentation, visual versus auditory, was combined with the manipulation of orienting task. When using a standard recall test in the

DRM paradigm, visual presentation is known to reduce false recall of critical items relative to auditory presentation (e.g., Cleary & Green, 2002; Gallo et al., 2001; Smith & Hunt, 1998). Experiment 3 addresses the following question: Does study modality exert its effect on false recall solely through post-access monitoring of retrieved items? The modality manipulation was orthogonal to a manipulation of study task, either intentional memory or PR orienting task, as well as to test type, standard free recall or inclusion free recall. This design allows a replication of the results of the first two experiments within a single experiment.

While our primary focus is on false memory, the results for correct recall provide an additional test of the event-based and item-based distinctive processing explanation. Although we expect visual presentation of study items and PR orienting tasks to have the same effect on false memory, we predict different effects of the two variables on correct performance (Table 1). Correct memory for studied items is assumed to be directly related to item-based distinctive processing. Theoretically, the PR task facilitates item-based distinctive processing in that the task encourages the encoding of meaning for each item. Given that each item has a different meaning, the PR task encourages the encoding of differences among the items in the context of the semantic and temporal/spatial similarity of list items. The effect is to enhance correct recall. On the other hand, all of the study items share the modality of presentation and thus it is not a potential contribution to item-based distinctive processing. That is, the information associated with visual presentation is the visual processing required to read the words. Because it is shared by all of the study items, visual processing is not a basis for differentiating among the study items. Therefore, visual presentation will not affect correct recall. Thus the distinctive processing analysis predicts similar effects of presentation modality and orienting tasks on false memory but no effect of modality on correct memory.

Method

Participants and design—Two hundred and eighty introductory psychology students from the University of Texas at San Antonio participated for course credit. Participants were assigned randomly to the eight conditions defined by the orthogonal combination of study task (intentional memory vs. PR task), presentation modality (visual vs. auditory), and test type (standard free recall vs. inclusion free recall).

Materials and procedure—The lists were those used in Experiments 1 and 2. The procedure for the visual condition was the same as in that in Experiment 1, and the procedure for the auditory condition was the same as that used in Experiment 2.

Results

False recall of critical items—The mean proportion of critical items that were produced on the recall test is shown in Table 3 as a function of study task, presentation modality, and type of test. False recall was higher following intentional memory instructions, $M = .33$, $SEM = .02$, than following pleasantness rating, $M = .24$, $SEM = .02$, $F(1,272) = 13.85$, $MSE = .04$, $p < .001$, $\eta_p^2 = .05$. Likewise, visual presentation at study led to lower false recall, $M = .24$, $SEM = .02$, than did auditory study presentation, $M = .33$, $SEM = .02$, $F(1,272) = 13.85$, $MSE = .04$, $p < .001$, $\eta_p^2 = .05$. The main effect of test type also was reliable, $F(1,272) = 7.93$, $MSE = .04$, $p = .005$, $\eta_p^2 = .03$. More critical items were produced on the inclusion test, $M = .32$, $SEM = .02$, than on the standard free recall test, $M = .25$, $SEM = .02$. None of the interactions among the variables were reliable, all Fs<1 and ps>.36. Our power to detect medium effects was .98 and twenty-nine hundred or more participants would be needed to reach a power level of .85 for detecting effects as small as those observed for the interactions in this analysis (fs < .06). Nonetheless, we conducted a separate analysis for the inclusion test condition. The pattern demonstrated in the omnibus test was confirmed: the main effects of study task and study modality were both significant, *F*s(1,136) > 9.00, *MSE* = .05, $p = .003$, $\eta_p^2 = .06$, and the variables did not interact, $F < 1$, $p > .51$.

Correct Recall—The mean proportion of study list items recalled is shown in Table 3. Correct recall was affected reliably by study task, $F(1,272) = 13.81$, *MSE* = .01, $p < .001$, $\eta_p^2 = .05$. Recall of study list items was better following the pleasantness rating task, *M* = .29, *SEM* = .01, than following the intentional memory instructions, *M* = .26, *SEM* = .01. Study task did not interact with either presentation modality or test type, *F*s < 1, *p*s > .64. The effects of test type, $F < 1$, $p > .75$, and modality, $F(1,272) = 1.74$, *MSE* = .01, $p > .18$, were not significant, nor did these two variables interact, $F(1,272) = 2.11$, *MSE* = .01, $p > .14$. Finally, the three-way interaction was not reliable, $F(1,272) = 1.26$, *MSE* = .01, $p > .26$.

Discussion

Consistent with prior research (e.g., Cleary & Green, 2002; Gallo et al., 2001; Smith & Hunt, 1998), visual presentation of the words at study led to fewer false recalls of critical items than auditory presentation under standard free recall instructions. The novel component of the third experiment is the effect of modality on the inclusion test where visual presentation continued to suppress false recall relative to auditory presentation. These data suggest that the effect of visual presentation on reduced false recall is not due exclusively to post-access monitoring.

The effect of the study tasks on false recall of critical items replicated the results of the first two experiments. The PR task led to lower recall of critical items on both standard and inclusion free recall tests. As in the first two experiments, the level of false recall was greater following inclusion recall instructions than following standard free recall instructions. This result provides an important marker for the presence of post-access monitoring in all of the conditions.

As predicted, the effects of study task and presentation modality on correct recall of list items were different. The PR task led to better correct recall than the intentional memory instructions, but modality of presentation had no effect on correct recall. Our prediction was based on the assumption that the PR task enhanced the processing of differences in the context of the shared semantic and spatial/temporal similarity among the list items, i.e., PR enhanced item-based distinctive processing (Hunt, 2003; 2006). Presentation modality is shared by all list items and hence does not contribute to the processing of differences among the list items. In other words, item-based distinctive processing does not differ for visual versus auditory presentation and therefore correct recall was not affected by the manipulation of study presentation modality.

General Discussion

In three experiments we posed the following question: What are the mechanisms through which deep processing reduces false memory relative to intentional study instructions? The third experiment also considered the mechanisms by which visual study presentation reduced false memory relative to auditory study presentation. These questions were addressed by comparing the effects of these manipulations on a standard recall test and an inclusion test. Both tests requests recall of study list items, but the latter test also reduces the need for monitoring as items related to the study list items are to be included in the inclusion test responses. Across the three experiments the data were consistent in showing that deep processing reduced false memory relative to intentional memory instructions and in the third experiment visual study presentation reduced false memory relative to auditory presentation under standard free recall test instructions, replicating previous studies (e.g., Gallo et al., 2001; Smith & Hunt, 1998). The important new results occurred with inclusion recall instructions which encouraged recall of list items as well as any related items that came to mind. Under these more lenient test instructions, the suppression of false memories following deep processing and/or visual presentation did not abate. Noteworthy is that false recall was greater in the inclusion recall test than in the free recall test in all of the experiments.

The pattern of the data implicates two mechanisms in the output process. One is post-access monitoring. The fact that false recall was higher under inclusion instructions than standard test instructions is consistent with the operation of a process that examines accessed memories for evidence of their presence in the cued event. When the requirement for accuracy is relaxed under the inclusion instructions, the monitoring strategy is attenuated to accept related items, resulting in more false recall than under standard instructions. Our data cannot speak to the particular form of monitoring, that is, whether monitoring in these cases is general source monitoring or the more specific distinctiveness heuristic. Nonetheless the results from all three experiments point to a role for post-access monitoring in reducing false recall.

The conclusion that post-access monitoring is necessary stems from the assumptions made to explain why false recall is higher under inclusion than standard recall instructions. Namely, the inclusion instruction reduces the need for a monitoring process that attempts to accurately recognize list items, as first argued by Brainerd and Reyna (1998). Ironically, this same assumption leads to the conclusion that monitoring, while necessary, is not sufficient to explain the data. If the suppressing effect of our variables on false memory in standard free recall were entirely the result of monitoring, one would expect that the suppressing effect of these variables would be eliminated or considerably reduced in the inclusion test. That did not happen. Consequently a second mechanism is required, and we favor the notion that the variables in question influence direct access to the items. That is, under certain conditions access at test is constrained to the items specified by the test cue, which in this case are the studied items. Obviously the constraint provided by the conditions of our experiment were not perfect: false memory does occur following visual presentation and following deep processing under standard instructions and increases under inclusion instructions. Nonetheless, these variables did improve memory accuracy through a reduction in false recall that cannot be accounted for by post-access monitoring.

In principle, the constraint on access could be due to reduced relational processing in the PR and visual presentation conditions of our experiments (Arndt & Reder, 2003; Hege & Dodson, 2004). This interpretation seems unlikely for two reasons. A number of studies have shown that impoverished relational processing lowers correct recall (Hunt & McDaniel, 1993), yet the reduced false memory in the PR and visual presentation conditions were not accompanied by reduced memory for study items. Moreover, in previous research direct indices of relational processing (clustering, category recall) show no reduction in relational processing as a function of either a PR orienting task or visual presentation of items (e.g., Hunt & Einstein, 1981; Hunt & Seta, 1984). Thus the failure to access critical lures in these experiments does not appear to be due to reduced relational processing at study.

Although our experiments were not designed to explore the relationship between direct access and monitoring, the obvious candidate is the traditional generate-recognize theory, where each accessed item is subjected to a recognition decision prior to output. This theory, however, cannot explain our data. From the perspective of generate-recognize theory, *all* false memory results from monitoring failure, and our inclusion data speak against that position.

A more complicated approach assumes that the problem is a failure to monitor all accessed items. That is, some items may be accessed with sufficient fluency that monitoring is by-passed, as first proposed by Jacoby and Hollingshead (1990). Such a combination of direct access and access plus monitoring can account for our results. If the fluency with which some items were accessed allowed monitoring to be by-passed, those items were destined for output, and in the event that they are not targets, they represent phantom recollection (Brainerd, Wright, Reyna, & Mojardin, 2001).

Precise Memory and Distinctive Processing

Avoiding false memory requires precision in the joint action of initial processing and the reinstatement of that processing at retrieval. One approach to describing that precision is distinctive processing (e.g., Hunt, 2006; Nairne, 2006). Defining distinctive processing as the processing of difference in the context of similarity has proven useful in previous analyses of memory (Hunt, 2003; 2006; Hunt & Rawson, 2011). This approach is derived from work on similarity/difference judgment that shows the processing of difference among items in the context of similarity is highly diagnostic of a particular item (Medin, Goldstone & Gentner, 1993). Applying that thinking to the joint action of encoding and retrieval yields precision in memory.

In addition, our analysis assumes that distinctive processing occurs at the level of both items and events (Table 1). All direct tests of memory begin with a cue that constrains the set of items from which the response is to be drawn. Thus the event is functionally defined by the cue. The event circumscribes a set of discrete items that comprises the correct responses to the memory query. The constraint provided by the cue can vary in grain size, which in turn changes the grain size of the items. For example, the event could be “What did you do in Chicago?” for which an item might be “Dinner at Topolobampo.” But a different event and set of items are defined by the query is “What did you have for dinner at Topolobampo?”. We assume that this distinction between events and items not only has heuristic value for analytic purposes but in fact describes real psychological units of memory. Note, however, that these units are not defined at encoding but rather by the test cue.

Both item and event memories are influenced by similarity. In the case of items, the similarity in question is among the items of an event, which will share spatial/temporal features and almost always will share semantic features (with the exception of unrelated word lists in the laboratory). Processing differences in the context of the similarity of these items confers the diagnosticity necessary to distinguish particular items within the event, enhancing correct memory for target items (Hunt & McDaniel, 1993). Similarity among events reduces discriminability among the events. Event similarity increases the probability of producing an incorrect item to the cue, i.e., false memory (e.g., Dobbins et al., 1998). Processing differences among events in the context of their similarity lowers the probability of false memory. Previous research has shown that the effect of item-based distinctive processing is to increase correct responding to target items, and the effect of event based distinctive processing is to decrease incorrect responses to incorrect items. Interestingly, these effects seem to be independent of each other (Dobbins, et al., 1998; Gruppuso et al, 1997; Hunt, 2003).

This distinction between item- and event-based distinctive processing provides a useful description of our data. For example, if all list items have been rated for pleasantness, the list items differ on that dimension of processing from other events, such as the critical lure in the DRM lists. Likewise, visual processing of list items at study is different from the processing of the critical lure at study, apparently much more so than is auditory processing of list items. Evidence from reality monitoring indicates that correct attribution of source is more highly correlated with visual detail than with auditory detail, suggesting that auditory perception is less different from thought than is visual perception (Johnson, Nolde, & De Leonardis, 1996).

Event-based distinctive processing can be strategically used for monitoring purposes but in addition, our data suggest that event-based distinctive processing increases precision through direct access. To that extent, the data are consistent with Nairne's (2006) theory of distinctive processing which he defines as the relationship between a cue and target whereby the cue brings a particular target to mind to the exclusion of other items. Jacoby and his colleagues have demonstrated convincingly that aspects of prior processing can be used to constrain access at test (Jacoby & Shimizu, 2005; Jacoby et al., 2005). Their idea of source constrained retrieval, as opposed to post-access source monitoring, captures an important function of event-based distinctive processing, which is limiting access to the cued event.

The distinction between item-based and event-based distinctive processing also provides insight into the effect of particular variables on correct responses relative to incorrect responses. In brief, a variable that encourages item-based distinctive processing will enhance correct responses to target items while a variable that encourages event-based distinctive processing will enhance correct rejections. Consider the effect of study task and mode of presentation in Experiment 3. The PR task led to a mirror effect, more correct recall and less false recall, relative to intentional memory instructions, but visual presentation reduced false memory without affecting correct recall relative to auditory presentation. A deep processing task encourages the processing of difference among the items sharing the temporal/spatial and semantic attributes of the list in that the meaning of each item is different. Therefore, we predicted that the deep processing of DRM target would increase correct recall. Visual presentation of the items, however, is an attribute shared by all of the list items, and consequently the mode of presentation will not affect item-based distinctive processing unless each item is presented in a different mode (e.g., see Arndt & Reder, 2003). Thus, the item-based/event-based distinctive processing framework successfully predicted association and dissociation between correct and false memory.

False Recall and False Recognition

As with any research on a topic as broad and as fundamental as the nature of retrieval processes, conclusions from our data are limited by the choice of particular variables and their values. Of special note is that our experiments used recall as the criterion tests. Hege and Dodson (2004) reported the only other comparison of standard and inclusion tests using recall and came to essentially the same conclusions as we do. As Gallo (2006) points out, most of the research investigating post-access monitoring, the bulk of which has been concerned with the distinctiveness heuristic, has used recognition tests. The general conclusion from the work involving recognition tests is that post-access monitoring is sufficient to account for the beneficial effects of variables on false memory.[2]

Summary

Given that non-presented information often arise during the processing of the presented information, there can be little to distinguish psychologically between the presented and the

---

[2]For example, Pierce et al (2005) investigated the modality suppression effect on false recognition using inclusion instructions and found no modality effect on the inclusion recognition test, which suggests that post-access monitoring is sufficient to explain the effects of modality on false recognition. Similar evidence using picture versus word manipulation was provided by Dodson and Hege (2005) who a speeded recognition test rather than an inclusion test to examine the question. Monitoring is an intentional strategy and the completion of such a controlled process is assumed to require time. A stringent time requirement for the recognition response would disrupt monitoring and thus eliminate the suppressive effect of a variable on false memory. That is exactly what Dodson and Hege found. Benjamin (2001) reported similar data showing that the suppressive effect of list repetition on false recognition was eliminated when a speeded response was required on the recognition test.

self-generated aspects of prior experience. If discrimination between the two is required, the probability of false memory is high unless some aspect of prior processing is available to differentiate presented from non-presented items. Variables encouraging such processing with DRM lists have been identified, and two of those were investigated here, deep orienting tasks and visual presentation of studied items. In both cases, false memory for critical, non-presented items was reduced relative to control conditions. On our description, deep processing and visual study presentation encourage event-based distinctive processing relative to the set of items that come to mind during the processing of the studied items. The data clearly indicated that event-based distinctive processing functions both to constrain access to studied items as well as input to a post-access monitoring process. Of special note is the differential effect of the variables on correct responses to studied items and to non-studied items. The predictions for both correct and false memory were derived cleanly from the distinction between item-based and event-based distinctive processing, indicating that the distinction is of use in understanding false memory and its occasional prevention.

Acknowledgments

Support for this project was provided in part by Grant SC1 AG034965 from the National Institute on Aging to RES. The authors thank Ana Alvarez-Keesee, Crystal Armitage, Joshua Brunsman, Laura Carrizales, Sadaf Kazi, Deborah Persyn, and Emmanual Villarreal for assistance with data collection.

References

Arndt J, Reder LM. The effect of distinctive visual information on false memory. Journal of Memory and Language. 2003; 48:1–15. [PubMed: 19079562]

Benjamin AS. On the dual effects of repetition on false recognition. Journal of Experimental Psychology: Learning, Memory, and Cognition. 2001; 27:941–947.

Brainerd CJ, Reyna VF. When things that were never experienced are easier to remember than things that were. Psychological Science. 1998; 9:484–489.

Brainerd CJ, Wright R, Reyna VF, Mojardin AH. Conjoint recognition and phantom recollection. Journal of Experimental Psychology: Learning, Memory, and Cognition. 2003; 27:307–327.

Bransford JD, Franks JJ. The abstraction of linguistic ideas. Cognitive Psychology. 1971; 2:331–350.

Bransford, JD.; Johnson, MK. Consideration of some problems of comprehension. In: Chase, WG., editor. Visual information processing. New York: Academic Press; 1973. p. 213-248.

Cleary AM, Greene RL. Paradoxical effects of presentation modality on false memory. Memory. 2002; 10:55–61. [PubMed: 11747576]

Craik FIM, Lockhart RS. Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior. 1972; 11:671–684.

Deese J. On the prediction of occurrence of particular verbal intrusions in immediate recall. Journal of Experimental Psychology. 1959; 58:17–22. [PubMed: 13664879]

Dobbins IG, Kroll NEA, Yonelinas AP, Liu Q. Distinctiveness in recognition and free recall: The role of recollection in rejection of the familiar. Journal of Memory and Language. 1998; 38:381–400.

Dodson CS, Hege ACG. Speeded retrieval abolishes the false memory suppression effect: Evidence for the distinctiveness heuristic. Psychonomic Bulletin & Review. 2005; 12:726–731. [PubMed: 16447388]

Dodson CS, Schacter DL. "If I had said it, I would remember it": Reducing false memory with a distinctiveness heuristic. Psychonomic Bulletin & Review. 2001; 8:155–161. [PubMed: 11340861]

Dodson CS, Schacter DL. When false recognition meets metacognition: The distinctiveness heuristic. Journal of Memory and Language. 2002; 46:782–803.

Gallo, DA. Associative illusions of memory: False memory research in DRM and related tasks. New York: Psychology Press; 2006.

Gallo DA, Meadow NG, Johnson EL, Foster KT. Deep levels of processing elicit a distinctiveness heuristic: Evidence from the criterial recollection task. Journal of Memory and Language. 2008; 58:1095–1111.

Gallo DA, McDermott KB, Percer JM, Roediger HL III. Modality effects in false recall and false recognition. Journal of Experimental Psychology: Learning, Memory, and Cognition. 2001; 27:339–353.

Gallo DA, Roediger HL III, McDermott KB. Associative false recognition occurs without strategic criterion shifts. Psychonomic Bulletin & Review. 2001; 8:579– 586. [PubMed: 11700910]

Gallo DA, Weis JA, Schacter DL. Reducing false recognition with criteria recollection tests: Distinctiveness heuristic vs. criterion shifts. Journal of Memory and Language. 2004; 51:473–493.

Gruppuso V, Lindsay DS, Kelley CM. The process-dissociation procedure and similarity: Defining and estimating recollection and familiarity in recognition memory. Journal of Experimental Psychology: Learning, Memory, and Cognition. 1997; 23:259–278.

Hege ACG, Dodson CS. Why distinctive information reduces false memories: Evidence for both reduced relational processing and the distinctiveness heuristic. Journal of Experimental Psychology: Learning, Memory, and Cognition. 2004; 30:787–795.

Hunt RR. Two contributions of distinctive processing to accurate memory. Journal of Memory and Language. 2003; 48:811–825.

Hunt, RR. The concept of distinctiveness in memory research. In: Hunt, RR.; Worthen, JB., editors. Distinctiveness and memory. New York: Oxford University Press; 2006. p. 1-25.

Hunt RR, Einstein GO. Relational and item-specific information in memory. Journal of Verbal Learning and Verbal Behavior. 1981; 19:497–514.

Hunt RR, McDaniel MA. The enigma of organization and distinctiveness. Journal of Memory and Language. 1993; 32:421–445.

Hunt, RR.; Rawson, KA. Knowledge affords distinctive processing in memory. 2011. Under review. (manuscript available on request)

Hunt RR, Seta CE. Category size effects in recall: The roles of relational and individual item information. Journal of Experimental Psychology: Learning, Memory, and Cognition. 1984; 10:454–464.

Jacoby LL, Hollingshead A. Toward a generate/recognize model of performance on direct and indirect tests of memory. Journal of Memory and Language. 1990; 29:433–454.

Jacoby, LL.; Kelley, CM.; McElree, BD. The role of cognitive control: Early selection versus late correction. In: Chaiken, S.; Trope, Y., editors. Dual-process theories in social psychology. New York: The Guildford Press; 1999. p. 383-400.

Jacoby LL, Shimizu Y. Similarity guided depth of retrieval: Constraining at the front end. Canadian Journal of Experimental Psychology. 2005; 59:17–21. [PubMed: 15832628]

Jacoby LL, Shimizu Y, Daniels KA, Rhodes MG. Modes of cognitive control in recognition and source memory: Depth of retrieval. Psychonomic Bulletin & Review. 2005; 12:852–857. [PubMed: 16524001]

Johnson MK, Nolde SF, De Leonardis DM. Emotional focus and source monitoring. Journal of Memory & Language. 1996; 35:135–156.

Kellogg R. Presentation modality and mode of recall in verbal false memory. Journal of Experimental Psychology: Learning, Memory, and Cognition. 2001; 27:913–919.

Kimball DR, Bjork RA. Influences of intentional and unintentional forgetting on false memories. Journal of Experimental Psychology: General. 2002; 131:116–130. [PubMed: 11900099]

McCabe DP, Presmanes AG, Robertson CL, Smith AD. Item-specific processing reduces false memory. Psychonomic Bulletin & Review. 2004; 11:1074–1079. [PubMed: 15875978]

McConnell MM, Hunt RR. Can false memories be corrected by feedback in the DRM paradigm? Memory & Cognition. 2007; 35:999–1006.

Medin DL, Goldstone RL, Gentner D. Respects for similarity. Psychological Review. 1993; 100:254–278.

Nairne, JS. Modeling distinctiveness: Implications for general memory theory. In: Hunt, RR.; Worthen, JB., editors. Distinctiveness and memory. New York: Oxford University Press; 2006. p. 27-46.

Neuschatz JS, Lynn SJ, Benoit GE, Payne R. Effective warnings in the Deese-Roediger-McDermott false-memory paradigm: The role of identifiability. Journal of Experimental Psychology: Learning, Memory, and Cognition. 2003; 29:35–40.

Payne DG, Elie CJ, Blackwell JM, Neuschatz JS. Memory illusions: Recalling, recognizing, and recollecting events that never occurred. Journal of Memory and Language. 1996; 35:261–285.

Pierce BH, Gallo DA, Weiss JA, Schacter DL. The modality effect in false recognition: Evidence for test-based monitoring. Memory & Cognition. 2005; 33:1407–1413.

Read DJ. From a passing thought to a false memory in 2 minutes: Confusing real and illusory events. Psychonomic Bulletin & Review. 1996; 3:105–111.

Rhodes MC, Anastasi JS. The effect of a levels of processing manipulation on false recall. Psychonomic Bulletin & Review. 2000; 7:158–162. [PubMed: 10780030]

Roediger HL III, McDermott KB. Creating false memories: Remembering words not presented in lists. Journal of Experimental Psychology: Learning, Memory, and Cognition. 1995; 21:803–814.

Roediger, HL., III; McDermott, KB. Distortions of memory. In: Tulving, E.; Craik, F., editors. The Oxford handbook of memory. Oxford Press; New York: 1995. p. 149-162.

Schacter DL, Cendan DL, Dodson CS, Clifford ER. Retrieval conditions and false recognition: Testing the distinctiveness heuristic. Psychonomic Bulletin & Review. 2001; 8:827–833. [PubMed: 11848606]

Schacter DL, Israel L, Racine C. Suppressing false recognition in younger and older adults: The distinctiveness heuristic. Journal of Memory and language. 1999; 40(1):1–24.

Seamon JG, Goodkind MS, Dumey AD, Dick E, Aufseer MS, Strickland SE, Woulfin JR, Fung NS. “If I didn’t write it, why would I remember it?”: Effects of encoding, attention, and practice on accurate and false memory. Memory & Cognition. 2003; 31:445–457.

Smith RE, Engle RW. Study modality and false recall: The influence of resource availability. Experimental Psychology. 2011; 58:117–124. [PubMed: 20494859]

Smith RE, Hunt RR, Gallagher MP. The effect of study modality on false recognition. Memory and Cognition. 2008; 36:1439–1449.

Smith RE, Hunt RR. Presentation modality affects false memory. Psychonomic Bulletin & Review. 1998; 5:710–715.

Smith RE, Lozito P, Bayen UJ. Adult age differences in distinctive processing: The modality effect on false recall. Psychology and Aging. 2005; 20:486– 492. [PubMed: 16248707]

Thapar A, McDermott KB. False recall and false recognition induced by presentation of associated words: Effects of retention interval and levels of processing. Memory & Cognition. 2001; 29:424–432.

Toglia MP, Neuschatz JS, Goodwin KA. Recall accuracy and illusory memory: When more is less. Memory. 1999; 7:233–256. [PubMed: 10645381]

Highlights

- False recall reduced by visual presentation and orienting tasks
- Reduction equivalent for standard test and inclusion test
- Results indicate importance of both monitoring and direct access in retrieval
- Distinctive processing affects both output processes

Table 1

Definitions, examples, and predictions for item-based and event-based distinctiveness.

	Item-based Distinctiveness	**Event-based Distinctiveness**
Definition	List items receive item-specific processing the in context of similarity.	Within a similar temporal/spatial context, different events are processed in event-specific ways.
Example	Items in the DRM study list share the similarity of being associated with the non-presented critical item. A pleasantness rating task adds differential processing of the item- specific information for each study list item within this context of similarity.	Items that are in the study list share the perceptual information associated with the study list event that is designated by the study list presentation. The critical items are not part of this event and do not share this perceptual information.
Correct Recall	Item-based distinctive processing increases correct recall.	Correct recall is not affected by event-based distinctive processing.
False Recall	Reduced by item-based distinctive processing if this processing contributes to event-based distinctive processing (i.e., items that were not part of the target list do not receive the same type of processing).	Reduced by event-based distinctive processing.
Effect of PR vs IS orienting tasks.	Correct recall better following PR than following IS.	False recall reduced following PR than following IS.
Effect of Visual vs Auditory Study Presentation.	Correct recall not affected by study modality because study modality does not increase item-based distinctive processing.	False recall reduced following visual study relative to

NOTE: PR = pleasantness rating. IS = intentional study.

NIH-PA Author Manuscript
NIH-PA Author Manuscript

Table 2

Experiments 1 and 2: Proportion of non-presented critical items and study list items produced on the standard free recall and inclusion tests.

				Critical Items		Study List Items	
Experiment	**Type of Test**	**Encoding Condition**	***N***	***M***	***SE***	***M***	***SE***
1	Standard	Intentional Study	33	.18	.03	.26	.02
		Pleasantness Rating	27	.12	.03	.30	.02
		Vowel Counting	30	.02	.01	.07	.01
	Inclusion	Intentional Study	30	.33	.04	.28	.01
		Pleasantness Rating	30	.22	.03	.31	.02
		Vowel Counting	30	.09	.03	.09	.01
2	Standard	Intentional Study	31	.32	.04	.25	.01
		Pleasantness Rating	31	.15	.03	.30	.01
	Inclusion	Intentional Study	30	.34	.03	.23	.02
		Pleasantness Rating	30	.25	.04	.29	.01

NIH-PA Author Manuscript
NIH-PA Author Manuscript

Table 3

Experiment 3: Proportion of study list items and non-presented critical items produced on standard free recall test and the inclusion test.

			Critical Items		Study List Items	
Type of Test	**Encoding Condition**	**Study Modality**	***M***	***SE***	***M***	***SE***
Standard	Intentional Study	Auditory	.32	.03	.24	.01
		Visual	.26	.03	.28	.02
	Pleasantness Rating	Auditory	.26	.03	.29	.01
		Visual	.19	.03	.30	.01
Inclusion	Intentional Study	Auditory	.42	.04	.26	.01
		Visual	.33	.04	.26	.01
	Pleasantness Rating	Auditory	.33	.04	.29	.01
		Visual	.20	.03	.29	.01

Note: N = 35 for all conditions.