Research Article

Study Modality and False Recall

The Influence of Resource Availability

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Abstract. False memories occur when individuals mistakenly report an event as having taken place when that event did not in fact occur. The DRM (Deese, 1959; Roediger & McDermott, 1995) paradigm provides an effective technique for creating and investigating false memories. In this paradigm participants study a list of words (e.g., SOUR, CANDY,...) that are highly associated to a non-presented critical item (e.g., SWEET). The study phase is followed by a test of memory for the study list words. Researchers typically find very high levels of false recall of the critical non-presented item. However, the likelihood of falsely remembering the non-presented critical items can be reduced by presenting studied associates visually rather than auditorally (e.g., Smith & Hunt, 1998). This is referred to as the modality effect in false memory. The current study investigated the role of resource availability in the expression of this modality effect in false recall. In Experiment 1 false recall was reduced in the visual study presentation condition relative to the auditory condition for participants with higher working memory capacity, but not for participants with lower working memory capacity. In Experiment 2 the effect of study modality on false recall was eliminated by the addition of a divided attention task at encoding. Both studies support the proposal that resource availability plays a role in the expression of the modality effect in the DRM paradigm (Smith, Lozito, & Bayen, 2005).

Keywords: false memory, study modality, false recall, working memory, divided attention, secondary task, modality

Human memory can be strikingly good; however, our memories are imperfect and subject to errors of omission and commission. Errors of commission are particularly problematic as they may be indistinguishable from correct memories. A useful paradigm for investigating errors of commission, or false memories, is based upon work originally introduced by Deese (1959) and revived by Roediger and McDermott (1995; see also Read, 1996). In the Deese/Roediger and McDermott (DRM) paradigm participants study lists of words that are all highly associated with non-presented critical items. For instance, participants might study SOUR, CANDY, and SUGAR, which are all high associates of the non-presented critical item SWEET. On subsequent recall and recognition tests participants are very likely to falsely recognize or falsely recall the critical item. False recall can be as high as correct recall (Roediger & McDermott, 1995).

In 1998 Smith and Hunt reported three experiments demonstrating that false recall and recognition in the DRM paradigm could be dramatically reduced by presenting the items visually rather than auditorally at study. This reduction in false memories following visual study presentation has been found on written recall tests in 12 published experiments (Cleary & Greene, 2002; Gallo, McDermott, Percer, & Roediger, 2001; Kellogg, 2001; Smith & Hunt, 1998; Smith, Hunt, & Gallagher, 2008; Smith, Lozito, & Bayen, 2005) and on visual recognition tests in 11 experiments (Cleary & Greene, 2002; Gallo & Roediger, 2003; Gallo et al., 2001; Pierce, Gallo, Weiss, & Schacter, 2005; Smith & Hunt, 1998; Smith et al., 2008; but see Smith et al., 2008, for discussion of exceptions). The current study investigates the role of the availability of cognitive resources in the expression of the modality effect on false recall in young adults. In Experiment 1 we compare the effects of study presentation modality on false memory for participants with higher or lower working memory span scores (operation span, Turner & Engle, 1989). In Experiment 2 resource availability is manipulated through the application of a divided attention task.

Explaining the Modality Effect

Smith and Hunt (1998) explained the effect of study modality in the DRM paradigm by drawing upon the concepts of relational and item-specific processing. Item-specific processing refers to information unique to individual items and relational processing refers to dimensions shared by all of the items (Hunt, 2003; Hunt & Einstein, 1981; Hunt & McDaniel, 1993; Hunt & Worthen, 2006). In the DRM paradigm, one source of relational processing is the semantic relationship between the critical and studied items. This relational information may lead to the critical item coming to mind during study phase, test phase, or during both study and test. The relational information would also encourage output of the critical item during a recall test. A source of relational processing comes in the form of the modality in which the items were presented at study. However, this

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second source applies only to studied items as the critical items are not perceptually processed. Therefore, the modality of study presentation can serve as a dimension along which the critical items and studied items can be differentiated from one another.

Smith and Hunt's (1998) explanation of the modality effect in false recall shares some commonalities with the distinctiveness heuristic approach which has been applied to explain a reduction in false memories when items are presented as pictures at encoding (Dodson & Schacter, 2001, 2002; Schacter, Israel, & Racine, 1999). According to this explanation, presenting the study list in the form of pictures leads to the expectation that memories for the study list items will include distinctive information, in this case vivid perceptual details. When the expected distinctive information is not present for an item that comes to mind during recall or is presented on a recognition test, then the participant will reject the item. This information is not present for the critical items, which were not presented at study, and therefore the likelihood of rejecting the critical items is increased.

Relevant to the current study, the effect of visual study presentation on false memories may require resources at encoding, at retrieval, or at both encoding and retrieval. Resources may be involved in encoding information that can be used for discriminating between studied and nonstudied items and for strategic decision processes that can be used to avoid false memories. The strategic decision processes may occur at encoding (e.g., recognizing that an item has come to mind that is related to, but not on the list) and/or retrieval (e.g., rejecting items that do not have the expected distinctive information). Even if strategic decision processes only occur at test, a reduction in resources at encoding could have a detrimental effect. Both Smith and Hunt's explanation and the distinctiveness heuristic depend upon modality information being processed sufficiently at encoding. If perceptual information is not encoded sufficiently well, for instance because of reduced resources, then the perceptual information may not be retrieved at the time of test and would therefore not play a role in discriminating between true and false memories. As discussed below, the encoding of this perceptual information may be sensitive to variations in resource availability.[1]

Motivation for the Current Study

The current work is motivated in part by a failure to find a reduction in false memories following visual presentation relative to auditory presentation for older adults (Smith et al., 2005). In the Smith et al. study, young and older adults either saw or heard the study lists in the DRM paradigm. On a subsequent free recall test the young adults who had seen the study list words were significantly less likely to falsely recall the critical non-presented items than were the young adults who had heard the study list. In contrast, older adults showed no difference in false recall as a function of study presentation modality. Smith et al. suggested that this was due to reduced resource availability on the part of older adults.

As discussed in Smith et al. (2005), there is evidence that differences in resource availability underlie an age-related difference in memory for perceptual information (Light & Zelinski, 1983). Furthermore, in a study by Norman and Schacter (1997), participants reported perceptual information for both true and false memories. The difference between the true and false memories was smaller for older adults relative to young adults. The effects of visual study presentation on false memories may rely on remembering perceptual information about the study list words in order to discriminate studied and non-studied items (Smith & Hunt, 1998). If the age-related difference in the expression of the modality effect reported by Smith et al. is due to resource-related differences in the ability to encode and/or retrieve perceptual information on the part of older adults, then differential resource availability in young adults should also impact the effect of study presentation modality on false recall.

Resource Availability and False Memories

Evidence that working memory capacity can play a role in avoiding false memories comes from a study by Watson, Bunting, Poole, and Conway (2005). Watson et al. used a warning manipulation for higher and lower span participants. Half of the higher and lower span participants received explicit instructions warning participants about the associative nature of the study lists and that they were designed to elicit false memories of critical, non-presented items. Participants were further encouraged to avoid recalling the critical words. The other half were given no such warning. Watson et al. found that higher span individuals, but not lower span individuals, showed an effect of warning, with reduced false recall in the warning condition relative to the "no warning" condition. Watson et al. point to attentional control as one of the key functions of working

[1] Another alternative explanation for the modality effect is that false memories will be reduced when there is a modality match between study and test relative to when the study and test are in different modalities (e.g., Kellogg, 2001). Consistent with this proposal, Kellogg found that presenting items visually at study reduced critical intrusions relative to auditory study presentation when using a written recall test, but not in the case of a spoken recall test. However, the power of this explanation is limited in that the expected modality match effect was not found for spoken recall tests: Auditory study list presentation did not reduce false memories relative to visual study list presentation on a spoken recall test. In terms of the current experiments, presumably the modality match explanation would propose that reduced resource availability could interfere with encoding and/or retrieval of the orthographic information provided in the visual condition and therefore would interfere with the expression of the modality effect.

memory (i.e., maintaining cognitive operations in an active state in the presence of distraction; see also, Kane & Engle, 2002). Watson et al. argued that higher working memory span participants were better able to maintain task goals (i.e., identify, but not recall, critical words) and avoid the influence of habit (i.e., automatic activation of critical words in an associative network). The Watson et al. study clearly shows that participants' working memory capacity can be a critical determinant in the success of a manipulation aimed at reducing false memories.

In addition to examining the effects of individual differences in working memory capacity, the effect of resource availability on false memories has been examined by imposing a divided attention task in the DRM paradigm. For instance, Dehon (2006) found that imposing a secondary task at encoding increased the rate of false recall relative to the full attention condition. Others have also found that divided attention at encoding can increase false recall in the DRM paradigm (e.g., Dewhurst et al., 2007; Peters et al., 2008; Skinner & Fernandes, 2009; but see Seamon et al., 2003, for an exception). In particular, Dehon (2006) found that young adults under conditions of divided attention had levels of false recall similar to older adults' levels of false recall when attention was not divided for the older adults. This finding suggests that resource availability is involved in the young adults' ability to avoid false memories.

The study by Peters et al. (2008) is of particular interest for the current discussion. As with the Watson et al. (2005) study, the Peters et al. study included a manipulation of warnings. Peters et al. found that warnings reduced critical item intrusions on a recall test following a full attention encoding condition, but found no significant advantage of warnings when attention was divided at encoding. Based upon these parallel findings in the Peters et al. and Watson et al. studies we predicted that visual study presentation would reduce false recall relative to auditory study presentation in the full attention condition but not in the divided attention condition of our second experiment.

Experiment 1

In the first experiment the effects of study presentation modality on false recall in the DRM paradigm were compared for individuals with either higher or lower working memory span scores. Based upon Watson et al. (2005) and Smith et al. (2005, 2008), only higher span individuals are predicted to benefit from visual study presentation. Specifically, we predicted that higher working memory span individuals would show a reduction in false recall following visual study relative to auditory study, but that lower span individuals would not show this reduction.

Method

Participants and Design

The 48 participants, who ranged in age from 18 to 35, were recruited from a departmental pool or from the community through newspaper advertisements and received either course credit or monetary compensation. Participants were tested individually in two sessions. The operation span task was completed in the first session. The median span score of 15.5 was computed after all participants had completed the first session. Participants with a span score that was below the median were classified as lower spans. Participants who scored above on the working memory measure were classified as higher spans.[2]

Materials and Procedure

Operation Span Task

In the operation span task (Turner & Engle, 1989) participants solve math problems while attempting to remember words. Equation-word pairs (e.g., *Is* $(2 \times 1) + 1 = 2$*? dog.*) were serially presented on the computer screen. Participants were instructed to read each equation aloud, say "yes" or "no" as to whether the given answer was correct, and then say the word. After the word was read, another equation-word pair was displayed. Participants saw two to six equation-word pairs in a block and then attempted to recall the words in order. The number of equation-word pairs in a block was randomly determined with the qualification that across 15 blocks, each of the five possible numbers occurred three times. A block was considered correct if all the words were recalled in the correct order. The number of words recalled was the score for a correct block. If the order was incorrect, or if words were missing, the score was zero for that block. Scores on all blocks were added together to get a final score.

DRM Task

The materials for the DRM task matched those used in Smith and Hunt (1998) and Smith et al. (2005, 2008). The highest 12 associates were selected for each of six critical items that were the most likely to be falsely remembered in the Roediger and McDermott (1995) study. Each associate list was blocked beginning with the highest associate and ending with the 12th associate. The blocks were presented as a single study list of 72 items at a rate of one item every 1.5 s. Participants were told that they would see/hear a list of words, one at a time, and that they should try to remember the words because they would be asked to recall the

[2] It may be preferable to use quartile splits (Conway et al., 2005) and multiple measures of span (Waters & Caplan, 2003) when classifying participants as higher or lower span. While these approaches have advantages, using a quartile split in Experiment 1 would have reduced power to less than .30 to detect even large effects (power analyses conducted with the G*Power 3 program; Faul, Erdfelder, Lang, & Buchner, 2007). Furthermore, concerns over possible span group misclassifications in Experiment 1 are minimized by the replication provided in Experiment 2 using divided attention.

Table 1. Scores on the operation span task as a function of span group assignment and study modality

	Study modality						Auditory and visual combined	
	Auditory			Visual				
Span group	*M*	*SEM*	Range	*M*	*SEM*	Range	*M*	*SEM*
Lower	9.08	1.31	2–15	7.08	1.29	2–15	8.08	0.92
Higher	22.33	1.76	16–39	21.00	1.30	16–33	21.67	1.08

Table 2. Proportion of study list words correctly recalled and critical items falsely recalled

			Correct recall		Critical intrusions	
	N	Modality	*M*	*SEM*	*M*	*SEM*
Experiment 1						
Span group						
Lower	12	Auditory	**.21**	.03	**.29**	.05
	12	Visual	**.19**	.02	**.32**	.05
Higher	12	Auditory	**.30**	.04	**.39**	.07
	12	Visual	**.30**	.02	**.21**	.03
Experiment 2						
Divided attention condition						
Divided	24	Auditory	**.12**	.01	**.26**	.05
	24	Visual	**.10**	.01	**.23**	.04
Full	26	Auditory	**.22**	.01	**.34**	.04
	23	Visual	**.24**	.01	**.16**	.03

words at the end of the list. In the case of visual presentation, the words appeared in black in the middle of a white screen. In the case of auditory presentation, recordings of each word were played on the computer speakers. Following the study list presentation, participants were instructed to recall as many words from the study list as possible, but not to guess randomly. Participants were given three minutes to write their recall responses on a sheet of paper.

Results and Discussion

An alpha level of .05 was used for all analyses.

Operation Span Scores

The mean span scores for each of the four conditions are shown in Table 1. An analysis of variance with the between-subjects factors of span group and study modality produced a main effect of span group, $F(1, 44) = 90.33$, $MSE = 24.51$, $p < .001$, $\eta_p^2 = .67$. Neither the main effect of study modality, $F(1, 44) = 1.36$, $p > .25$, nor the interaction, $F < 1$, $p > .81$, reached significance.

False Recall

The independent effects of study modality, $F(1, 44) = 2.22$, $MSE = 0.03$, $p > .14$, and working memory span group, $F < 1$, $p > .89$, did not significantly impact the likelihood of falsely recalling the critical items (Table 2). However, the two variables did interact, $F(1, 44) = 4.12$, $MSE = 0.03$, $p = .049$, $\eta_p^2 = .09$. This interaction was investigated with separate analyses for each span group. Study modality did not significantly affect false recall in the lower span group, $F < 1$, $p > .69$, but did have a significant effect for higher span participants, $F(1, 22) = 5.76$, $MSE = 0.03$, $p = .025$, $\eta_p^2 = .21$. Specifically, higher span participants were less likely to produce the critical intrusions on a recall test following visual presentation than following auditory presentation of study list items.[3]

[3] It is possible to view the relationship between working memory span and the ability to avoid false memories as either a quantitative relationship (more capacity leads to greater false memory reduction) or as threshold sort of relationship (a certain level of capacity is required to avoid false memories) in the visual condition. Either scenario could be in play. We selected to compare higher and lower working memory groups using a factorial ANOVA in order to facilitate the transition between Experiments 1 and 2. However, we also computed the correlation between span score and the proportion of critical items falsely recalled separately for each modality condition. In the auditory condition, the relationship was not significant, $r = .17$, $p > .41$. The negative correlation between span and false recall approached significance in the visual condition, $r = -.40$, $p = .05$.

Correct Recall

The proportion of study list items recalled (Table 2) was influenced by working memory span classification, $F(1, 44) = 13.43$, $MSE = 0.01$, $p = .001$, $\eta_p^2 = .23$, with participants with higher working span recalling more studied items than participant in the lower span group. Study modality did not influence recall and the two variables did not interact, Fs < 1, ps $> .66$.

Experiment 2

While the first experiment indicates that working memory resource availability plays a role in the expression of the modality effect in the DRM paradigm, the assignment to the higher or lower working memory group is not random. The results of the first experiment could potentially be attributed to other differences in the two groups of participants, such as potential differences in education or verbal ability. Thus it is desirable to directly manipulate resource availability in such a way that participants can be randomly assigned to the higher or lower resource availability conditions. This was accomplished in the second experiment through the addition of a divided attention task for half of the participants. In the full attention condition visual study presentation should reduce false memories relative to auditory study presentation, just as for the higher span participants in Experiment 1. In contrast, when a secondary task is imposed the reduction in resource availability is predicted to eliminate the effect of visual study presentation on false recall.

Method

Participants and Design

Introductory psychology students between the ages of 17 and 35 completed the experiment for credit toward a course requirement. The 97 participants were randomly assigned to one of four conditions created by the orthogonal combination of the between-subjects variables of study modality (auditory vs. visual) and attention condition (full vs. divided).

Materials and Procedures

Materials and procedures matched those of Experiment 1 with the following exceptions. Participants did not complete the operation span task. Participants in the divided attention condition completed a secondary task during encoding.

In the visual study condition, the secondary task was a continuous tone identification task. Participants heard a high, medium, or low tone over headphones and were instructed to press the 1, 2, or 3 keys for each tone, respectively. After reading the instructions for the tone task participants were introduced to the different tones, followed by 30 s of practice in which the tone task was performed alone. During the tone task, a randomly selected tone was played until the correct response was entered. When a correct response was entered the current tone stopped and a new tone began. After practicing the tone task participants received instructions for the study phase of the DRM task. The tone task continued throughout the presentation of the visual study list.

In the auditory study list presentation condition, the secondary task was a continuous color identification task. Rectangles (approximately 15×15 cm) were presented in the center of the computer display in dark, medium, or light blue on a white background. Participants were introduced to the colors one at a time and pressed the 1, 2, or 3 keys for the light, medium, or dark colors, respectively. Participants performed the continuous color identification task alone for 30 s before continuing to the DRM task. The color task continued throughout the auditory study list presentation.

Results and Discussion

False Recall

False recall is shown in Table 2. The main effect of attention condition was not significant, $F < 1$, $p > .93$. The main effect of study presentation modality, $F(1, 93) = 7.36$, $MSE = 0.04$, $p = .008$, $\eta_p^2 = .07$, was significant. The interaction of modality and attention approached significance, $F(1, 93) = 3.37$, $MSE = 0.04$, $p = .070$, $\eta_p^2 = .04$. Planned comparisons were conducted to test the prediction that visual study presentation would reduce false memory relative to auditory study presentation in the full attention condition, but not in the divided attention condition. As predicted a significant effect of modality was demonstrated in the full attention condition, $F(1, 47) = 13.45$, $MSE = 0.03$, $p = .001$, $\eta_p^2 = .22$, but not in the divided attention condition, $F < 1$, $p > .58$. Thus, the pattern of results parallels the results found in Experiment 1: When cognitive resources are reduced, the advantage for visual study presentation in avoiding false memories is eliminated.

Correct Recall and Secondary Task Performance

Correct recall, also shown in Table 2, was not significantly affected by study modality, $F < 1$, $p > .77$. The significant main effect of attention condition, $F(1, 93) = 136.74$, $MSE = 0.003$, $p < .001$, $\eta_p^2 = .60$, was qualified by a significant interaction of attention condition and study modality, $F(1, 93) = 3.97$, $MSE = 0.003$, $p = .049$, $\eta_p^2 = .04$. The interaction was investigated with separate analyses for each divided attention condition. In the case of full attention, correct recall did not differ in the two study modality conditions, $F(1, 47) = 1.15$, $p > .29$. In the case of divided attention, the effect of study modality approached significance, $F(1, 46) = 3.61$, $MSE = 0.002$, $p = .064$, $\eta_p^2 = .07$, with fewer list items correctly recalled in the visual study list condition. This suggests that the secondary tone task had a greater impact than did the secondary color task. Consistent with this interpretation, response times on the secondary task were significantly longer in the visual study condition (tone task), $M = 783$, $SEM = 21$, than in the auditory study condition (color task), $M = 630$, $SEM = 16$, $F(1, 46) = 33.69$, $MSE = 8{,}331$, $p < .001$, $\eta_p^2 = .42$.

General Discussion

Within the DRM paradigm visual study presentation can reduce the rate of false recall relative to auditory study presentation (e.g., Smith & Hunt, 1998; Smith et al., 2008). In the first experiment this reduction in false recall following visual study presentation was demonstrated for individuals with higher working memory capacity, but not for individuals with lower working memory capacity. In the second experiment, dividing attention at encoding eliminated the advantage for visual study presentation in avoiding false memories. The effect of dividing attention at study suggests that reduced resource availability may affect the encoding of perceptual information that otherwise would contribute to the expression of the modality effect. While avoiding false memories may also require resources at the time of test for strategic decision processes, in the case of the modality effect, these processes appear to depend at least in part upon the processing of relevant information at encoding.

The current results shed light on a possible discrepancy in false memory findings involving older adults. In contrast to the lack of an effect of study modality on false recall for older adults (Butler, McDaniel, McCabe, & Dornburg, 2010; Smith et al., 2005), the presentation of pictures rather than words can reduce false memories in both younger and older adults (Schacter et al., 1999). Insight into this contrast may be provided by findings that suggest that the benefits for memory associated with pictures accrue through automatic processes. For instance, Maisto and Queen (1992) found equivalent picture superiority effects for both younger and older adults. Parkin and Russo (1990) found that dividing attention did not impact performance on a picture completion test. Smith et al. argue that the benefits of pictures for reducing false recall involve more automatic processes, while the benefits associated with the visual presentation of words for reducing false recall involve more controlled processing. Consistent with this argument, Koutstaal, Schacter, Galluccio, and Stofer (1999) found that false memories were reduced for older adults when distinctive information was provided for the participants relative to when the older adults had to engage in item-specific processing without support (see also Butler et al., 2010). This analysis also implies that the benefits of distinctive information for reducing false memories will vary depending upon the resource demands required for encoding (and perhaps retrieving) relevant information and depending upon the resources available to the individual.[4]

This adds a new twist to the framework of relational and item-specific processing for explaining memory phenomena (Hunt, 2006; Hunt & McDaniel, 1993). Smith and Hunt (1998) argued that the effect of visual study presentation on false memory relies upon the encoding and retrieval of distinctive information. Visual presentation of the list items may result in the encoding of more perceptual information relative to auditory presentation, a proposal supported by the finding that memory for visual sources are accompanied by more perceptual details than memory for auditory sources (Johnson, Nolde, & De Leonardis, 1996). This increased perceptual information provides a dimension along which studied and critical items can be differentiated. More direct support for the distinctiveness explanation comes from experiments in which participants engaged in a pleasantness rating task at encoding. The pleasantness rating task, a task which encourages distinctive processing, reduced false recall regardless of the modality of presentation (Smith & Hunt, 1998). In combination with the distinctiveness explanation of the modality effect, the current work suggests that cognitive resources may sometimes be required in order to benefit from distinctive processing. This proposal is consistent with work by Hay and Jacoby (1999). Hay and Jacoby demonstrated that limitations in processing resources underlie age differences in the ability to benefit from distinctive information. Thus, the effect of manipulations thought to induce distinctive processing will depend upon the resources available to an individual.

Before concluding our discussion it should be noted that a careful comparison of the results from Experiment 1 with the results presented by Watson et al. (2005) points to factors that might mediate the effects of working memory and study modality on false memory. Watson et al. used visual study presentation in their first experiment and auditory study presentation in their second experiment. Based upon the current demonstration of a reduction in false memories with visual study versus auditory study for higher span participants, but not for lower span participants, one might expect the same pattern across experiments in Watson et al., at least in the no-warning condition. In Watson et al.'s Experiment 2 false recall in the no-warning condition following auditory study did not differ as a function of span and was $\sim .36$ when collapsing over span, which is similar to the current finding of false recall of .34 in the auditory condition when collapsing over span group in Experiment 1. However, higher and lower span individuals did not differ significantly in Experiment 1 (visual study only) of Watson et al. with false recall rates of .20 and .23, respectively. This pattern is noticeably different from the false recall rates of .21 and .32 in the current Experiment 1 for higher and lower span groups, respectively. Thus, the difference in the two studies seems to lie in the visual study conditions.

The cross experimental comparison in Watson et al. (2005), as well as the comparison with the first experiment in the current study, is complicated by numerous differences across the three experiments. Nonetheless, careful consideration of the methods used in the two studies points to a

[4] See Gallo (2006) for an alternative analysis of the differential effects of pictures and words as a function of age.

potential explanation for the different outcomes. In the current experiments all visual study list items were presented in lowercase. In contrast, Watson et al. presented words in either uppercase or lowercase, alternating between the two cases throughout the study list. Arndt and Reder (2003) demonstrated that when a mixture of fonts is used for study list presentation false memories can be reduced relative to a condition in which all items in an associate list are presented in the same font. Thus, the cross experimental comparison in the Watson et al. study does not really parallel the modality comparison in the current study: The visual conditions in the Watson et al. experiment also included additional perceptual variations that have been shown to reduce false memory. Furthermore, Arndt and Reder propose that the use of mixed fonts within an associate list will increase item-specific processing and reduce relational processing, both of which would lead to fewer false memories. The cross experimental comparison in Watson et al. indicates that, in contrast to study presentation modality, the effect of mixed versus consistent font is not sensitive to changes in resource availability.

Conclusion

In the current experiments the beneficial effects of visual study presentation in the DRM paradigm for reducing false memories were sensitive to variations in resource availability. Similarly, previous research has shown that the effectiveness of warnings for avoiding false memories can also depend upon resource availability (Peters et al., 2008; Watson et al., 2005). At the same time, the above discussion of Watson et al.'s (2005) use of mixed font case and the earlier discussion of the effectiveness of pictures for reducing false memories in young and older adults indicate that not all manipulations aimed at reducing false memories will be sensitive to differences in working memory or divided attention. In the case of study modality (Smith & Hunt, 1998), font (Arndt & Reder, 2003), and pictures versus words (Schacter et al., 1999), the effects of these variables on false memory have all been discussed in terms of item-specific, relational, and distinctive processing. In the future researchers should consider whether the same mechanisms are in fact underlying all of these different techniques for reducing false memories.

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