Individual differences in susceptibility to false memories: The effect of memory specificity.

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Individual differences in susceptibility to false memories: The effect of memory specificity

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Abstract

Previous research has highlighted the wide individual variability in susceptibility to the false memories produced by the Deese/Roediger-McDermott (DRM) procedure [Deese, J. (1959). On the prediction of occurrence of particular verbal intrusions in immediate recall. *Journal of Experimental Psychology*, *58*, 17–22; Roediger, H. L., III, & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, *21*, 803–814]. The current study investigated whether susceptibility to false memories is influenced by individual differences in the specificity of autobiographical memory retrieval. Memory specificity was measured using the Sentence Completion for Events from the Past Test (SCEPT) [Raes, F., Hermans, D., Williams, J. M. G., & Eelen, P. (2007). A sentence completion procedure as an alternative to the Autobiographical Memory Test for assessing overgeneral memory in non-clinical populations. *Memory, 15*, 495-507]. Memory specificity did not correlate with correct recognition, but a specific retrieval style was positively correlated with levels of false recognition. It is proposed that the contextual details that frequently accompany false memories of nonstudied lures are more accessible in individuals with specific retrieval styles.

Keywords: false memories; autobiographical memory specificity; individual differences

Individual Differences in Susceptibility to False Memories: The Effect of Memory Specificity

The Deese/Roediger-McDermott (DRM) paradigm, named after studies by Deese (1959) and Roediger and McDermott (1995), has been widely used to investigate the creation of false memories under controlled laboratory conditions. In this procedure, participants study lists of words (e.g., *bed*, *rest*, *wake*, etc.) that are semantic associates of a nonstudied "critical lure" (e.g., *sleep*). When memory for the lists is then tested, participants show surprisingly high levels of false recall or false recognition of the critical lures. Roediger and McDermott found that levels of false recall exceeded the correct recall of items presented in the middle of the lists. In addition, the false recognition of critical lures was associated with high levels of confidence and the subjective experience of conscious recollection, as measured by "remember" responses (Tulving, 1985). The compelling nature of the DRM illusion has been demonstrated in many subsequent studies (see Gallo, 2010, for a review).

A number of theoretical explanations of the DRM illusion have been proposed. According to activation-monitoring theory (Roediger, Watson, McDermott, & Gallo, 2001), critical lures are spontaneously activated in response to the items presented at study. When the critical lures are presented at test, participants make errors of source monitoring (Johnson, Hashtroudi, & Lindsay, 1993) and falsely claim that they were externally presented rather than internally generated. According to fuzzy-trace theory (see Brainerd, Reyna, & Ceci, 2008) participants encode two parallel traces of the items presented at study. Verbatim traces preserve contextual details of individual items whereas gist traces represent the overall theme of a set of items. The DRM illusion occurs because the critical lures presented at test are consistent with the gist of the studied items.

One surprising finding that has to be accounted for by any theory of false memory is the considerable individual variability in susceptibility to the DRM illusion. For example, elevated levels of false memories have been found in patients with frontal lobe damage (Melo, Winocur, & Moscovitch, 1999), whereas reduced levels of false memories have been reported in patients with Alzheimer's disease (e.g., Budson, Daffner, Desikan, & Schacter, 2000; Budson, Desikan, Daffner, & Schacter, 2001). Within the general population, susceptibility to the DRM illusion is affected by age, with reduced levels in children (e.g., Brainerd, Reyna, & Forrest, 2002) and elevated levels in the elderly (Balota et al., 1999). An effect of gender has also been observed whereby women show elevated levels of false recall for critical lures of negative emotional valence (Dewhurst, Anderson, & Knott, 2012). Susceptibility to the DRM illusion has also been shown to be associated with high levels of dissociative experiences and vivid imagery (Winograd, Peluso, & Glover, 1998), low working memory capacity (Watson, Bunting, Poole, & Conway, 2005), high need-for-cognition (Graham, 2007), and extroversion (Sanford & Fisk, 2009).

There have also been attempts to relate the DRM procedure to memory distortions observed within autobiographical memory (see Gallo, 2010, for a review). Some studies have shown increased susceptibility to the DRM illusion in participants who claim to remember personal events that might be considered unlikely, such as alien abduction (Clancy, McNally, Schacter, Lenzenweger, & Pitman, 2002) and events from past lives (Meyersburg, Bogdan, Gallo, & McNally, 2009). Other studies have found that susceptibility to the DRM illusion is negatively associated with the recall of verifiable events. For example, Platt, Lacey, Iobst, and Finkelman (1998) investigated consistency of recall of a widely reported news event (the trial of O.J. Simpson) and found that participants who were more susceptible to the DRM illusion had less consistent memories of the event over time. These findings suggest that susceptibility to the DRM illusion is associated with inaccurate autobiographical memory (but see Patihis et al., 2013, who found that individuals with highly superior autobiographical memories are susceptible to the DRM illusion).

In contrast to these findings, studies comparing the DRM illusion and autobiographical memory distortions induced in the laboratory have found little evidence for an association. For example, Qin, Ogle, and Goodman (2008) found that susceptibility to the lost-in-the-mall technique (Loftus & Pickrell, 1995) was not associated with susceptibility to the DRM illusion. Other studies have compared the DRM illusion with the misinformation effect (see Loftus, 2005, for a review of the misinformation effect) and have produced conflicting results. For example, Ost et al. (2013) found no reliable relationship between the DRM illusion and the misinformation effect. In contrast, Zhu, Chen, Loftus, Lin, and Dong (2013) used a signal detection analysis to measure sensitivity and response bias and found that participants who showed high sensitivity in the DRM task (as measured by d') were less susceptible to the misinformation effect. More recently, Calvillo and Parong (2016) developed a modified version of the misinformation paradigm that enabled them to compare discrimination and response bias measures with those produced by the DRM illusion. Despite these modifications, no significant relationship was observed between the DRM illusion and the misinformation effect.

It is evident from the studies discussed above that the relationship between the DRM illusion and the accuracy of autobiographical memory is unclear. In the current study, we took a different approach by investigating the relationship between the DRM illusion and the *specificity* of autobiographical memory retrieval, rather than the accuracy. Specificity in this context refers to the retrieval of episodic details within an autobiographical memory. The importance of autobiographical memory specificity is illustrated by findings that reduced specificity, or overgeneral memory, is associated with impairments in problem solving (Raes et al., 2005) and increased vulnerability to mood disturbances such as depression and dysphoria (Anderson, Goddard, & Powell, 2010; Williams et al., 2007). Memory specificity has also been related to other aspects of memory functioning. For example, Raes et al. (2006)

investigated the relationship between specificity and a range of laboratory-based memory measures, including working memory, verbal memory, and source memory, in patients with major depressive disorder. They found that overgeneral memory was related to impairments in working memory (particularly executive functioning) and source memory. These findings are particularly relevant to the current study because susceptibility to the DRM illusion has been shown to be associated with executive functions (Watson et al., 2005) and source monitoring (Roediger & McDermott, 1995).

Autobiographical memory specificity has been investigated using the Autobiographical Memory Test (AMT) developed by Williams and Broadbent (1986), in which participants are instructed to retrieve specific autobiographical memories in response to cue words. According to Raes, Hermans, Williams, and Eelen (2007), however, the AMT is not sufficiently sensitive to measure memory specificity in non-clinical respondents. Compared to clinical groups, the proportion of non-clinical respondents who exhibit an overgeneral retrieval style in the AMT is relatively small. In addition, such respondents can override their habitual retrieval style and retrieve specific memories when instructed to do so. Raes et al. (2007) developed an alternative method for measuring habitual retrieval style based on a sentence completion task. In the Sentence Completion for Events from the Past Test (SCEPT) participants are provided with 11 sentence stems relating to the past (e.g., Last week I…). They are free to complete the stems however they wish, as long as each sentence relates to a different topic. The main advantage of the SCEPT is that it provides a measure of a participant's habitual retrieval style by removing the instruction to retrieve only specific memories.

In the current study, participants took part in both the SCEPT and the DRM procedure and our aim was to investigate whether performance on the two tasks was associated. Intuitively, one might expect individuals with less specific retrieval styles to be more susceptible to the DRM illusion, as they may be less able to recall the contextual details that are typically associated with studied items. Research has shown that false memories can be reduced by a “recollection rejection” strategy whereby participants reject lures by recollecting the related studied items (Brainerd, Reyna, Wright, & Mojardin, 2003). It is possible that such strategies are impaired in individuals with less specific retrieval styles. If so, we would expect participants with high specificity to show increased correct recognition and reduced false recognition relative to those with low specificity. On the other hand, a common finding in DRM studies is that critical lures are accompanied by the illusory recollection of contextual details (e.g., Lampinen, Neuschatz, & Payne, 1999, Lyle & Johnson, 2006). It is possible that participants with specific retrieval styles will be more inclined to accept an item in a recognition test as “old” if their memory for the item features such contextual details. If this is the case, then participants with specific retrieval styles might be more susceptible to false memories. In order to investigate the relationship between memory specificity and recollection and shed light on these contradictory theoretical predictions, we incorporated a “remember/know” decision into the recognition test (see Roediger & McDermott, 1995, Experiment 2).

We also manipulated list type within the DRM procedure by presenting participants with words that were associates either of negatively valenced or of neutral critical lures. One of the criticisms of the DRM procedure is that it lacks the emotionality of false memories that occur in real-life scenarios (see Freyd & Gleaves, 1996). This is particularly relevant to the current study as reduced memory specificity has been interpreted as a response to negative life events (Williams et al., 2007). On this basis, it could be predicted that memory specificity will be associated with false memories for negative items but not neutral items. Previous research has shown that a DRM effect can be observed when list items are associates of emotional critical lures, though the direction of the effect varies between studies. Some studies have shown that emotional DRM lists produce lower levels of false memory than neutral lists (e.g., Kensinger & Corkin, 2004, Palmer & Dodson, 2009, Pesta, Murphy, & Sanders, 2001), whereas others have shown that emotional lists lead to higher levels of false memory (e.g., Brainerd, Stein, Silveira, Rohenkohl, & Reyna, 2008, Dewhurst et al., 2012, El Sharkawy, Groth, Vetter, Beraldi, & Fast, 2008). These differences are likely due to the use of different lists (see Dewhurst et al. for further discussion of this). The manner in which memory is tested also appears to be crucial. For example, Howe, Candel, Otgaar, Malone, and Wimmer (2010) found that negative DRM lists produced higher levels of false recognition relative to neutral lists but lower levels of false recall. These differences notwithstanding, the use of emotional and neutral lists in the current study allowed us to investigate whether the relationship between memory specificity and susceptibility to false memories is influenced by the valence of the word lists. Establishing the effects of valence will also have important implications for the selection of stimuli in future false memory studies.

Method

Participants.

Eighty-five undergraduate students (67 females) in the age range 18-31 participated for payment or course credit. All were native English speakers. They were tested at individual workstations in groups of up to six.

Stimuli and Design.

The SCEPT (Raes et al., 2007) requires participants to complete 11 sentence stems relating to the past (e.g., Last week I…). Participants are free to complete the stems however they wish provided each completion relates to a different topic. In the procedure developed by Raes et al., sentence completions are coded into four categories: specific memory (with reference to a particular place and time, and not lasting more than 1 day), categoric (reference to a category of events containing a number of episodes), extended (reference to a single event lasting longer than 1 day), or a semantic associate (personal semantic information). Any failures to complete a stem are recorded as omissions. As we were interested in the effects of memory specificity on false memory, responses were simply coded into specific versus non-specific.

True and false recognition were measured using 10 negatively-valenced and 10 emotionally neutral DRM lists developed by Dewhurst et al. (2012). Each list consisted of 12 semantic associates of a critical lure. The negative lists consisted of associates of the following critical lures: *sick, lie, anger, fear, evil, cry, pain, hate, alone, danger*. The neutral lists consisted of associates of the following critical lures: *sleep, chair, foot, high, rough, king, fruit, sweet, mountain, slow*. Half the participants studied the lists in the order shown above with negative and neutral lists alternating. This order was reversed for the remaining participants. The negative and neutral lists were matched for backwards associative strength. Dewhurst et al. reported independent samples t-tests showing that the negative lists and critical lures were of significantly lower valence than the neutral lists. The full set of lists and their psycholinguistic properties can be found in Stimuli section of Dewhurst et al.

Procedure

The DRM lists were presented on Apple Macintosh computers using custom-written software. Each list was preceded by the instruction *List 1, List 2*, etc., which was shown for 2 seconds, after which the 12 associates appeared one at a time for 1 second each, separated by a 1 second interval. After the presentation of the final list, participants were given a nonverbal filler task (maths problems) for 5 minutes. This was followed by a recognition test consisting of 40 studied items (two from each list), 20 critical lures, and an additional 40 unstudied words (20 neutral and 20 negative) not related to the DRM lists. Test items were presented one a time and participants pressed the z and / keys to indicate “old” and “new" respectively. Old responses were followed by an instruction inviting participants to make the remember/know/guess decision by pressing the R, K, or G key. Participants were instructed to make a "remember" response if they could recollect some contextual detail of seeing the word at study, such as an image or association formed at study, or a "know" response if they recognised the word on the basis of familiarity but had no recollection of contextual information. They were instructed to make a "guess" response if their old/new decision had been a guess.

After completing the recognition test, participants were introduced to the SCEPT. They were instructed to complete each stem any way they wished, with the only constraints being that each completion had to relate to a different topic and to correspond to the provided stem. Participants were allowed 6 minutes to complete the SCEPT. There were no failures to complete within this time.

Results

As we were interested in the relationship between specificity and memory performance, responses on the SCEPT were categorised as specific or non-specific. Responses from all participants were coded by the second author and responses from a random sample of ten participants were second coded by the first author. Inter-rater reliability was good (Cohen's Kappa = .96). The few discrepancies that occurred were resolved by discussion.

Preliminary analyses consisted of separate 2 (list type: negative versus neutral) x 2 (response type: remember versus know) repeated measures ANOVAs on correct and false recognition proportions. Guess responses were not included in the analyses as they were made below chance levels. The analysis of correct recognition showed a significant main effect of list type, whereby participants correctly recognized more words from neutral lists than from negative lists, F (1,84) = 25.99, MSE = .01, p < .001, η_p^2 = .24. A significant main effect of response type was also observed, whereby participants made more correct remember responses than correct know responses, $F(1,84) = 235.58$, $MSE = .07$, $p < .001$, $\eta_p^2 = .74$. The interaction between list type and response type was also significant, $F(1,84) = 47.91$, $MSE = .02$, $p < .001$, $\eta_p^2 = .36$. Bonferroni-adjusted pairwise comparisons showed that the advantage for negative words was present in both remember responses, $p < .001$, and know responses, $p < .001$, but Table 1 indicates that the difference was greater in remember responses.

In the analysis of false recognition, the main effect of list type was not significant, $F(1,84) = 2.61$, $MSE = .01$, $p = .11$, $\eta_p^2 = .03$, nor was the main effect of response type, $F < 1$. There was, however, a significant interaction between list type and response type, $F(1,84) = 17.99$, $MSE = .02$, $p < .001$, $\eta_p^2 = .18$. Bonferroni-adjusted pairwise comparisons showed that participants made more false remember responses to neutral lures than to negative lures, $p = .006$, but more false know responses to negative lures than to neutral lures, $p < .001$.

Our primary interest, however, was in the relationship between autobiographical memory specificity and the levels of correct and false recognition for negative and neutral lists. This relationship was analysed in a series of correlations, with separate analyses of remember responses, know responses, and total recognition scores (remember plus know). Table 2 shows the correlations between the numbers of specific memories reported and correct recognition scores for negative and neutral lists. As can be seen from Table 2, no significant correlations with memory specificity were observed for total recognition scores, remember responses, or know responses. Table 3 shows the correlations between the numbers of specific memories reported and false recognition scores for negative and neutral lists. As can be seen, memory specificity showed significant positive correlations with overall recognition scores and false remember responses for negative and neutral lures. No significant correlations were observed for false know responses.

We also conducted signal detection analyses to investigate whether memory specificity was related to measures of sensitivity and response bias. In order to avoid proportions of 0 and 1 in the signal detection analyses, we used the correction recommended by Snodgrass and Corwin (1988) whereby 0.5 was added to the hit and false alarm rates, which were then divided by the maximum possible score +1. Table 4 shows the correlations between the number of specific memories and measures of sensitivity (*d′*) and response bias (*C*) for negative and neutral lists. As can be seen from Table 4, there were no significant correlations between memory specificity and *d′* for negative or neutral lists in terms of total recognition scores, remember responses, or know responses. In contrast, significant correlations were observed between memory specificity and response bias in the total recognition scores for both negative and neutral lists. The correlation was also significant for remember responses to neutral lists.

Discussion

The main finding from the current study is that autobiographical memory specificity, as measured by the SCEPT (Raes et al., 2007), was positively correlated with susceptibility to the DRM illusion. A specific retrieval style was associated with higher false recognition rates for critical lures, both in terms of overall false alarm rates and in terms of false remember responses. We speculated that the effects of memory specificity might be confined to negative lists, based on the view that reduced memory specificity developed in response to negative life events (Williams et al., 2007). The effect of memory specificity was, however, present for both negative and neutral DRM lists, indicating that the effect of memory specificity is not confined to words of one particular valence. In contrast to the effects in false recognition, autobiographical memory specificity was not significantly associated with levels of correct recognition. This pattern suggests that participants with a specific retrieval style are more likely to endorse a new item as old if it is related to items presented at study. This is supported by the signal detection analyses showing that high memory specificity was associated with a more liberal response bias.

The finding that high memory specificity was associated with greater susceptibility to the DRM illusion could be considered counterintuitive, as one might expect individuals with specific retrieval styles to be more accurate. We speculated that participants with high memory specificity might be more successful in rejecting critical lures because of their superior recognition of studied items. If this was the case, memory specificity would have been associated with increased correct recognition and reduced false recognition. However, there were no significant correlations between specificity group and correct recognition, and the effects in false recognition were in the opposite direction. The observed pattern is more consistent with the view that participants with specific retrieval styles are more inclined to accept a test item as "old" if their recollection of the item features specific details. In short, they associate detail with veridicality. This is consistent with previous findings that false memories in the DRM paradigm often feature illusory contextual details (see Lyle & Johnson, 2006, for a review). The finding that the effect of memory specificity was located in false "remember" responses also supports this interpretation.

In terms of activation-monitoring theory (Roediger et al., 2001), the current findings could be attributed to source monitoring errors in participants with specific retrieval styles. This appears to be at odds with the findings of Raes et al. (2006) that source monitoring errors were associated with reduced memory specificity. However, in the task used by Raes et al., participants studied two lists of words and were then given a recognition test in which they had to identify the source of each target (List A or List B). This is notably different from the DRM procedure used in the current study, in which participants have to indicate whether an item is old or new. It is easy to see how participants with less specific retrieval styles would find it difficult to distinguish between two similar sources, as they would be less able to retrieve source-specific detail. In the DRM procedure, however, participants with a specific retrieval style might be more likely to create false memories that feature episodic details. Previous DRM studies have shown that contextual details from studied items can be erroneously bound to critical lures, giving rise to false memories that feature details of the encoding context (Lampinen et al., 1999; Lyle & Johnson, 2006). The current findings have clear implications for activation-monitoring theory as they suggest that such details are more accessible in participants with a specific retrieval style.

The view that a specific retrieval style increases susceptibility to source monitoring errors is also supported by findings from the visual memory literature. For example, Johnson, Raye, Wang, and Taylor (1979) reported that participants who were rated as “good imagers” were more prone to source monitoring errors. Participants in this study were presented with pictures either two, five or eight times and also had to generate images of the pictures two, five or eight times. Johnson et al. found that good imagers (as determined by performance on a picture imagery test) overestimated the number of times each picture was presented. This finding suggests that the tendency to generate sensory detail impairs the ability to distinguish between studied and self-generated events. An interesting direction for future research would be to investigate the effects of retrieval style on source monitoring.

At first glance, the current findings appear to be at odds with fuzzy-trace theory, which attributes the DRM illusion to gist traces. Gist traces lack the specificity of verbatim traces, therefore it could be argued that fuzzy-trace theory predicts that false memories would be more prevalent in participants with less specific retrieval styles. However, fuzzy-trace theory acknowledges the possibility of “phantom recollection”, whereby participants have the conscious experience of recollecting a nonstudied item (Brainerd, Wright, Reyna, & Mojardin, 2001). Brainerd et al. observed phantom recollection in false recognition using both DRM lists and lists of category exemplars from which some typical items were removed to provide critical lures. More recently, Marche and Brainerd (2012) found phantom recollection in false recall using DRM lists. They argued that phantom recollection occurs when gist traces are sufficiently strong that they take on phenomenological detail. Fuzzy-trace theory can explain the current findings if one assumes that the tendency to derive phantom recollection from strong gist traces is enhanced in participants with specific retrieval styles.

Although not the main focus of the current study, it is important to note that the effects of word type were consistent with those reported by Dewhurst et al. (2012) who used the same word lists. Specifically, Dewhurst et al. found higher levels of correct and false recall for neutral than for negatively valenced lists (though the latter was only present in female participants). In the current study, we found higher levels of correct and false remember responses for neutral than for emotional lists. Although these patterns were not observed in overall recognition scores due to reversed effects in know responses, they are consistent with previous findings that effects selectively observed in remember responses often follow the same pattern as effects observed in free recall (e.g., Dewhurst, Hitch, & Barry, 1998).

To summarise, the main finding from the current study is that autobiographical memory specificity was positively associated with susceptibility to the DRM illusion. False memories produced by the DRM procedure typically feature illusory contextual details (see Lyle & Johnson, 2006, for a review). The current findings suggest that participants with a specific retrieval style are more likely to falsely recollect such details. Previous research has highlighted the benefits of having a specific retrieval style. For example, it has been shown to be a protective factor against mood disturbances such as depression and dysphoria (Anderson et al., 2010; Williams et al., 2007). The current findings suggest a possible negative consequence of having a specific retrieval style, albeit within the context of a memory illusion that is driven by relatively simple verbal associations. An interesting direction for future research would be to investigate the effects of retrieval style on susceptibility to more naturalistic false memory paradigms, such as the misinformation effect and the imagination inflation paradigm. In the meantime, our results add to the growing body of evidence that the retrieval of episodic detail is no guarantee of the veridicality of a memory.

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Table 1

Mean proportions (with standard deviations) of hits and false alarms as a function of list type and response type.

	Emotional	*Neutral*
Hits (R+K)	.73 (.15)	.80 (.13)
Hits (R)	.52 (.19)	.68 (.16)
Hits (K)	.21 (.12)	.13 (.08)
False alarms (R+K)	.48 (.26)	.47 (.23)
False alarms (R)	.22 (.22)	.27 (.19)
False alarms (K)	.27 (.18)	.19 (.13)

Table 2

Mean correlations with number of specific memories for correct recognition of negative and neutral lists.

	Pearson's r	*p-value*
Negative (R+K)	.117	.076
Negative (R)	-.002	.985
Negative (K)	.131	.233
Neutral (R+K)	.172	.116
Neutral (R)	.121	.268
Neutral (K)	.019	.860

Table 3

Mean correlations with number of specific memories for false recognition of negative and neutral critical lures.

	Pearson's r	*p-value*
Negative (R+K)	.236	.030
Negative (R)	.214	.049
Negative (K)	.096	.381
Neutral (R+K)	.285	.008
Neutral (R)	.233	.032
Neutral (K)	.158	.148

Table 4

Mean correlations with number of specific memories for sensitivity (d') and response bias (C) for negative and neutral lists.

		Pearson's r	*p-value*
Negative (R+K)	*d'*	-.140	.202
	C	-.255	.018
Negative (R)	*d'*	-.186	.088
	C	-.160	.143
Negative (K)	*d'*	.042	.703
	C	-.177	.105
Neutral (R+K)	*d'*	-.121	.269
	C	-.301	.005
Neutral (R)	*d'*	-.096	.381
	C	-.219	.044
Neutral (K)	*d'*	-.114	.298
	C	-.133	.225