

Sadder and Less Accurate? False Memory for Negative Material in Depression

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Previous research has demonstrated that induced sad mood is associated with increased accuracy of recall in certain memory tasks; the effects of clinical depression, however, are likely to be quite different. The authors used the Deese-Roediger-McDermott paradigm to examine the impact of clinical depression on erroneous recall of neutral and/or emotional stimuli. Specifically, they presented Deese-Roediger-McDermott lists that were highly associated with negative, neutral, or positive lures and compared participants diagnosed with major depressive disorder and nondepressed control participants on the accuracy of their recall of presented material and their false recall of never-presented lures. Compared with control participants, major depressive disorder participants recalled fewer words that had been previously presented but were more likely to falsely recall negative lures; there were no differences between major depressive disorder and control participants in false recall of positive or neutral lures. These findings indicate that depression is associated with false memories of negative material.

Keywords: depression, memory, cognition, emotion, bias

Mood states and emotions affect memory in various ways. Mood-induction studies, for example, have demonstrated that negative affect is associated with increased accuracy in retrieval (Storbeck & Clore, 2005), whereas positive mood states are associated with decreases in processing capacity (Mackie & Worth, 1989) and reduced processing motivation (Wegener & Petty, 1994), resulting in less accurate recall (Ruder & Bless, 2003). At the same time, research on mood-congruency suggests that affective states increase the accessibility of mood-congruent material (Bower, 1981). Understanding this complex interaction of mood and memory is important, given its critical role in emotion regulation and emotional disorders.

Individual differences in mood-congruent memory and in the accessibility of mood-incongruent material have been proposed to predict the ability to regulate negative mood states (Joormann & Siemer, 2004; Joormann, Siemer, & Gotlib, 2007). Indeed, depression, by definition a disorder characterized by difficulty regulating negative mood states, is associated with two distinct but related memory impairments.

First, difficulties in cognitive control (i.e., focal attention to relevant stimuli and inhibition of irrelevant material) result in memory deficits for nonemotional material (Burt, Zembor, & Niederehe, 1995; Hertel, 2004). In a series of studies, Hertel and her collaborators (Hertel, 1998; Hertel & Rude, 1991) presented evidence indicating that depression-related impairments are not observed in all components of memory but are found primarily in free-recall tasks and in other unstructured memory tasks in which attention is not well controlled. These results suggest that, at least with respect to memory deficits, depressed people might have the ability to perform at the level of nondepressed people in structured situations but have problems doing this in unconstrained situations (Hertel, 2004). Moreover, these authors demonstrated that eliminating the opportunity to ruminate also eliminated the impairment in the memory task, a result that might explain why unconstrained tasks lead to impaired performance in the depressed group. Unconstrained situations require cognitive control (Hertel, 2004). Thus, performance deficits in free recall in depression likely do not reflect a generalized deficit, but might instead be due to depression-related deficits in cognitive control.

Second, negative affect associated with depressive disorders makes mood-congruent material more accessible and mood-incongruent material less accessible, a finding that is consistent with predictions from schema and network theories of emotion (see Mathews & MacLeod, 2005). Indeed, biased memory for negative, relative to positive, information represents perhaps the most robust cognitive finding associated with major depression (Blaney, 1986; Matt, Vazquez, & Campbell, 1992). In a meta-analysis of studies assessing recall performance, Matt et al. (1992) found that people with major depression remember 10% more negative than positive words. Nondepressed control participants,

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in contrast, demonstrated a memory bias for positive information in 20 of 25 studies. It is important to note that the effects of mood on memory may help explain why depressed people are caught in a vicious cycle of increasingly negative mood and enhanced accessibility of negative material that maintains or exacerbates negative affect and hinders emotion regulation. This process is likely to be different in nonclinical samples, in which negative mood frequently leads to enhanced recall of mood-incongruent material, a finding commonly interpreted as stemming from efforts to repair negative mood (Parrott & Sabini, 1990; Rusting & DeHart, 2000).

Previous studies of mood and memory have focused almost exclusively on the number of items that are correctly recalled. It is important to recognize, however, that there are different errors of memory: People can forget stimuli that they have seen, and they can “remember” items that they have not seen. This latter error, often termed a “commission error” or “false memory,” has rarely been investigated in depression. Results of research examining mood and memory in nonclinical samples and findings from studies of mood-congruent biases in depressed samples lead to different predictions regarding the production of false memories in major depressive disorder (MDD). If negative affect is generally associated with more careful processing and greater accuracy than is positive affect (e.g., Ruder & Bless, 2003), as suggested by mood-induction studies with nonclinical samples (e.g., Storbeck & Clore, 2005), depressed participants should be less prone to report false memories. On the other hand, if depression is associated with deficits in cognitive control (e.g., Hertel, 2004) and increased accessibility and activation of negative material, as suggested by network theories of emotion (e.g., Bower, 1981) and cognitive theories of depression (e.g., Beck, 1976), depressed participants may produce more false memories than will nondepressed individuals when processing negative stimuli.

To test these competing predictions, we administered the Deese-Roediger-McDermott (DRM; Roediger & McDermott, 1995) task to depressed and nondepressed participants. In the DRM task, participants are presented with several word lists. Within each list, each word is highly associated with a single, never-presented word, commonly referred to as the *critical lure*. For example, a list with the word “king” as the critical lure could include “castle,” “queen,” “horse,” etc. (but not “king”). When participants hear or see these lists, they tend to recall or recognize the critical lure as having been presented (Roediger & McDermott, 1995). In fact, recall of the critical lures has been found to be equal to, and often greater than, recall of words that were actually presented, despite instructions to participants not to guess, warnings about the possibility of false memories, and incentives for accurate recall (Jou & Foreman, 2007; see Roediger, Watson, McDermott, & Gallo, 2001, for a review of this literature). In fact, unlike false recall in other paradigms, participants typically recall the critical lures with a high degree of confidence and state that they recalled the word because they actually remember seeing or hearing it, and not just because it seemed familiar (see Roediger & McDermott, 1995, 2000).

To date, few researchers have examined individual differences in DRM performance and the effects of emotional states on DRM recall. Storbeck and Clore (2005) recently demonstrated that nonclinical individuals in a negative mood state were less likely to recall critical lures than were participants who had undergone a positive mood induction, a finding consistent with predictions of

greater accuracy because of item-specific processing in sad moods. It is important to note, however, that Storbeck and Clore used only one negative list and that their sample was unselected, so it presumably did not have chronic activation of negative material. In the only published study to examine false memory in a diagnosed depressed sample, Moritz, Glaescher, and Brassen (2005) used a variant of the DRM design and reported a nonsignificant trend that depression was associated with an increased production of false memory for negative material. These findings are intriguing but difficult to interpret because Moritz et al. presented only four lists in total (only one of which was depression-relevant) and tested recognition, rather than recall. This is important because memory biases in depression have been found most consistently in free-recall tasks (Hertel, 2000). Moreover, because their lists were not part of the original set of DRM lists, it is difficult to compare their findings with other studies using the DRM task. All of these factors have been shown to influence the size of DRM effects (see Roediger et al., 2001) and may explain Moritz et al.’s nonsignificant trend.

In the current study, we used a classic DRM paradigm and analyzed recall separately for lists that were associated with positive, negative, and neutral lures. We hypothesized that, given their chronic activation of negative material, depressed participants would “recall” more negative, but not more positive or neutral, critical lures than would nondepressed control participants.

Method

Participants

Participants were solicited from two outpatient psychiatry clinics and through advertisements posted within the community. We excluded individuals if they were not fluent in English, were not between 18 and 60 years of age, or if they reported severe head trauma or learning disabilities, psychotic symptoms, bipolar disorder, or alcohol or substance abuse within the past 6 months. Trained interviewers administered the Structured Clinical Interview for the *DSM-IV* (First, Spitzer, Gibbon, & Williams, 1996) to eligible individuals during their first study session. Interrater reliability was high ($\kappa = .93$ for the MDD diagnosis, and $\kappa = .92$ for the “nonpsychiatric control” diagnosis; i.e., the absence of current or lifetime psychiatric diagnoses, according to the *Diagnostic and Statistical Manual of Mental Disorders* [4th ed.; *DSM-IV*; American Psychiatric Association, 1994] criteria).

Participants were included in the depressed group if they currently met the *DSM-IV* criteria for MDD. The never-disordered control group consisted of individuals with no current diagnosis and no history of any Axis I disorder. Participants also completed the Beck Depression Inventory–II (Beck, Steer, & Brown, 1996), a 21-item, self-report measure of the severity of depressive symptoms and the 22-item Ruminative Response Scale (Nolen-Hoeksema & Morrow, 1991) to examine how participants tend to respond to sad feelings and symptoms of dysphoria. Fifty-two individuals (25 currently diagnosed with MDD, 27 never-disordered controls) participated in this study.

Materials

We presented 40 lists, each containing 15 words. Thirty-five of the 40 lists were taken from McDermott and Watson (2001). We

added to this the happy list and the sad list used by Storbeck and Clore (2005) and created three additional lists using valence, arousal, frequency, and association norms. To assess false memory separately for neutral, negative, and positive lures, we compared valence ratings for critical lures from these lists to the Affective Norms of English Words (ANEW; Bradley & Lang, 1999), which lists valence and arousal ratings for over 1,000 English adjectives, verbs, and nouns on 9-point scales (1 = *not at all arousing/very negative* to 9 = *very arousing/very positive*). Because 11 of the 40 critical lures are not included in the ANEW, we obtained ratings from 12 undergraduate and graduate students using scales that were identical to the ANEW (full details on the ratings and lists may be obtained from Jutta Joormann). Of the 40 lures associated with the lists, we identified 3 as positive, 3 as negative, and 34 as neutral. Combining ANEW ratings with our ratings, the positive lures had an average valence rating of 7.67 ($SD = 0.55$) and an average arousal rating of 5.43 ($SD = 0.96$); the negative lures had an average valence rating of 2.87 ($SD = 2.18$) and an average arousal rating of 4.43 ($SD = 0.26$). The remaining (neutral) lures had an average valence rating of 5.20 ($SD = 1.46$) and an arousal rating of 4.63 ($SD = 1.33$). As expected, the three types of critical lures differed significantly in their valence ratings, $F(2, 37) = 7.91$, $p < .01$, but it is important to note that they did not differ in arousal, word frequency, or average word length (all F s < 1 , ns).

Design and Procedure

The false-recall paradigm was modeled after Storbeck and Clore (2005). All words were presented in the same order, with the first word of each list being most strongly associated with the critical lure and associative strength decreasing throughout the list. The sequence of the lists was randomized for each participant. The words were presented for 250 ms each with a 32-ms interstimulus interval.

Participants were tested individually within a week after their initial diagnostic interview. They read instructions on a computer screen telling them to remember as many words as possible from a list of 15 words that would be presented to them. They were further informed that a memory test was to follow the presentation of each list, and that they would be given 45 s to write down as many of the 15 words as they could remember. Following Roediger and McDermott's (1995) original instructions, we cautioned participants not to guess during the recall task. All participants began with the "King" list as a practice trial. After each list, a tone signaled the start of the memory test. Participants were given a booklet to write down the words they recalled. After 45 s, another tone signaled the end of the recall period and the start of the presentation of the next list. This procedure was repeated for all 40 lists.

Results

Participant Characteristics

Demographic and clinical characteristics of the two groups of participants are presented in Table 1. The two groups did not differ significantly in age, $t(50) < 1$, or education, $t(46) = 1.41$, $p > .05$; as expected, MDD participants had significantly higher Beck Depression Inventory-II scores than did control participants, $t(50) =$

Table 1
Characteristics of Participants, Proportion of Correctly Recalled Words, and Mean Error Rates

Variable	Group	
	MDD	CTL
<i>N</i>	25	27
Female	14	19
Male	11	8
<i>M</i> age (years)	32.56 (8.33)	31.29 (10.69)
<i>M</i> years of education	15.42 (2.53)	16.22 (2.26)
% Caucasian	65	66
% income < \$50,000	77	70
<i>M</i> BDI	27.48 (11.48)	1.19 (1.99)
<i>M</i> RRS	56.97 (12.51)	31.13 (6.80)
<i>M</i> recall: % correct positive	.30 (.08)	.37 (.07)
<i>M</i> recall: % correct negative	.28 (.06)	.32 (.06)
<i>M</i> recall: % correct neutral	.34 (.06)	.37 (.05)
<i>M</i> errors positive	0.41 (0.31)	0.22 (0.35)
<i>M</i> errors negative	0.44 (0.33)	0.32 (0.32)
<i>M</i> errors neutral	1.23 (0.30)	1.23 (0.23)

Note. MDD = participants diagnosed with major depressive disorder; CTL = control participants; BDI = Beck Depression Inventory-II (Beck, Steer, & Brown, 1996); RRS = Ruminative Response Scale (Nolen-Hoeksema & Morrow, 1991). Standard deviations are shown in parentheses.

16.23, $p < .01$. MDD participants also had higher scores on the Ruminative Response Scale, $t(50) = 9.35$, $p < .01$. Five participants in the MDD group were diagnosed with current comorbid anxiety disorders (1 with current and lifetime social anxiety disorder and post-traumatic stress disorder [PTSD], 2 participants with current and lifetime social anxiety disorder and lifetime PTSD, and 1 participant with current and lifetime PTSD; 1 participant was diagnosed with lifetime PTSD but no current comorbid condition). No other current or lifetime comorbid diagnoses were observed in our sample.

Accurate Recall of Presented Words

To examine whether the MDD and control participants differed in their recall of words from the lists, we first examined the mean percentages of correctly recalled words per list (see Table 1). We conducted a repeated-measures analysis of variance (ANOVA) examining correct recall, with group (MDD, control) as the between-subjects factor and valence of the lure (neutral, positive, negative) as the within-subject factor. This analysis yielded significant main effects of group, $F(1, 50) = 8.00$, $p < .01$, $\eta^2 = .14$, and valence, $F(2, 100) = 28.55$, $p < .01$, $\eta^2 = .35$, which were qualified by a significant interaction of group and valence, $F(2, 100) = 3.13$, $p < .05$, $\eta^2 = .04$. Although MDD participants exhibited lower recall of previously presented words than did control participants across all lists—neutral, $t(50) = 2.12$, $p < .05$, $d = .60$; positive, $t(50) = 3.15$, $p < .01$, $d = .89$; negative, $t(50) = 2.22$, $p < .05$, $d = .63$ —this difference was most pronounced for the lists associated with the positive lures, indicating that the depressed participants had less accurate recall than did their non-depressed counterparts, particularly for material from the positive lists. In addition, control participants recalled significantly fewer words from the negative lists than from the positive, $t(26) = 4.18$,

$p < .05$, $d = .82$, and neutral, $t(26) = 5.37$, $p < .05$, $d = 1.05$, lists, which did not differ from each other, $t(26) < 1$, *ns*. In contrast, MDD participants recalled significantly fewer words from the positive, $t(24) = 4.25$, $p < .05$, $d = .87$, and negative, $t(24) = 6.14$, $p < .05$, $d = 1.25$, lists than they did from the neutral lists; they did not differ in their recall for words from positive and negative lists, $t(24) = 1.40$, $p > .05$, $d = .29$.

Mean Error Production

To investigate group differences in the number of errors on the memory test, we examined whether MDD and control participants differed in the average number of words per list they falsely recalled, excluding the critical lures (see Table 1). The Group \times Valence ANOVA conducted on the mean number of errors per list type (excluding lures) yielded only a main effect of valence, $F(2, 100) = 169.11$, $p < .01$, $\eta^2 = .77$. Participants made more errors on the neutral lists than they did on the positive, $t(51) = 15.88$, $p < .01$, $d = 4.45$, and negative, $t(51) = 17.14$, $p < .01$, $d = 4.80$, lists, which did not differ from each other, $t(51) = 1.08$, $p > .05$, $d = .22$.

Critical Lures

Finally, and most important, to examine false recall of the critical lures, we conducted a two-way (Group \times Valence) ANOVA on the probability of recalling critical lures. Neither the main effect of group, $F(1, 50) = 1.89$, nor the main effect of valence, $F(2, 100) = 1.94$, was significant (both $ps > .05$). The critical interaction of group and valence, however, was significant, $F(2, 100) = 3.47$, $p < .05$, $\eta^2 = .06$ (see Figure 1). Follow-up tests indicated that the MDD and the control participants did not differ in their probability of recalling positive, $t(50) < 1$, or neutral, $t(50) = 1.36$, lures (both $ps > .05$); as predicted, however, the MDD participants falsely recalled a significantly greater number of critical lures from the negative lists than did the control participants, $t(50) = 2.20$, $p < .05$, $d = .63$.¹

Discussion

The present study was designed to investigate whether clinical depression is associated with increased false recall of neutral and/or emotional material. Compared with control participants, depressed participants falsely recalled a higher proportion of negative lures. It is important to note that no group differences were obtained for recall of positive and neutral lures, indicating that the higher propensity for false recall in depression does not reflect a general deficit but, instead, is specific to the processing of negative material. Depressed participants also demonstrated less accurate recall than did their nondepressed counterparts for previously presented items, especially those from the positive lists. Thus, even though depressed participants exhibited a general deficit in recall, consistent with prior literature (e.g., Burt et al., 1995), they were also more likely to recall negative lures that had not been presented to them.

Our findings have important clinical and theoretical implications. If depressed people are more prone than are their nondepressed counterparts to produce false memories for negative material, the impact of memory on emotion dysregulation in this

disorder is likely to be even more powerful than has been postulated. In fact, the present findings suggest that the effects of clinically significant depression are quite different from those of induced mood. Whereas Storbeck and Clore (2005) reported that induced negative mood was associated with less recall of critical lures, participants diagnosed with depression, a disorder defined by sustained negative affect, exhibited enhanced recall of negative critical lures.

How can we explain this difference between induced negative mood and MDD in accuracy of recall? The primary theoretical account of false memories is the activation-monitoring framework proposed by Roediger et al. (2001). Through spreading activation, semantic activation processes during encoding of a list can bring to mind items that are related to the list but that were not presented. Indeed, the stronger the initial activation, the higher the probability for false recall. The activation of these items, however, is not sufficient to lead to false memory. A second process, monitoring, can affect the false memory effect by selecting items at recall that the participant does not remember seeing, even though they seem familiar. Thus, the activation-monitoring framework proposes that the probability of false recall is a function of the strength of activation of never-presented but related items and the monitoring process at retrieval. Storbeck and Clore (2005) added a variant of the DRM paradigm to their study that allowed them to investigate whether mood influences accessibility of lures at encoding or monitoring at recall. They concluded that critical lures were less likely to be accessible in the negative mood group than in the positive mood group but that mood state did not affect monitoring at retrieval.

Unlike transient negative mood, however, depression may have unique effects at both the activation and monitoring phases. Specifically, depression may be associated with increased activation of negative lures at encoding because of its more chronic accessibility of negative material and/or with reduced monitoring at retrieval. To examine this issue systematically, it will be important in future research to assess these processes, in a single study, in depressed and nondepressed participants and in nondepressed individuals who are put in a negative mood state. With respect to effects at retrieval, recent studies suggest that the monitoring process is closely related to working memory and that poor working memory is associated with increased recollection of critical lures (e.g., Peters, Jelicic, Verbeek, & Merckelbach, 2007). Previous studies have identified depression-associated deficits in working memory and cognitive control (Joormann & Gotlib, 2008), suggesting that reduced monitoring in depression is likely. If it was only monitoring that was deficient, however, depressed participants would be expected to have a greater overall number of false memories than would control participants. The fact that false memories were confined to negative material suggests that depression is associated with two difficulties: impairment in monitoring because of deficits in cognitive control and increased accessibility of negative material.

¹ This group difference remained significant when we excluded MDD participants diagnosed with a current comorbid condition, $t(45) = 2.14$, $p < .05$. False recall was not significantly correlated with measures of rumination (Ruminative Response Scale) or Beck Depression Inventory-II scores.

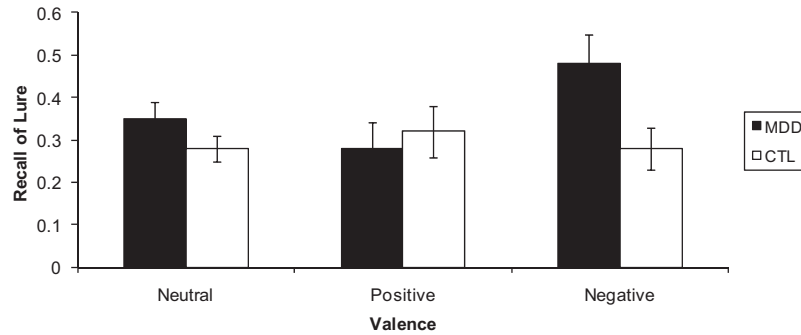


Figure 1. Probability of recalling critical neutral, positive, or negative lures in the Deese-Roediger-McDermott task in participants with major depressive disorder (MDD) and control participants (CTL). Error bars represent one standard error.

Consistent with these ideas, Watkins (2008) recently proposed that negative mood is associated with more careful processing, whereas clinical depression leads to over-general and abstract processing of negative material because depression is associated with deficits in cognitive control. The observed differences across studies between people in a negative mood state versus depressed participants may, therefore, also be due to impaired item-specific processing at encoding in depression. Future research is clearly needed to disentangle these various explanations of false memory in depression.

We should note two limitations of the current study. First, because of our decision to use as many of the original DRM lists as possible without considerably lengthening the task so that our findings could readily be compared with other DRM studies, we used 3 positive, 3 negative, and 34 neutral lists. The relatively small number of positive and negative lists was also due to the inherent difficulties in constructing novel, high-quality DRM lists. Although this design choice somewhat limits direct comparison of false recall of neutral versus emotional lures, our main hypotheses focused on between-group comparisons of the original DRM neutral and emotional material, making this limitation less critical. As a related point, the lists were not constructed to be matched on valence, arousal, and word frequency, although it is important to note that the critical lures from these lists did meet these criteria. Second, it should be kept in mind that the MDD and control participants likely differed on other characteristics, such as personality/temperament. For example, previous studies have demonstrated that individual differences in neuroticism are associated with biases in memory (Chan, Goodwin, & Harmer, 2007; Ruiz-Caballero & Bermúdez, 1995). Thus, although we took care to recruit clinically depressed participants with few comorbid conditions, future research is needed to investigate whether group differences in personality or temperament may have contributed to the current results.

Taken together, the current findings suggest a double whammy for memory biases in depression: Depressed people recall more negative and less positive information from an event than actually occurred and simultaneously “recall” negative information that did not occur. Increased accessibility of negative material and deficits in cognitive control may thus affect the use and effectiveness of mood-regulation strategies by increasing ruminative responses to negative affect and by enhancing difficulties in using mood-

incongruent memories to repair mood. Examining the treatment implications of altering the increased accessibility of negative material and subsequent impairment in monitoring will be critical next steps to try to break depression’s vicious cycle of increasingly harmful cognition and negative mood.

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