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Cognitive Bias Modification: Retrieval Practice to Simulate and Oppose Ruminative Memory Biases

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Retrieval Practice to Simulate and Oppose Ruminative Memory Biases

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Abstract

Ruminative tendencies to think repetitively about negative events, like retrieval practice in laboratory experiments, should enhance long-term recall. To evaluate this claim, ruminators and non-ruminators learned positive, negative, and neutral adjective-noun pairs. Following each of four study phases, "practice" participants attempted cued recall of nouns from positive or negative pairs; study-only participants performed a filler task. Half the pairs of each valence were tested after the four learning cycles, and all pairs were tested a week later. Large practice effects were found on both tests, even though ruminators showed a trait-congruent bias in recalling unpracticed negative pairs on the immediate test. Positive practice also improved the moods of ruminators. Thus, repetitive positive retrieval shows promise in counteracting ruminative recall and its consequences.

122 words

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Categorically speaking, depressed people attend, interpret, and remember in somewhat biased ways (see Joormann & Gotlib, 2010). Of these patterns, negative memory biases have received the earliest and most sustained attention (e.g., Teasdale & Fogarty, 1979; see Matt, Vasquez, & Campbell, 1992). Attempts to explain depression-congruent memory biases were initially provided by schema theory (Kovacs & Beck, 1967) and by network models that stressed the compatibility between the nature of the memories and mood at encoding or retrieval (Bower, 1981). Elements of both approaches can be found in recent frameworks that emphasize the habitual cognitive practices that characterize depression and are referred to by the phenomenological term *rumination* (see Hertel, 2004; Koster, De Lissnyder, Derakshan, & De Raedt, 2011; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008; Watkins & Nolen-Hoeksema, 2014; Whitmer & Gotlib, 2013). In designing the current experiment, our aim was to model one aspect of ruminative habit—repetitive thinking—by aligning it with the retrieval-practice paradigm (see Roediger & Butler, 2011).

The alignment of ruminative processes with retrieval practice rests on the observation that people who ruminate do not merely bring negative events to mind, as is suggested by some perspectives on mood-congruent recall. Instead, they focus repetitively on the *same* events, and in so doing they practice retrieval. Subsequent recall then benefits from retrieval practice as well as sometimes subtle changes in context and meaning as events are reconsidered anew each time. Our first goal for the current experiment was a straightforward simulation of rumination-congruent recall by asking participants to study adjective-noun pairs, both positive and negative, varying whether they repeatedly practiced negative or positive pairs or had no opportunity for practice before they took a test over both types of pairs at the end of the session. To our knowledge, investigations of retrieval-practice effects have not been extended to emotional materials (nor to a category-based subsets of studied materials), so evidence for this basic extension is interesting in its own right (also see Vrijsen, Hertel, & Becker, 2016). In addition, because retrieval-practice paradigms sometimes produce very large effects when recall is tested a week later (e.g., Karpicke & Roediger, 2008), similar findings with negative materials (studied amidst other materials) should constitute a successful simulation of rumination-congruent recall.

Our second goal was to demonstrate that a ruminative bias can be opposed by retrieval practice. Evidence for successful opposition could be established by naturally ruminative participants who practice retrieval of positive materials in the context of having studied negative materials as well. This evidence would augment current research on cognitive bias modification (CBM; see Hertel & Mathews, 2011). CBM research documents the modification of attentional and interpretive biases experienced by anxious and depressed people. A few attempts to modify depressive or ruminative memory biases have been reported, but most have succeeded in modifying memory indirectly by training biases in the interpretation of ambiguous events and observing memorial consequences of interpretation training (e.g., Hertel, Mor, Ferrari, Hunt, & Agrawal, 2014). In the current project (and in one described by Vrijsen et al., 2016), we hoped to succeed with a more direct approach.

Any attempt to oppose a ruminative bias presupposes evidence *for* that bias. In our experiment, however, it was not obvious whether and under what conditions such evidence should be found. First, evidence for negative bias is not consistently found in undiagnosed samples (Matt et al., 1992). Moreover, we recruited participants according to their ruminative tendencies, not self-reported depression, although these measures are highly correlated.

Therefore it seemed merely possible that our ruminative sample of students would produce an unpracticed negative bias, given the right conditions. The second consideration, then, concerned the identification of those conditions. A reasonable hypothesis is that the bias could be produced by ruminators in a study-only condition who are exposed to all materials (a prediction compatible with network perspectives, on grounds that negative materials would be more elaborately or self-referentially encoded.) On the other hand, if self-initiated rehearsal is an important contributor to this study effect, recall in our study-only condition would not reveal the bias, because the intervals between study cycles were occupied by an attention-demanding task (digit/symbol substitution) to prevent that very possibility of rehearsal. However, two measures of performance by ruminators in *practice* conditions might reveal an unpracticed recall bias: They might learn the negative pairs more rapidly across the learning cycles, or they might recall unpracticed negative pairs at a higher rate on the end-of-session test. We explored these possibilities.

Method

Overview

Students who reported either low or high levels of rumination on the Ruminative Response Scale of the Response Styles Questionnaire (RRS; Treynor, Gonzales, & Nolen-Hoeksema, 2003) attempted to learn 48 adjective-noun pairs (16 positive, 16 neutral, and 16 negative) in four cycles. After studying the pairs in each cycle, participants in retrieval-practice conditions practiced recalling the nouns when cued with the adjectives from the neutral filler pairs and either the positive or the negative pairs. Then the study phase of the next cycle served as feedback opportunities for these participants. Participants in the study-only condition were exposed to the pairs for the same amount of time during study phases and at the same distributed intervals, but they performed digit/symbol substitutions in place of retrieval practice. Everyone attempted to recall nouns from half of the neutral, negative, and positive pairs following the learning cycles and all nouns a week later. Measures of mood, depression, and rumination were administered in both sessions.

In typical experiments designed to reveal valence-related differences in recall, the to-be-recalled words differ. Any resulting recall differences, however, cannot be attributed entirely to emotional meaning, because the words differ concomitantly on other characteristics—for example, negative words are more abstract—and controlling for these potentially confounding variables sometimes produces word sets that seem unusual in other ways. We took a different approach (see Hertel & Parks, 2002) by asking all participants to learn the same nouns after imbuing them with differential emotional meaning through their learned associations with the cues. Whereas some participants studied *disgusting habit*, for example, just as many studied *constructive habit*. Using emotionally meaningful cues also has the advantage of modeling situations in which current feelings cue concepts connected to those feelings (Bower, 1981).

Participants and Design

We recruited 123 students enrolled in undergraduate courses at Trinity University. During in-class screening, all students completed the RRS; those who scored in the top and bottom quartiles (ruminators and non-ruminators, respectively) were invited to participate. Within each RRS grouping, participants were randomly assigned to a learning condition with constraints to establish equal cell size, balanced gender, and balanced scores on the RRS. Assignments also considered the counterbalancing of materials with two within-subjects factors, described below. Double-blind procedures ensured that the students did not know the recruitment basis and experimenters did not know RRS scores.

The final sample included 20 participants in each combination of RRS grouping and learning condition (the sample size based on a similar experiment by Hertel & Parks, 2002). Their ages ranged from 18 to 22 (other characteristics summarized in Table 1). The data from three additional participants were set aside due to experimenter error. Seven participants failed to complete Session 2, and one additional participant did not complete the questionnaires in Session 2 (distributions in Table 1). Participants were compensated with class credit or entry into a drawing for gift cards.

Materials

We compiled a list of neutral nouns by using the Affective Norms for English Words (ANEW; Bradley & Lang, 1999) and paired each of them with both a negative and a positive adjective to serve as cues. In constructing negative pairs we attempted to imbue the nouns with ruminative meanings (e.g., *humiliating moment*) that were somewhat distinct from the meanings established in the corresponding positive pairs (*intimate moment*). The pairs were judged for emotional valence by 24 students as they finished an unrelated experimental session. Mean ratings were then used to select 32 triads (adjective-adjective-noun). Four sets of 8 triads each were balanced on noun valence, number of letters, word frequencies, and pair valences. Positive pairs averaged 7.1 on the 9-pt rating scale, negative pairs 2.7.

To distract attention from our valence manipulation, we also included two sets of 8 neutral adjective-noun pairs as fillers (e.g., *embossed fabric, informative pamphlet*). These sets were balanced with the experimental sets for frequency and word length. The final list therefore included 48 adjective-noun pairs and took one of two forms (A and B). List A included positive pairs from Sets 1 and 2 and negative pairs from Sets 3 and 4; List B contained the opposite arrangement. Both lists contained the neutral sets (5 and 6). Following the learning cycles in

Session 1 we tested half of the pairs of each type with cues from either Sets 1, 3, and 5 or Sets 2, 4, and 6.

Procedure

In Session 1, conducted in the lab, all participants first completed a Positive and Negative Affect Scale with "momentary" instructions (PANAS; Watson, Clark, & Tellegen, 1988). Then they were told about the upcoming four learning cycles and the delayed test. They were instructed to study each pair in order to recall the noun when given the adjective subsequently.

Each learning cycle consisted of a study phase for all participants, followed by a practice phase for participants assigned to practice retrieval or by a digit/symbol substitution task in the study-only condition. During study phases, the 48 pairs appeared on the screen for 5 s each. Order was randomized within blocks of six, two of each valence. (The same block membership was preserved throughout the learning cycles and tests, with order randomized anew each time.) During each practice phase, the adjectives from the neutral and either the positive or negative pairs were presented for 8 s each as cues for typing the corresponding noun. (A response was not required on any test.) Between learning cycles, everyone calculated answers to simple multiplication problems for 30 s. Once participants completed all cycles, they responded to the PANAS a second time before the immediate test. On that test, cues from 8 positive, 8 negative, and 8 neutral pairs were each presented for 8 s, and participants typed their responses. [1]

Finally, participants completed the PANAS a third time, the RRS, the Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996), and a short form for indicating their age and race or ethnicity. All paper forms and questionnaires were placed in an envelope and sealed by the participant, who understood from the outset that someone other than the experimenter would open it and record the data.

After a 1-week delay, the experimenter sent an email that contained the link to the final test. This test included all 48 cues, presented for 15 s each. It was administered online via Qualtrics and followed by the PANAS, RRS, and BDI-II.

Results

Retrieval Practice

First examined was the percentage correct during practice, with a within-subjects factor for trial number and between-subjects factors for learning condition (positive-practice, negative-practice) and RRS group (non-ruminators, ruminators). Participants improved with practice and feedback across the four trials (M = 36.0, 66.8, 85.0, 91.9), $F(3, 225) = 467.32$, $MSE = 105.47$, $p < .001$, $\eta_p^2 = .86$. Relevant to possible evidence for a ruminative bias, all interactions were small and nonsignificant, $\eta_p^2 < .02$, $p > .20$.

Session-1 Recall

The analysis of the percentage recalled from the 8 positive and 8 negative pairs on the immediate test included a within-subjects factor for pair valence and between-subjects factors for RRS group and learning condition (positive-practice, negative-practice, study-only). The two counterbalancing factors—studied list and tested sets—were each added in separate analyses, as methods for reducing error variance. Only the factor for studied list interacted with other factors and was therefore maintained in the analysis, although we do not report associated effects. Following the overall analysis, we report RRS-group differences to evaluate evidence for unpracticed bias.

Overall analysis. First, practicing retrieval was obviously beneficial, as shown by the main effect of learning condition, $F(2, 108) = 20.51$, $MSE = 940.05$, $p < .001$, $\eta_p^2 = .28$. The means presented in the top portion of Table 2 depict the advantage of retrieval practice, compared to study-only, as well as the more informative practice-congruent outcomes. Retrieval practice clearly established a pattern of practice-congruent recall, as shown by the interaction of pair valence with learning condition, $F(2, 108) = 27.54$, $MSE = 183.68$, $p < .001$, $\eta_p^2 = .34$. All other effects in the main design were very small and nonsignificant ($\eta_p^2 < .01$, $p > .20$), with the exception of the three-way interaction (valence-X-learning-X-group), $F(2, 108) = 2.36$, $p = .099$, $\eta_p^2 = .04$. Although nonsignificant, the form of the interaction is consistent with our understanding of ruminative cognition. And the simple interactions of RRS group and valence within each learning condition reveal outcomes related to the issues of demonstrating and overcoming ruminative retrieval tendencies.

Recall within each learning condition. Central to those issues, the effect of practicing positive retrieval produced a larger positive bias for non-ruminators than for ruminators, $F(1, 36) = 4.59$, $MSE = 187.72$, $p = .04$, $\eta_p^2 = .11$. In contrast, the corresponding simple interactions in the other two learning conditions were small and nonsignificant, (negative practice: $\eta_p^2 = .03$, $p = .32$; study only: $\eta_p^2 = .002$, $p = .78$).

Specific comparisons. Making the point most clearly (Figure 1), dependent *t* tests compared the percentages of positive and negative recall in each combination of RRS group and practice condition. Significant practice-congruent biases were found in three of those combinations ($p < .02$); the exception was provided by ruminators who practiced positive pairs but recalled nearly as many nouns from negative pairs, $t(19) = 1.92$, $p = .07$, CI = [-0.8, 19.6]. (In the study-only condition, recall revealed nonsignificant valence-related differences: $p = .08$ for non-ruminators, $p = .62$ for ruminators.) Similarly, independent *t* tests revealed significant effects of the type of practice on positive recall in both RRS groups ($p < .02$) and on negative recall by non-ruminators ($p = .04$). But the type of practice did not affect ruminators' negative recall, $t(38) = 1.13$, $p = .26$, CI = [-5.4, 19.2]. In short, structured retrieval practice of negative (vs. positive) concepts made little or no difference in ruminators' immediate recall of negative pairs.

Session-2 Recall

We next examined the percentage recalled from all 16 positive and 16 negative pairs tested after a 1-week delay. The mixed design included within-subjects factors for pair valence and test status (tested or untested following the learning cycles) and between-subjects factors for learning condition and RRS group. Again, the counterbalancing factors were each added in separate analyses. This time only the factor for sets that had been tested in Session 1 was maintained as a method for variance reduction.

First, the overall retrieval-practice effect, collapsed across pair valence and RRS group, was large, $F(2, 101) = 22.32$, $MSE = 1278.38$, $p < .001$, $\eta_p^2 = .31$ (means in the bottom portion of Table 2). Second, as on the immediate test, the effect of learning condition depended on pair valence and revealed a very large practice-congruent effect, $F(2, 101) = 153.86$, $MSE = 196.25$, $p < .001$, $\eta_p^2 = .75$. However, this time, there was no tendency for the effect to depend on RRS group, $F(2, 101) < 1.0$, $p = .74$, $\eta_p^2 = .006$. Ruminators recalled fewer nouns from unpracticed negative pairs ($M = 38.2$, $SD = 13.8$) than from practiced positive pairs ($M = 65.0$, $SD = 18.8$), $t(19) = 9.87$, $p < .001$, CI = [21.1, 32.4], and fewer than others recalled nouns from practiced negative pairs ($M = 72.5$, $SD = 15.0$), $t(38) = 7.53$, $p < .001$, CI = [25.0, 43.5]. Practicing negative retrieval simulated depression-congruent recall in the long run, and practicing positive retrieval was sufficient to overcome the trait bias that had occurred in the short run.

The remaining significant outcome from the overall analysis was the three-way interaction of valence and learning condition with test status, $F(2, 101) = 8.89$, $MSE = 198.49$, *p* < .001, $\eta_p^2 = .15$. The middle portions of Table 2 show a stronger practice-congruent effect for pairs that were practiced but not tested in Session 1, compared to practiced and tested pairs. And apparently just one test benefited recall of unpracticed pairs (negative pairs in the positive-practice condition and positive pairs in the negative-practice condition), compared to their untested counterparts (a 16-20% benefit, versus 4-7% for practiced pairs). Apart from the main effects of valence (a negative advantage) and test status, all other outcomes in the main design were small and nonsignificant, $\eta_p^2 < .02$, $p > .38$. (As indicated in Table 2, unpracticed positive pairs were recalled at significantly higher levels than their counterparts in the study-only condition but unpracticed negative pairs were not.)

Mood and Other Self-Report Measures

Questionnaires. The RRS scores of ruminators (only) were lower at the end of Session 1 than during screening, $F(1, 57) = 471.01$, $MSE = 64.88$, $p < .001$, $\eta_p^2 = .45$. This reduction might reflect regression toward the mean, but it could also result from more conservative reporting during individual sessions, compared to the anonymous class setting. Regardless, the pattern of recall results did not change when we omitted data from those participants whose Session-1 scores did not reach the cut-off for the top quartile. RRS groups clearly differed on Session-1 BDI-II scores, $F(1, 114) = 41.00$, $MSE = 60.36$, $p < .001$, $\eta_p^2 = .26$. Session-2 BDI-II scores differed according to RRS group, $F(1, 106) = 38.44$, $MSE = 72.37$, $p < .001$, $\eta_p^2 = .27$ (as did RRS scores). All other effects in the analyses of RRS and BDI-II scores were small and nonsignificant, $\eta_p^2 < .03$, $p > .29$. Correlations between RRS and BDI scores within sessions were .73 in Session 1 and .69 in Session 2, $p < .001$.

PANAS. For Session 1 scores, the mixed design included within-subjects factors for time (session-start, after-cycles, session-end) and PANAS dimension (positive, negative) and between-subjects factors for learning condition and RRS group. The four-way interaction was significant, $F(4, 228) = 2.45$, $MSE = 10.31$, $p = .047$, $\eta_p^2 = .04$. The first follow-up tests assessed pre-experimental differences. Additional follow-up tests were restricted to the two retrieval-practice conditions and examined positive and negative scores separately, comparing either the second or third assessment with the first. We report only the outcomes that include assessment time as a factor.

Pre-experimental differences. The first follow-up test was performed on scores at the start of the session. In addition to a large simple main effect of dimension (a positive bias found at all three time points in Session 1 and in Session 2), the outcomes included a marginally significant simple interaction of RRS group and dimension, $F(1, 114) = 3.81$, $MSE = 36.59$, $p = .053$, $\eta_p^2 = .03$. The two groups were similarly positive, but the ruminators indicated higher negative affect. Learning conditions did not produce different valence patterns at this point, $\eta_p^2 < .02$, $p > .30$.

Changes in positive or negative mood across Session 1. At the close of the learning cycles, all participants reported nonsignificant changes in positive mood ($\eta_p^2 > .03$, $p < .13$) and reduced negative mood,. $F(1, 76) = 22.48$, $MSE = 4.56$, $p < .001$, $\eta_p^2 = .23$.

From the beginning to the end of the session, changes in positive mood interacted with RRS group and learning condition, $F(1, 76) = 4.70$, $MSE = 13.84$, $p = .03$, $\eta_p^2 = .06$. Of the four conditions, all except the non-ruminators in the negative-practice condition felt less positive. This finding invites the post-hoc speculation that these students might have tried to counteract negative influences. Similarly, from the beginning to the end of the session, changes in negative mood also interacted with RRS group and learning condition, $F(1, 76) = 5.44$, $MSE = 5.95$, $p = .02$, $\eta_p^2 = .07$. Of the four conditions, only the ruminators in the positive-practice condition reported feeling less negative, $t(19) = 2.88$, $p = .01$, CI = [0.5, 3.3]. In general, negative mood scores at the end of Session 1 were correlated with Session-1 RRS and BDI-II scores [$r(118) = .35$ and .36, $p < .001$], but it is nevertheless notable that they were highest for ruminators who had practiced negative pairs, even though their BDI-II scores were not as high in this condition.

Session-2 differences. At the end of Session 2, the effects of learning condition interacted with the PANAS dimension, $F(2, 106) = 5.18$, $MSE = 42.74$, $p = .01$, $\eta_p^2 = .09$. Nonsignificant effects were found for negative scores ($\eta_p^2 < .03$, $p > .11$), although the lowest levels were reported by those who had practiced positive retrieval. Similarly, positive affect scores were higher in retrieval-practice conditions than in the study-only condition, $t(109) = 2.90$, $p = .01$, d = 1.18. (The retrieval-practice conditions did not differ in positive affect, $p = .13$.)

Discussion

Our first notable outcome was a replication of retrieval-practice effects with emotional word pairs and under conditions in which some pairs were not practiced. Compared to study-only, retrieval practice more than doubled recall levels a week later. Even the unpracticed positive pairs were better recalled in the negative retrieval-practice conditions than by those who merely studied (see Table 2). The primary motivation for the research, however, concerned the possibility that retrieval practice would simulate ruminative processes in producing depression-congruent recall and possibly oppose ruminative bias that occurs more naturally. We discuss outcomes relevant to those issues.

Measures of depression and rumination tend to be strongly correlated (Nolen-Hoeksema et al., 2008), and they were in this experiment. Depressed ruminators think repetitively about the emotionally negative events in their lives, and we tried to loosely simulate that phenomenon by requiring repetitive retrieval of negative word pairs designed to be meaningful to ruminators, in the context of exposing them to positive and neutral materials as well. Cuing with the adjective member of the pair was much like asking, for example, what was embarrassing? (Oh yes, my body.) Or what was invaded? (My privacy.) These are the sorts of things students might ruminate about if they had such habits. And asking our participants to practice negative retrieval clearly simulated depression-congruent recall on the immediate and delayed tests, regardless of whether participants were ruminators by habit.

We also attempted to oppose such a habit by requiring other participants to practice retrieving the positive pairs, in the context of having also studied negative and neutral pairs. In an outcome we interpret as evidence for a ruminative habit, ruminators remembered the unpracticed negative pairs almost as well as if they had practiced them (not significantly less well). Perhaps exposure to these negative concepts during study was sufficient to make them memorable as a result of self-initiated elaborative or self-referential processing. If so, we might also expect ruminators in the study-only condition to show a negative bias on the immediate test, and they did not. Therefore, the trait effect that we observed was unlikely due purely to "encoding" procedures and might instead have resulted from carryover effects of their retrieval practice (the advantage of being cued to recall and to receive feedback), unavailable to the study-only participants. We emphasize the fact that these possible carryover effects were larger for ruminators than for non-ruminators, and only with respect to recalling unpracticed negative material. Any metacognitive hints to attend to unpracticed materials were less effective without the habit to think in ruminative terms. Regardless of its nature, however, the mechanism for producing an unpracticed ruminative bias was ineffective after a week had passed; in the long run all that mattered was prior deliberate and repetitive practice. This outcome suggests a clinical route for opposing the memorial fuel for rumination through systematic practice in recalling positive events (*healthy body, protected privacy*).

In addition to cognitive modifications, clinical interests in research on CBM also focus on affective change by examining outcome measures of mood or disordered state. Some evidence in this reports suggests a short-term reduction in negative mood as a consequence of positive retrieval. Ruminators who practiced positive and negative pairs started the session with similar negative scores in Session 1, but by the end of the session those who practiced positive pairs reported less negativity. Ruminators who practiced negative pairs regained their negative mood state, even though their BDI-II scores were relatively low. Although nonsignificant, a similar difference between the two practice conditions was found in Session 2. Thus, the possibility that practicing positively cued recall improves mood deserves further investigation. More generally the pattern of mood reports were consistent with findings that experimental rumination or distraction affects depressed mood (Nolen-Hoeksema & Morrow, 1993). And other forms of CBM have shown short-term improvements in anhedonia in a sample of depressed persons (e.g., practice in positive mental imagery; Blackwell et al., 2015).

In a final note, we ask whether similar outcomes might obtain for worriers who happen also to be anxious. Rumination and worry share many cognitive features; only the focus of concerns has been thought to differ, ruminators on past events and worriers on future possibilities. But recent use of experience sampling has revealed that both rumination and worry are transdiagnostic of individuals diagnosed with Major Depressive Disorder and Generalized Anxiety Disorder (Kircanski, Thompson, Sorenson, Sherdell, & Gotlib, 2015). Thus, the benefits of practicing positive recall might also extend to anxious individuals and to imagining events in the future. We hope this report instigates these and other investigations.

References

Beck, A. T., Steer R. A., & Brown, G. K. (1996). Manual for the Beck Depression Inventory (2nd Ed.). San Antonio, TX: Psychological Corporation.

Blackwell, S. E., Browning, M., Mathews, A., Pictet, A., Welch, J., Davies, J.,…Holmes, E. A. (2015). Positive imagery-based cognitive bias modification as a web-based treatment tool for depressed adults: A randomized controlled trial. *Clinical Psychological Science, 3,* 91-111.

Bower, G. H. (1981). Mood and memory. *American Psychologist, 36*, 129-148.

Bradley, M. M., & Lang, P. J. (1999). *Affective Norms for English Words (ANEW): Instruction manual and affective ratings* (Technical Report C-1). Gainesville: Center for Research in Psychophysiology, University of Florida.

Hertel, P. T. (2004). Memory for emotional and nonemotional events in depression: A question of habit? In D. Reisberg & P. Hertel (Eds.), *Memory and emotion (pp. 186-216)*. New York: Oxford University Press.

Hertel, P. T., & Mathews, A. (2011). Cognitive bias modification: Past perspectives, current findings, and future applications. *Perspectives on Psychological Science, 6,* 521-536.

Hertel, P. T., Mor, N., Ferrari, C., Hunt, O., & Agrawal, N. (2014). Looking on the dark side: Rumination and cognitive bias modification. *Clinical Psychological Science. 2*(6), 714-726.

Hertel, P. T., & Parks, C. (2002). Emotional episodes facilitate word recall. *Cognition and Emotion, 16,* 685-694.

Joormann, J., & Gotlib, I. H. (2010). Cognition and depression: Current status and future directions. *Annual Review of Clinical Psychology, 6*, 285-312.

Karpicke, J. D., & Roediger, H. L., III. (2008). The critical importance of retrieval for learning. *Science*, *319*, 966–968.

Kircanski, K., Thompson, R. J., Sorenson, J. E., Sherdell, L., & Gotlib, I. H. (2015). Rumination and worry in daily life: Examining the naturalistic validity of theoretical constructs. *Clinical Psychological Science, 3,* 926-939.

Koster, E. H. W., De Lissnyder, E., Derakshan, N., & De Raedt, R. (2011). Understanding depressive rumination from a cognitive science perspective: The impaired disengagement hypothesis. *Clinical Psychology Review*, *31*, 138-145.

Koster, E. H. W., Marchetti, I., & Mor, N. (2013, September). *The Momentary Ruminative Self-focus Inventory (MRSI): Validation and psychometric evaluation*. Paper presented at the meeting of the European Association of Behavioural and Cognitive Therapies, Marrakech, Morocco.

Kovacs, M., & Beck, A. T. (1978). Maladaptive cognitive structures in depression. *American Journal of Psychiatry, 135*, 525-533.

Matt, G. E., Vazquez, C., & Campbell, W. K., (1992). Mood-congruent recall of affectively toned stimuli: A meta-analytic review. *Clinical Psychology Review, 12,* 227-255.

Nolen-Hoeksema, S., & Morrow, J. (1993). The effect of rumination and distraction on naturally occurring depressed moods. *Cognition and Emotion, 7,* 561-570.

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science*, *3*, 400-424.

Roediger, H. L., III, & Butler, A. C. (2011). The critical role of retrieval practice in long-term retention. *Trends in Cognitive Sciences, 15*, 20-27.

Teasdale, J. D., & Fogarty, S. J. (1979). Differential effects of induced mood on retrieval of pleasant and unpleasant events from episodic memory. *Journal of Abnormal Psychology, 88,* 248-257.

Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric analysis. *Cognitive Therapy and Research, 27,* 247-259.

Vrijsen, J.N., Hertel, P. T., & Becker, E.S. (2016). Practicing emotionally biased retrieval affects mood and establishes biased recall a week later. Submitted.

Watkins, E. R., & Nolen-Hoeksema, S. (2014). A habit-goal framework of depressive rumination. *Journal of Abnormal Psychology, 123*, 24-34.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063–1070.

Whitmer, A. J., & Gotlib, I. H. (2013). An attentional scope model of rumination. *Psychological Bulletin*, *139*, 1036–1061.

Author Contributions

PH and AM designed the experiment. JV contributed to the design and procedure. PH, AM, and JC contributed constructed materials and analyzed results. Data collection and scoring were performed by AM and JC. PH wrote the paper, aided by AM. All authors approved the final version of the paper for submission.

Footnote

[1] Following immediate recall, we asked participants to think about a recent emotionally negative experience and type its description. After 4 min for the description and another 2-min interval (to allow rumination), they filled out a state measure, the Momentary Ruminative Self-focus Inventory (MRSI; Koster, Marchetti, & Mor, 2013). Ruminators produced higher MRSI scores (*M* = 61.6, *SD* = 17.5, vs. non-ruminators' *M* = 48.3, *SD* = 15.8), $F(1, 114) = 18.84$, $MSE = 278.08$, $p < .001$, $\eta_p^2 = .14$. Other differences were nonsignificant and small.

Table 1

Means (Standard Deviations) for Questionnaires and Mood Measures, Counts for Gender and Ethnicity

	Non-Ruminators			Ruminators		
	Positive practice	Negative practice	Study only	Positive practice	Negative practice	Study only
Session-1 n (female)	20 (12)	20 (12)	20 (12)	20 (12)	20 (12)	20 (13)
Cau/His/Asn/Other	13/4/1/2	15/6/0/0	13/3/4/1	12/5/8/2	13/6/5/0	16/3/6/0
RRS: Screening	35.6 (5.6)	35.2 (5.8)	36.0 (4.6)	65.2 (5.4)	65.2 (5.4)	65.6 (7.5)
RRS: Session 1	35.0 (7.3)	36.0 (9.2)	33.5 (5.4)	56.8 (10.1)	56.1 (11.9)	52.8 (12.5)
BDI-II	7.2 (4.0)	9.8 (8.7)	7.6 (4.7)	17.2 (7.5)	15.8 (7.8)	18.8 (11.5)
PANAS-P, start	26.5 (6.7)	29.0 (7.7)	28.2 (7.5)	30.2 (8.0)	27.3 (7.1)	24.7 (5.6)
PANAS-P, learn	24.2 (7.8)	29.4 (8.5)	26.2 (8.4)	29.7 (8.7)	27.9 (7.8)	21.9 (6.6)
PANAS-P, test	20.6 (6.1)	27.8 (9.5)	23.8 (8.9)	25.8 (9.9)	22.6 (7.9)	18.9 (5.4)
PANAS-N, start	12.6 (2.1)	15.2 (4.3)	13.2 (3.1)	16.4 (5.6)	16.3 (5.5)	15.9 (4.5)
PANAS-N, learn	11.5 (2.2)	13.4 (2.8)	13.8 (4.0)	14.0 (4.9)	15.2 (7.2)	16.0 (5.1)
PANAS-N, test	12.6 (3.2)	14.0 (4.1)	13.0 (3.4)	14.5 (5.0)	**16.7** (7.1)	15.0 (4.9)
Session-2 n (female)	18 (11)	18 (11)	18 (10)	20 (12)	19 (12)	19 (12)
RRS	32.9 (7.7)	32.4 (6.0)	31.9 (6.9)	50.2 (9.7)	54.3 (12.6)	50.7 (14.8)
BDI-II	5.9 (3.8)	8.4 (9.9)	6.2 (4.5)	16.0 (8.3)	15.7 (8.5)	19.6 (12.5)
PANAS-P, test	22.4 (7.3)	28.0 (7.0)	21.8 (6.7)	24.2 (9.3)	24.0 (7.7)	18.9 (5.6)
PANAS-N, test	13.7 (4.6)	14.7 (5.8)	16.7 (5.5)	15.6 (4.9)	**17.5** (6.8)	17.2 6.8)

Note. RRS = Ruminative Response Scale, BDI-II = Beck Depression Inventory, PANAS-P = positive dimension on the Positive and Negative Affect Scale, PANAS-N = negative dimension, Cau/His/Asn/Other = the number of participants identifying as Caucasian, Hispanic, Asian (East, Middle East, South East), and/or other race or ethnicity.

Table 2

Mean Percentages of Nouns Recalled (Standard Deviations)

	Positive practice	Negative practice	Study only
Session-1 recall (half)	n = 40	n = 40	n = 40
Positive pairs	91.6 (15.3)	73.1 (25.2)	53.0 (25.2)
Negative pairs	75.6 (23.5)	88.4 (24.9)	57.8 (26.8)
Average	83.6	80.8	55.4
Session-2 recall (tested)			
Positive pairs	65.5 (21.6)	49.3 (22.1)	35.5 (23.7)
Negative pairs	47.0 (22.8)*	74.3 (23.6)	38.5 (24.0)
Session-2 recall (untested)			
Positive pairs	58.6 (27.3)	32.6 (20.0)	19.9 (14.6)
Negative pairs	26.8 (18.4)*	70.1 (25.3)	25.0 (22.4)
Session-2 recall (all)	n = 38	n = 38	n = 37
Positive pairs	61.8	41.0	27.6
Negative pairs	36.9*	72.2	31.7
Average	49.4	56.6	29.7

Note. * means that the corresponding mean is not significantly different from the study-only mean, $p > .10$. Otherwise, the difference is significant at the .01 level or less.

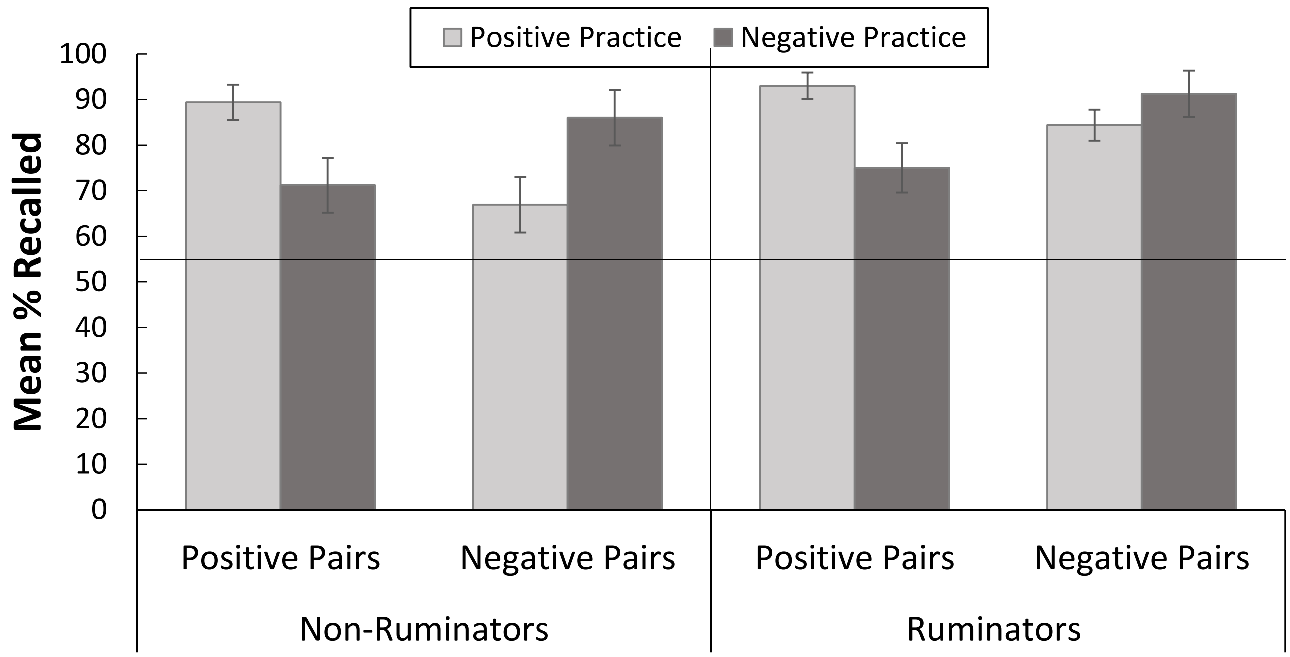

Figure 1. Mean percent recall on the Session-1 test, with cues from half of the pairs of each type. The line represents percent recall in the study-only condition, collapsed across RRS group. Error bars represent 1 standard error.