

## The Interplay of Depression, Rumination, and Negative Autobiographical Memory

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**ABSTRACT.** This experiment investigated rumination as a possible mechanism for the phenomenon of depression increasing negative autobiographical memories. Participants recalled a negative autobiographical memory involving school before rating the negative mood intensity of that memory, then half of the participants ruminated on that memory and half of the participants were distracted from it. Participants then rated the memory again, and either ruminated or were distracted for a second time before rating the memory for a third time and completing the Beck Depression Inventory-II, the Rumination on Sadness Scale, and demographic questions. The negative mood intensity of the autobiographical memory decreased over time, but did so to a lesser extent when participants ruminated on it versus being distracted (interaction  $p < .001$ ,  $d = 1.01$ ). Furthermore, for the rumination condition, participants with greater depression scores reported negativity ratings that decreased at a slower rate over time; for the distraction condition, participants with greater depression scores reported negativity ratings that decreased at a faster rate over time (interaction  $p = .040$ ,  $\Delta R^2 = .047$ ). Depression leads to rumination, and may also amplify the effect of rumination on the negativity of autobiographical memories. The effects of rumination may be due to memory effects such as retrieval practice and mood congruency. Individuals experiencing higher levels of depressive symptom severity may be more likely to experience increasingly negative memories due to rumination.

**Keywords:** depression, rumination, autobiographical memory, mood congruency, negative mood intensity



Open Data badge earned for transparent research practices. Data are available at <https://osf.io/h657r>

Depression is a general negative affective state in which individuals can experience symptoms of unhappiness, lack of motivation, and changes in habits regarding social connections, eating, and sleeping (American Psychological Association [APA], n.d.-a). Autobiographical memory includes an individual's memory for events that they have experienced (APA, n.d.-b). Depression influences autobiographical memory by biasing recall to negative events (Hitchcock et al.,

2020; Lyubomirsky & Nolen-Hoeksema, 1995; Peeters et al., 2003; Vrijnsen et al., 2001). One potential mechanism by which depression may have this effect is through rumination, which is when an individual repeatedly has similar thoughts to the point of interference with other mental activities (APA, n.d.-c). Thus, for the current study, we investigated the interplay between depression, rumination, and autobiographical memory.

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### Depression and Autobiographical Memory

Research has shown a negativity bias in memory for simple materials in people with depression. For example, results from a study by Bianchi et al. (2020) found that a group of participants who scored low on a self-report depression scale recalled more positive words and fewer negative words compared to a group of participants who scored high on the scale, with the latter group recalling fewer positive words and more negative words. The results were based on responses from 1,015 participants who completed a free recall task involving 10 positive and 10 negative words. It is possible that a negativity bias also extends to memories from everyday life.

There are a number of ways to investigate depression's effects on autobiographical memory. Simply having participants attempt to recall good and bad days is one approach. For example, when participants were asked to remember both positive and negative events from their lives, Hitchcock et al. (2020) found that healthy control participants (who had never been depressed) recalled significantly more positive memories than negative memories. This was in contrast to participants with depression, for whom there was no significant difference in the number of positive memories and negative memories recalled. However, results also showed that participants with depression rated their memories less positively compared to healthy control participants.

Another approach is to use experience sampling to form records of participants' experiences. For example, Peeters et al. (2003) conducted a study in which participants filled out self-report forms reporting their current mood, negative and positive events, and appraisals of the events 10 times a day for six days. Results showed that participants with depression reported fewer positive than negative events and reported negative events as more unpleasant compared to participants without depression. Results also showed that overall, participants with depression had higher base levels of negative mood for memories compared to participants without depression, and this was particularly true for participants with more severe depression and/or who had a longer duration of depression. Studies using experience sampling have also shown that people with depression are biased to recall more negative experiences than they actually had. Urban et al. (2018) conducted a study in which 1,657 participants made daily records of emotional experiences for eight days in a row, and recalled those experiences at the end of the final day. Results showed that participants with a history of depression particularly overestimated how often they had experienced negative emotions, consistent with a negative memory bias due to depression.

### Depression and Rumination

One hallmark of depression is the tendency toward repetitive thoughts, known as rumination. A variety of studies have shown such a relationship (Mitchell, 2016). For example, Harrington and Blankenship (2002) found a medium correlation of  $r = .33$  between rumination and depression with 199 participants. Nolen-Hoeksema (2000) interviewed 1,132 participants on two occasions, one year apart, and found that participants with depression at Time 1 experienced greater levels of rumination at Time 1 and Time 2 compared to participants without depression. Additionally, results showed that rumination at Time 1 predicted diagnostic status for depression at Time 2.

The relationship between rumination and depression is further evidenced by studies that experimentally manipulate rumination. For example, Lyubomirsky and Nolen-Hoeksema (1995) found that inducing rumination in participants with dysphoria led them to have more negative interpretations of hypothetical situations as compared to participants with dysphoria who were not induced to ruminate.

### Rumination as a Mechanism Linking Depression and Negative Memories

Some studies have suggested rumination as a possible reason for depression increasing a bias towards negative memories. Research by Lyubomirsky et al. (1998) experimentally investigated the effects of distraction compared to rumination on mood and autobiographical memory in participants with and without depression. In Experiment 1, there were 72 participants who either ruminated or were distracted before recalling personal memories and rating the emotional valence of those memories. Results showed that depressed participants who ruminated became more depressed, but depressed participants who were distracted became less depressed; there was no significant difference in non-depressed participants who ruminated or were distracted. Additionally, results showed that depressed participants who ruminated rated their autobiographical memories as more negative and less positive than any other group. Park et al. (2004) found similar results with adolescents, showing that there was a greater increase in depressed mood with rumination than distraction for adolescents with depression compared to adolescents without depression.

### Current Study

In summary, previous research has suggested that there is a relationship between depression and rumination such that rumination causes an increase in negative mood (Lyubomirsky et al., 1998; Lyubomirsky & Nolen-Hoeksema, 1995; Park et al., 2004). The current

experiment sought to further explore such a relationship by measuring the effects of rumination and distraction at multiple timepoints, before and after more than one round of distraction or rumination, thus investigating how rumination changes the emotional context of an autobiographical memory, with depressive symptom severity as a moderator and general rumination tendency as a covariate.

Participants described a negative past event involving school and rated the emotional intensity of the memory three times (Time 1, Time 2, and Time 3). Half of the participants were induced to ruminate about the memory for 3 min between ratings, and the other half were distracted for 3 min between ratings. Finally, participants completed the Beck Depression Inventory-II (Beck et al., 1996), the Rumination on Sadness Scale (Conway et al., 2000), and demographic questions.

We investigated three hypotheses. The first hypothesis was that there would be a two-way interaction between time and task such that by distracting from a negative autobiographical memory, the negative mood intensity of the memory would stay the same across Times 1, 2, and 3. In contrast, by ruminating on a negative autobiographical memory, the negative emotional intensity of the memory would increase across Times 1, 2, and 3. This prediction can be seen in Figure 1.

The second hypothesis was that there would be a three-way interaction between time, task, and depression such that participants with greater levels of depressive symptom severity in the rumination condition would have a greater increase in negative mood intensity across time compared to participants with lower levels of depressive symptom severity in the rumination condition. That is, depression would amplify the negative effect of rumination.

The third hypothesis was that there would be a main effect of depression so that, even at Time 1, participants with greater depressive symptom severity would have higher ratings of negative mood intensity for their memory.

## Method

### Participants

Participants were 73 students in the introductory psychology course at Southern Illinois University Edwardsville who participated for partial fulfillment of a course requirement in February 2022. Participants completed the study online via Qualtrics, and gave consent to participate by checking a box. Data were additionally collected from 10 other participants but were excluded from analysis due to incomplete data. The mean age of the participants was 19.49 ( $SD = 2.06$ , range = 18–31), with one participant not reporting their

age. There were 61 women and 12 men. With sample size  $N = 73$  the study obtained 80% power to detect effect sizes of size  $d = 0.66$  or greater for between-subjects  $t$  tests, and  $r = .32$  or greater for correlations. This study received ethical approval from the Institutional Review Board of Southern Illinois University Edwardsville (Protocol #1488).

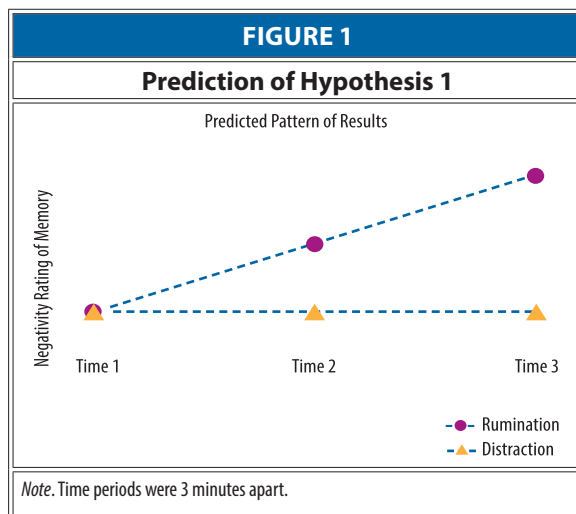
### Design

The independent variables were time (Time 1, Time 2, and Time 3; within-subjects) and task (distraction vs. rumination; between-subjects). Participants were randomly assigned to either the distraction group ( $n = 36$ ) or rumination group ( $n = 37$ ). The main dependent variable was the negative mood intensity for the autobiographical memory and was measured using a sliding scale with values ranging from 0–100 (0 = *extremely positive*, 100 = *extremely negative*), where higher numbers corresponded with a higher negative mood intensity. In addition, depressive symptom severity was measured as a quasi-independent variable using the Beck Depression Inventory-II, and rumination frequency was measured as a potential covariate using the Rumination on Sadness Scale.

### Materials

The Beck Depression Inventory-II (Beck et al., 1996) is a 21-item, self-report questionnaire that was used to measure the level of participants' depressive symptoms from within the past 2 weeks. Questions use a 4-point scale, with higher values indicating greater symptom severity. Across many studies, the BDI-II has been found to have high internal consistency, with a mean Cronbach's alpha of .90 (Wang & Gorenstein, 2013). In the current study, Cronbach's alpha was .93.

The Rumination on Sadness Scale (Conway et al.,



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2000) is a 13-item, self-report questionnaire that was used to measure the extent to which participants ruminate on sad memories in general. Questions use a 5-point scale (1 = *not at all*, 5 = *very much*), with higher values indicating greater rumination. Conway et al. (2000) reported a Cronbach's alpha of .91. In the current study, Cronbach's alpha was .93.

For both the Beck Depression Inventory-II and the Rumination on Sadness Scale, we calculated each participant's score as the mean of their responses on the questions for each scale. This was done instead of summation in order to allow for missing values.

**Procedure**

The experiment was completed online using the Qualtrics website after participants signed up on the Sona participant pool website. Participants were first told to describe a single clear and specific negative experience involving school, which they typed in a free-response textbox. They then reported how long ago the experience occurred, and rated the negative mood intensity of the experience using a sliding scale from 0 (*extremely positive*) to 100 (*extremely negative*). Participants could view the value for their rating when moving the slider. After initially describing the experience, participants were randomly assigned to either think about that negative experience for 3 minutes (rumination condition), or to think about the external stimuli of clouds forming in the sky for 3 minutes (distraction condition).<sup>1</sup> Next, participants again rated the negative mood intensity of their past experience on a 0–100 sliding scale for a second time. Then, participants in the rumination group again ruminated on the experience for 3 minutes and participants in the distraction group again focused on the external stimuli of clouds forming in the sky for 3 minutes. The participants then rated the negative mood intensity of their past experience on a 0–100 sliding scale for a third time. Finally, all participants completed the Beck Depression Inventory-II, the Rumination on Sadness Scale, and demographic questions (age and

<sup>1</sup>The task for the distraction condition was derived from Lyubomirsky et al. (1998).

gender). As part of debriefing, participants were given a link to free counseling services at Southern Illinois University Edwardsville. See Figure 2 for a diagram of the procedure. Complete instructions are included at <https://osf.io/h657r>

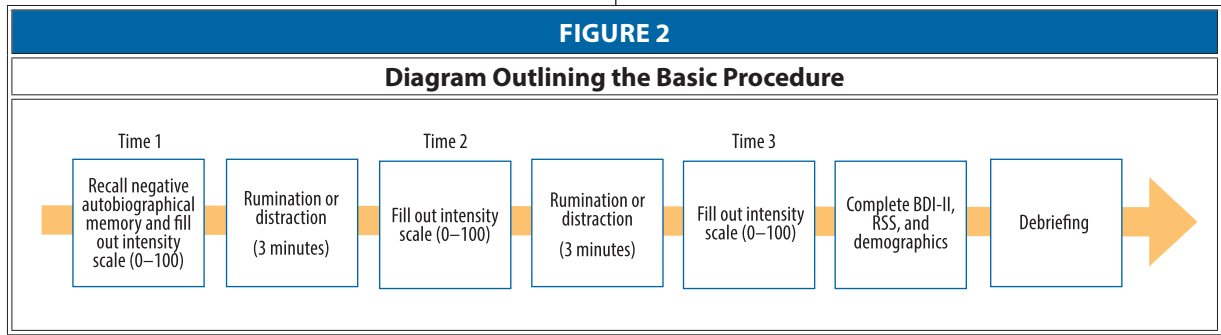
**Results**

Both the Beck Depression Inventory-II and the Rumination on Sadness Scale showed high reliability as measured by Cronbach's alpha (.93 for both). Participant scores on both scales were calculated as the mean of their responses to all items. The obtained range for the Beck Depression Inventory-II score was 1–3.24 ( $M = 1.78, SD = 0.55$ ) with the total possible range being 1–4. The obtained range for Rumination on Sadness Scale score was 1–4.85 ( $M = 2.71, SD = 0.93$ ) with the total possible range being 1–5. Data are available at <https://osf.io/h657r>

**Hypothesis 1: Rumination Will Increase the Negative Mood Intensity**

Table 1 shows the means and standard deviations of the negativity ratings across time periods, separately for the distraction and rumination conditions. The skewness of the distributions for these ratings were -0.36, -0.10, and 0.65 for the distraction condition, and -1.29, -0.69, and -0.85 for the rumination condition, for Time 1, Time 2, and Time 3 respectively. As illustrated in Figure 3, negativity ratings appeared to decrease over time for both conditions. In order to analyze these decreases, we calculated a simple linear regression slope across Times 1–3 for each participant.<sup>2</sup> These slopes were used for all subsequent analyses, because the change in negativity rating over time was of key interest. Two-tailed single-sample *t* tests compared the mean

<sup>2</sup>For example, one participant's three negativity ratings were 76, 51, and 37. A simple linear regression for that participant yields a slope of -19.5. This slope gives a single number representing the overall change in rating across the three time periods for this participant. Having such a single score for each participant simplifies analyses, for example allowing a comparison of mean slopes across conditions using a *t* test, rather than requiring a 2-way ANOVA.



slopes of the distraction and rumination conditions to zero. For the distraction condition the mean slope was  $-17.07$  ( $SD = 11.67$ ),  $t(35) = -8.65$ ,  $p < .001$ ,  $d = -1.46$ . For the rumination condition the mean slope was  $-5.08$  ( $SD = 11.77$ ),  $t(36) = -2.59$ ,  $p = .014$ ,  $d = -0.43$ . Thus, in both conditions, negativity ratings statistically significantly decreased over time. The single-sample  $t$  tests were followed by a two-tailed between-subjects  $t$  test comparing the mean slopes between the distraction and rumination conditions (i.e., looking for a 2-way interaction between time and task). The mean slope was indeed significantly different in the two conditions such that the negative mood intensity decreased more in the distraction condition than the rumination condition,  $t(71) = -4.31$ ,  $p < .001$ ,  $d = 1.01$ .

**Hypothesis 2: Depression Will Amplify the Effect of Rumination**

First, we analyzed the overall relationship between depressive symptom severity and the negative mood intensity over time (i.e., the slope) and no correlation was found,  $r(71) = .03$ ,  $p = .807$ , suggesting no overall relationship between depressive symptom severity and change in negativity rating. However, when we analyzed this correlation separately for the two conditions, an interesting pattern emerged. For the distraction condition, there was a *negative* correlation between depressive symptom severity and slope,  $r(34) = -.20$ ,  $p = .255$ ; for the rumination condition, there was a *positive* correlation between depressive symptom severity and slope,  $r(35) = .29$ ,  $p = .080$ . Although neither was statistically significant with our sample size, these small-to-medium sized correlations were in the opposite direction, suggesting that the relationship between depressive symptom severity and negativity rating over time depended on the condition (distraction vs. rumination). Thus, we next analyzed depressive symptom severity as a potential moderator using a multiple linear regression to determine if there was an interaction between the effect of depressive symptom severity and condition on negative mood intensity over time. Results of this regression are shown in Table 2, and the interaction was indeed significant. To better understand this interaction, we created a scatterplot, shown in Figure 4. The y-axis shows the direction and extent to which negativity ratings changed over time for a given participant (i.e., the participant's slope). For the distraction condition, the higher a participant's depressive symptom severity, the *more* negative their slope was (i.e., their negativity ratings decreased over time to a greater extent). For the rumination condition, the higher a participant's depressive symptom severity, the *less* negative their slope was (i.e., their negativity ratings decreased over time to

a lesser extent). Simple linear regression equations for both conditions are shown in Figure 4.

Although we had originally predicted that negativity ratings would increase over time in the rumination condition, in fact the ratings decreased over time for the majority of participants in both conditions. However, as seen in Figure 4, the negativity rating did increase over time for 12 participants as seen by the dots above zero

**TABLE 1**

**Mean (SD) of Negativity Ratings by Condition and Time**

Condition	Time 1	Time 2	Time 3
Distraction	75.97 (17.37)	46.44 (23.40)	41.83 (23.69)
Rumination	76.92 (19.04)	69.70 (23.33)	66.76 (27.64)

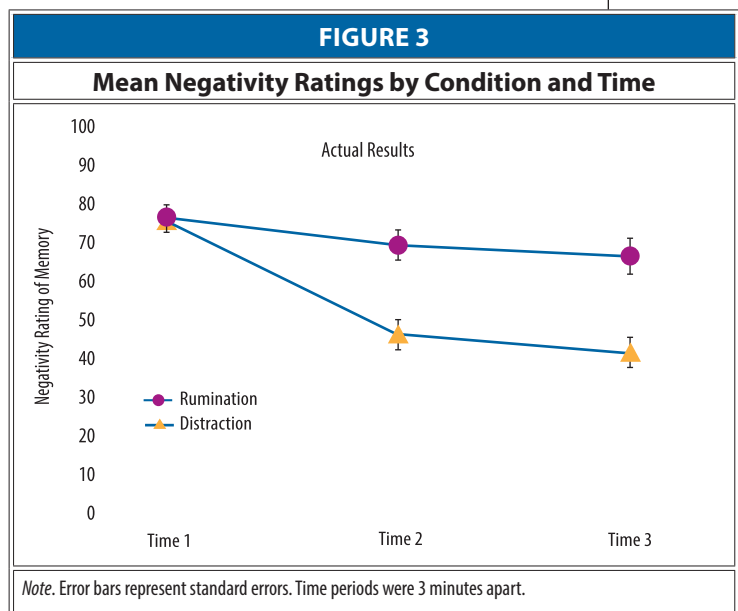
*Note.* Ratings were made on a 0–100 sliding scale, where 0 was extremely positive and 100 was extremely negative. Time periods were 3 minutes apart.

**TABLE 2**

**Regression of Condition on Negativity Rating Over Time With Beck Depression Inventory-II (BDI) as Moderator**

Effect	Estimated Coefficient	95% CI	SE	$p$	$\Delta R^2$
Constant	-9.86	-22.78 to 3.07	6.48	.133	
Condition	-6.50	-24.96 to 11.95	9.25	.484	.207
BDI Score	-4.01	-10.87 to 2.84	3.44	.247	.002
Interaction	10.38	0.50 to 20.27	4.95	.040	.047

*Note.* Outcome variable is slope of negativity rating across Times 1–3; Condition = distraction (0) vs. rumination (1); BDI = Beck Depression Inventory-II. Overall  $R^2 = .256$ .



on the y-axis. Interestingly, 11 of these 12 cases were in the rumination condition. A sign test verified that this is a significant difference,  $z = 2.73, p = .006$ . These results of the sign test allude to the original hypothesis, but do not fully support it.

The Rumination on Sadness Scale was measured to see how much a participant tends to ruminate on their own. This could contribute to how the rumination manipulation affects participants, and thus be

**TABLE 3**

**Regression of Condition on Negativity Rating Over Time With Beck Depression Inventory-II (BDI) as Moderator and Rumination on Sadness Scale (RSS) as Covariate**

Effect	Estimated Coefficient	95% CI	SE	p	$\Delta R^2$
Constant	-10.56	-23.57 to 2.45	6.52	.110	
Condition	-7.66	-26.27 to 10.95	9.33	.414	.207
BDI Score	-6.53	-15.10 to 2.03	4.29	.133	.002
Interaction	10.84	0.91 to 20.77	4.98	.033	.047
RSS Score	1.99	-2.05 to 6.03	2.03	.330	.010

*Note.* Outcome variable is slope of negativity rating across Times 1–3; Condition = distraction (0) vs. rumination (1); BDI = Beck Depression Inventory-II; Interaction is between Condition and Beck Depression Inventory-II Score; RSS = Rumination on Sadness Scale. Overall  $R^2 = .267$ .

an additional source of variance. So, we included Rumination on Sadness Scale in an additional regression in order to see if the relationship between task, depressive symptom severity, and negativity rating over time could be clarified when variance due to rumination was explicitly modeled. The results of this regression are shown in Table 3. The regression did not provide any additional insights. A possible reason for this is that the Beck Depression Inventory-II and Rumination on Sadness Scale are similar in what they measure; Conway et al. (2009) reported  $r(211) = .56, p < .001$ . This shows a large positive correlation between rumination and depressive symptom severity, which is replicated in the current study,  $r(71) = .68, p < .001$ .

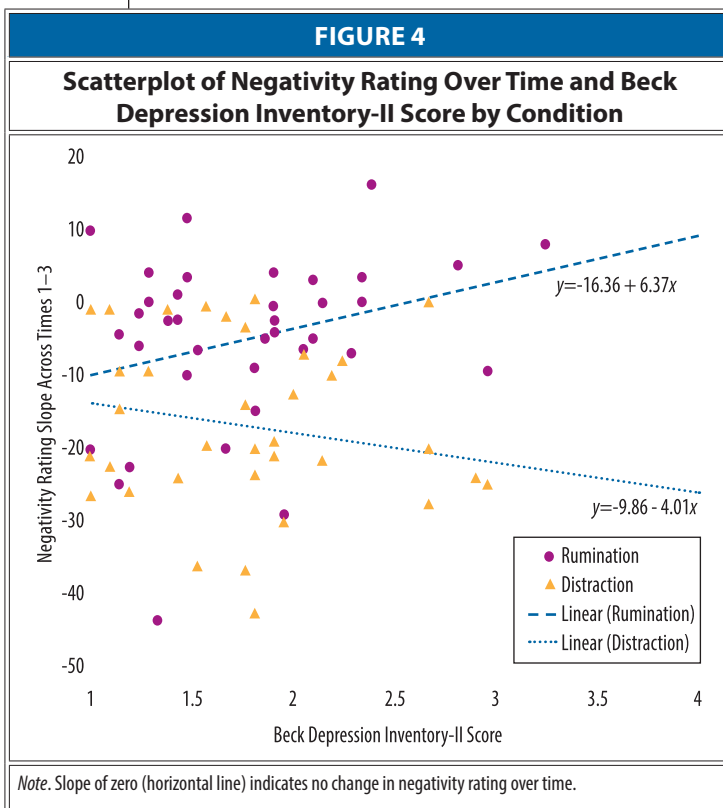
**Hypothesis 3: High Depression Levels Will Correlate With High Negativity Ratings at Time 1**

Finally, to test the third hypothesis, we calculated a correlation between depressive symptom severity and negativity rating at Time 1 and found that it was small and positive but not significant  $r(71) = .18, p = .136$ . Thus, there was no statistically significant difference in the initial negativity of the autobiographical memory as a function of depressive symptom severity.

**Discussion**

Results showed that negative mood intensity ratings of an autobiographical memory decreased across time when participants repeatedly ruminated about the memory and when they were repeatedly distracted. This pattern (see Figure 3) differed from our first hypothesis that negative ratings would increase with rumination and stay the same with distraction (see Figure 1). However, the difference in the effects of the distraction condition compared to the rumination condition was statistically significant, so that the negative memory was viewed less negatively over time for the distraction condition than the rumination condition. That is, the relative difference in the slopes was as we predicted, but the absolute direction of the slopes was not.

The results were somewhat consistent with our second hypothesis that there would be an interaction between depression, time, and task. We did find a three-way interaction (see Figure 4). However, rather than our prediction that participants with a greater level of depression would show a greater increase in negative ratings of their memory across repeated ruminations, they instead showed a *diminished decrease* relative to less depressed participants. Furthermore, participants with a greater level of depression in the distraction condition showed a *greater decrease* in negative ratings of their memory across time relative to less depressed participants. Overall, 11 of the 12 participants who showed an increase



in negative mood intensity were in the rumination condition (in line with our first hypothesis); however, placement into the rumination condition alone did not guarantee an increase in negative mood intensity.

Finally, we also hypothesized that participants with a greater level of depression would begin with a more negatively rated autobiographical memory at Time 1. A small correlation between depressive symptom severity and negativity rating at Time 1 showed that the results were in the predicted direction but not statistically significant.

The overall pattern seen in the current study was similar to that found in two previous studies. Lyubomirsky et al. (1998) found that people with dysphoria who ruminated once became more depressed, but people with dysphoria who were distracted once became less depressed. They found no significant changes in depressed mood in people without dysphoria who ruminated versus were distracted. Dysphoric rumination leads to retrieving more negative autobiographical memories and rating autobiographical memories as more negative and unhappy. Park et al. (2004) similarly found a greater increase in depressed mood with rumination versus distraction for participants with depression compared to participants without. In the current study, in the rumination condition, the higher a participant's depressive symptom severity, the *less* their negativity rating decreased over time (i.e., the decline was shallower); however, in the distraction condition, the higher a participant's depressive symptom severity, the *more* their negativity rating decreased over time (i.e., the decline was deeper). The results of the current study are similar to those of the previous two studies, but instead of finding an increase in negativity over time for the rumination condition, we found a *diminished decrease* in negativity rating over time.

Overall, evidence implicates rumination as a mechanism for the effect of depression on autobiographical memory. We offer a few possible explanations for this observed effect. First of all, studies of mood dependence and congruency in memory have shown that it is easier for someone to recall a previous episode when their current mood is congruent with their previous mood (Eich & Metcalfe, 1989). Thus, when someone is feeling sad, previous sad experiences may come more readily to mind when they try to think back. This can in turn feed into the availability heuristic, whereby things that come more readily to mind are judged as more frequent or probable (Tversky & Kahneman, 1973), leading depressed people to overestimate how often they have felt sad in the past or might again feel sad in the future. MacLeod and Campbell (1992) found that participants estimated higher probability of future negative events when they had been induced into a sad mood

and asked to retrieve unpleasant memories. Finally, rumination—that is, thinking about a sad memory over and over again—can serve to further strengthen that memory because of the well-established retrieval practice effect (i.e., testing effect; Roediger & Butler, 2011), such that the very act of retrieving a memory strengthens that memory, making it even more likely to be retrieved again in the future. Thus, rumination amplifies the effect of depression on autobiographical memory, and also further perpetuates depression itself.

There were several strengths and limitations of the current study. One strength was that our results support findings from previous studies and were obtained using different methodology. A second strength was the use of the slider with a 0–100 scale which allowed for a greater range of results for the DV (negativity rating) than would have been obtained using a traditional 5-point scale. A third strength was that the memory prompt successfully elicited specific negative memories from college students with an overall high mean negativity rating at Time 1 without a ceiling or floor effect.

One limitation of the current study was that it was completed using only a sample of college students. As such, it may be beneficial to complete a future study using a sample with a larger age range than what is generally provided by college students. Additionally, future research could investigate the extent to which antidepressants might influence the effect of rumination on negative autobiographical memories in participants with depression. Finally, a major source of variance in the current study was likely due to the variety of negative experiences that participants recalled. In order to reduce such variance, a future study could look at a negative experience designed by the researcher, or elicit negative memories with a more specific prompt.

Additionally, it may be beneficial to complete a qualitative analysis on the content of the negative autobiographical memories to investigate if the content impacts the effectiveness of distraction and rumination. Future research could also further investigate the relationship between depression and rumination in regard to how they interact with each other, for example to see if verbally describing a negative autobiographical memory or experience to an acquaintance in conversation (rather than simply thinking about it) leads to a decrease or increase in the negative mood intensity rating for that memory. Another topic of future investigation could be over-general autobiographical memories in the context of rumination in participants with depression, similar to studies such as one by Mitchell (2015).

The broader implication of this study is that depressed individuals may be susceptible to persistence or amplification of negative memories because of

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ruminating on them. But they may be able to avoid this by distracting themselves from rumination. For example, college students who are distressed over a course experience may ruminate on their distress and thus become more distressed. However, by distracting themselves from the distress, students may be able to become less distressed and thus be able to focus more on other memories or cognitive processes. The results could also have beneficial implications for therapy and counseling as teaching patients who are in counseling or therapy to distract themselves from ruminative thoughts could be beneficial in terms of decreasing the intensity of their overall negative affect (Watkins, 2015).

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We have no conflicts of interest related to this project. Data are available at <https://osf.io/h657r>

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