

Responses to Positive Affect in Daily Life: Positive Rumination and Dampening Moderate the Association Between Daily Events and Depressive Symptoms

Y. Irina Li¹ · Lisa R. Starr¹ · Rachel Hershenberg²

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Abstract Depressive rumination has been strongly linked to the development and maintenance of depression; however, less attention has been paid to ruminative processes in response to positive affect, and fewer have examined these processes in daily life. The current study sought to address these gaps by exploring depressive rumination and two forms of responses to positive affect, *dampening* and *positive rumination*, under ecologically valid conditions using daily diary methodology. One hundred fifty-seven young adults completed 14-day end-of-day diaries assessing positive affect and depressive symptoms in relation to depressive rumination, responses to positive affect, and daily positive and negative events. Daily depressive rumination predicted stronger associations between negative events and daily depressive symptoms. Higher daily dampening was associated with higher daily depressive symptoms and decreased positive affect and predicted lower associations between daily positive events and improvements in mood (including reduced daily positive affect and increased daily depressive symptoms). Higher daily positive rumination was negatively associated with daily depressive symptoms and interacted with daily positive events such that positive rumination had a greater impact on depressed mood on days when positive experiences were low. Results indicate that both depressive rumination and responses to positive affect play a role in influencing daily mood and depressive symptoms.

Keywords Depression · Positive affect · Emotion regulation · Positive rumination · Dampening · Daily diary

In everyday life, people regularly face situations that have the potential to elicit a range of emotions. Specific styles of responding to these emotions have been robustly and consistently linked to depression and other forms of psychopathology (Aldao and Nolen-Hoeksema 2012; Gross and John 2003; Gruber et al. 2008, 2011). In particular, ruminating about negative mood has been shown to contribute to depression (Brinker and Dozois 2009; Nolen-Hoeksema 2000; Nolen-Hoeksema et al. 2008). However, relatively little work has focused on the role of ruminative responses to positive mood in psychopathology. The limited emerging literature has suggested that how individuals respond to positive mood may likewise contribute to depression and other forms of psychopathology (Forbes et al. 2009; Parrott 1993; Raes et al. 2012). The current study seeks to elucidate how ruminative responses to positive and negative mood influence mood reactivity to naturally occurring events in daily life.

Depressive Rumination in Daily Life

Depressive rumination (a repetitive pattern of thinking that focuses on depressive symptoms and implications of those symptoms) has been shown to be a contributing factor to the onset of depression as well as anxiety, self-harm, binge-eating, and problematic-drinking behaviors (Nolen-Hoeksema et al. 2008). Depressive rumination has been shown to uniquely predict depression and remains correlated with depression even after controlling for other negative cognitive styles and neuroticism (Ciesla and Roberts 2002; Lyubomirsky et al. 1999; Robinson and Alloy 2003; Spasojević and Alloy

✉ Y. Irina Li
yihan.li@rochester.edu

¹ Department of Clinical and Social Sciences in Psychology, University of Rochester, 355 Meliora Hall, Box 270266, Rochester, NY 14627-0266, USA

² Department of Psychiatry and Behavioral Sciences, Emory University, Atlanta, GA, USA

2001). Although the majority of past studies have approached depressive rumination as a single, broad construct, more recent studies have shown that the brooding component (passive, repetitive focus on one's emotions) is more strongly associated with maladaptive outcomes than the reflection component (attempting to understand the reason for one's depressed mood; Arney et al. 2009; Nolen-Hoeksema et al. 2008; Schoofs et al. 2010; Treynor et al. 2003).

An extensive literature has examined the relationship between depressive rumination and depression, but the majority has relied on self-reports of general ruminative tendencies or experimentally induced laboratory paradigms (Donaldson et al. 2007; Watkins and Brown 2002; Watkins and Teasdale 2001). Laboratory paradigms of depressive rumination induction typically involve instructing participants to focus on emotional aspects of negative stimuli. While these studies allow for causal inference, results may not be analogous to experiences encountered in everyday life. On the other hand, reliance on longer-term recall in correlational studies risks retrospection bias and fails to capture dynamic processes that may vary on a daily basis. Examination of an individual's day-to-day behavior in naturalistic settings is crucial for improving external validity as well as understanding how rumination influences depression in the context of daily life.

Addressing this gap, an emergent body of research has begun to examine the association between depressive rumination in response to daily events and day-to-day fluctuations in mood. These studies have suggested that daily depressive rumination may intensify the association between daily stressors and downward fluctuations in daily negative affect (Genet and Siemer 2012; Moberly and Watkins 2008); however, few studies have extended the research further to examine daily depressive symptoms as an outcome. One exception found that rumination moderated the association between daily negative events and daily depressed mood in individuals with Major Depressive Disorder (McIntosh et al. 2010); Starr (2015) additionally found that daily brooding predicted daily stress reactivity in a sample of college students over-selected for depression. Given the importance of this work in extending our understanding of how daily processes influence mood, further research that examines how these processes interact with daily events is needed.

Responses to Positive Affect in Daily Life

Research has only more recently started to directly apply the construct of rumination to *positive* mood (Feldman et al. 2008). This is an important addition to the literature, given that deficits in positive emotions are linked to several disorders and appear to be particularly tied to depression (Feldman et al. 2008; Heller et al. 2009; Yoon et al. 2009). Evidence suggests that how individuals respond to their affective states

is more strongly linked to the onset and maintenance of emotional disorders than the affective states themselves (Nolen-Hoeksema 1991; Teasdale 1988). The traditional diathesis-stress framework of depression suggests that vulnerability factors amplify the negative impact of stressful events on depression (Metalsky and Joiner 1992; Monroe and Simons 1991). We propose an analogous model of diathesis-positive contingency, where individual differences in responses to positive mood represent a vulnerability factor for depression, by modifying the degree to which individuals affectively benefit from *positive* events. Positive affect (PA) regulation theories suggest that some people tend to engage in positive forms of rumination, that is, by responding to positive affective states by thinking about one's positive affective experience, self-quality, and life circumstances in a recurrent and ruminative manner, in order to bolster self-confidence and esteem as well as to increase or maintain positive mood (Larsen and Prizmic 2004; Martin and Tesser 1996). Importantly, not all responses to PA serve to bolster positive mood. Wood et al. (2003) found that individuals with low self-esteem tend to use strategies to decrease their positive mood ("dampening"), perhaps to maintain the stability of their negative world-views.

Emerging research suggests that repeated dampening of PA may have important effects on the maintenance of depressive symptoms. In a sample of non-clinical young adults, a dampening response style predicted increases in depressive symptoms at five-month follow-up, controlling for baseline depressive symptoms (Raes et al. 2012). Both depressed and recovered depressed individuals report a greater tendency to dampen positive emotions than never-depressed controls (Werner-Seidler et al. 2013). Bijttebier et al. (2012) found a similar pattern between dampening and depressive symptoms in children, with high levels of dampening associated with concurrent depressive symptoms in a sample of children ages 10 to 14. However, less is known about the effect of ruminative dampening in response to positive events in a naturalistic context, or the relationship between dampening and daily depressive symptoms. As depression is associated with decreased responsivity to positive stimuli, understanding positive emotional processes is crucial in elucidating the relationship between dampening responses and depression. We specifically hypothesized that daily dampening would reduce the associations between daily positive experiences and improvements in mood, including increases in PA and reductions in depressive symptoms.

As with dampening, existing research on positive rumination has mainly relied on self-reports of trait tendencies of how individuals respond to PA. Positive rumination refers to affective regulatory strategies to enhance PA that are focused on the positive affective experience, one's positive self-qualities, and one's favorable life circumstance (Feldman et al. 2008). These thoughts are recurrent and repetitive in nature, just as depressive rumination involves recurrent thoughts in response to

one's depressed mood (Nolen-Hoeksema 1991). In a study of young adolescents, using strategies to maximize positive events—including reflecting on PA—was associated with stronger PA about the event later, although the study did not find any effects of maximizing on internalizing problems (Gentzler et al. 2014). Use of savoring strategies (a broader construct that includes positive rumination as well as expressive strategies to boost the positive impact of positive events such as sharing with a friend or marking the event in some way) has been associated with greater self-esteem, life satisfaction, and intensity and frequency of happiness (Bryant 2003; Martin and Tesser 1996; Quoidbach et al. 2010; Wood et al. 2003). However, in a study of children ages 7–10, positive rumination did not interact with positive life events to predict depressive symptoms (Gilbert et al. 2017). Given the relative lack of research and somewhat inconsistent findings, clarifying the role of ruminative responses to PA in depression is critical. It is likely that certain forms of positive rumination potentially protect against depressed mood, perhaps by amplifying the ameliorative effects of positive experiences on mood.

Although some evidence suggests that momentary engagement in positive mood regulation strategies plays a role in individual variation in normative mood states (including positive and negative affect), for example by moderating the impact of positive events on momentary positive mood (Jose et al. 2012), no study to our knowledge has tested positive rumination and dampening as predictors of fluctuations in daily depressive symptoms. Understanding the contribution of PA regulation on within-subjects variations in daily depressive symptoms is critical both for understanding the mechanisms and phenomenological experience of depression and for refining effective treatment targets. Although prior research has often treated depression as a static, between-persons variable, evidence suggests that depressive symptoms fluctuate on a daily basis, including as a function of emotion regulation strategies (Peeters et al. 2003; Starr 2015; Starr and Davila 2012; Wichers et al. 2010). Use of more ecologically valid methodology such as daily diaries can greatly enhance our understanding of these processes. One study that did examine savoring and dampening responses to PA using a daily diary design found that higher baseline depressive and anxiety symptoms were associated with increased daily dampening of PA (Carl et al. 2014). In addition, higher baseline savoring was associated with increased reports of PA following positive events. Although this study represents an important step in understanding positive rumination in daily life, the design of the study did not allow for more fine-grained conclusions about daily processes. For example, it remains unclear whether use of PA enhancing strategies suggests a broader trait propensity toward positive mood, or if it specifically amplifies the effects of positive environmental events. A more rigorous test would apply a moderation model, examining interactive effects between positive rumination/dampening and daily

positive events on mood and depressive symptoms. Further, no studies to date have examined the use of ruminative responses to PA in daily life. Thus, in line with our goal of contextualizing positive mood regulation strategies as potential moderators of daily fluctuations in depression and more clearly delineating the role of positive rumination in the relationship between positive daily events and depression, we examined daily depressive symptoms as our primary outcome. However, we also tested PA as an additional outcome, given its direct relevance to positive rumination and dampening.

The Current Study

To address these gaps in the literature, the present study examines the relationship between depressive and positive rumination and positive and negative events on same-day positive mood and depressive symptoms. We used a 14-day, end-of-day diary design, tested in a sample of young adults overselected for depressive symptoms. Daily diary methods decrease reliance on longer-term retrospection and increase ecological validity by allowing for an examination of momentary processes in naturalistic contexts (Bolger et al. 2003).

Hypotheses 1) We predicted that brooding would moderate the association between daily negative events and depressive symptoms such that depressive symptoms would be stronger when brooding is high. 2) We predicted that dampening would moderate the association between daily positive events and mood such that positive events would more strongly predict increased PA and decreased depressive symptoms when dampening is low. 3) We predicted that positive rumination would moderate the association between positive events and improvements in mood, such that positive events would more strongly predict increased PA and decreased depressive symptoms when positive rumination is high.

Method

Participants

Participants were recruited from undergraduate psychology courses and received extra credit for their participation in the study as well as raffle tickets based on diary compliance. Participants were eligible if they were 18 years of age or older, had access to the Internet and a personal cell phone (relevant for other study measures), and had no English comprehension difficulties that would preclude completion of study tasks.

To recruit a sample with a broad range of depressive symptoms (allowing for sufficient variation on variables of interest), potential participants completed an initial screening questionnaire with a self-report depression measure, the Quick

Inventory of Depressive Symptomatology (QIDS; Rush et al. 2003). For recruitment purposes only, in order to achieve approximately equal distribution across the three categories, we used scores on the QIDS to categorize potential study participants into three groups, following published clinical thresholds (Rush et al. 2003): no symptoms (<6), mild symptoms (6–10), or moderate/severe symptoms (>10). Participants were then preferentially recruited based on their scores. Consequently, depressive symptoms were over-represented in our sample: 33% scored within the mild symptom range and 36% of participants scored within the moderate to severe symptom range at baseline. Mean level of depressive symptoms was 8.81 ($SD = 5.19$).

Of the 160 total participants, three participants were not included in the final sample. One participant dropped out of the study after the baseline visit and did not complete daily diaries. Two additional participants were excluded from analyses after failing inattention checks (described below). The final sample of 157 participants had a mean age of 20.10 ($SD = 1.23$) and was 81% female. Fifty-seven percent of participants identified as Caucasian, 29% as Asian American, 6% as African American, and 7% as Other. In addition, 8% identified as being of Hispanic/ Latino ethnicity.

Procedure

Participants first attended a baseline visit and completed a set of self-report measures. Following completion of baseline measures, participants received detailed instructions on how to complete daily measures. Participants were also provided with a unique identification number and written instructions to access study measures via an online survey platform (www.Qualtrics.com) with secure data transmission. Participants completed daily diaries at the end of day for 14 consecutive days, beginning the evening of their baseline visit. Participants were instructed to complete the diaries as close to bedtime as convenient. To increase compliance, participants were given the option of receiving a daily automatic reminder email. Item presentation was randomized in blocks. On average, participants completed 10.97 diaries (78.3%). Number of diaries missed was not significantly related to baseline depression. This research was approved by University of Rochester's Research Subjects Review Board.

Inattention Items Following Maniaci and Rogge's (2014) recommendation for identifying inattentive respondents, we included six inattention items in the baseline battery that would indicate likely inattention if responses were atypical. Maniaci and Rogge (2014) demonstrated that exclusion of inattentive participants' data enhances statistical power. Two participants consistently failed inattention checks and were excluded from analyses.

Measures

Baseline Depressive Symptoms Baseline depressive symptoms were included for descriptive analyses. We measured current depressive symptom severity with the QIDS (Rush et al. 2003). Note that the QIDS was re-administered at baseline and treated as a continuous measure in all analyses. The QIDS is a 16-item self-report questionnaire with items ranging from 0 to 3 assessing the nine criterion symptom domains necessary to diagnose a major depressive episode according to the Diagnostic and Statistical Manual of Mental Disorders—4th edition (DSM-IV; American Psychiatric Association 1994). Symptom domains include sad mood, concentration, interest, self-criticism, fatigue, sleep disturbance, changes in appetite or weight, and psychomotor agitation or retardation. One suicidal ideation item was excluded due to institutional review board concerns. The scale for the remaining items was adjusted accordingly by taking the mean of the eight remaining symptom domain scores and multiplying by nine, so that scores could be interpreted using established cut-off scores. The psychometric properties of the QIDS are well-established (Rush et al. 2003, 2006). In the present study, Cronbach's alpha was .84.

Baseline Depressive Rumination and Response to Positive Affect

Trait depressive rumination, dampening, and positive rumination were assessed to test the validity of daily measures. The Responses to Positive Affect questionnaire (RPA; Feldman et al. 2008) was used to assess participants' tendencies to engage in dampening or positive rumination in response to PA. The RPA is a 17-item self-report questionnaire that includes three subscales: dampening, self-focused (SF) positive rumination, and emotion-focused (EF) positive rumination. Although the RPA was originally developed to differentiate between two forms of positive rumination—SF and EF, subsequent factor analyses suggest that a two-factor model is more parsimonious than the three-factor model, and that the two forms of positive rumination were not differentiated by age of respondents or depressive symptoms (Nelis et al. 2016). In our sample, examination of SF and EF scales separately did not yield substantially different results. Thus, in the present study the SF and EF subscales were combined into a single positive rumination subscale (ex: "Think about how happy you feel" and "Think of everything you are achieving"). Sample items for the dampening subscale include, "Think 'my streak of luck is going to end'" and "Think 'I don't deserve this'". Responses were rated on a scale from 1 (*almost never*) to 4 (*almost always*). Cronbach's alpha for dampening and positive rumination were .85 and .86, respectively.

The Ruminative Response Scale (RRS; Nolen-Hoeksema and Morrow 1991) was used to assess participants' tendencies to ruminate in response to depressed mood. The RRS is a 21-item self-report questionnaire that includes responses to

negative mood focused on self, symptoms, and causes and consequences of symptoms (ex: “Think about how sad you feel”). The RRS has demonstrated good reliability and convergent and predictive validity (Nolen-Hoeksema and Morrow 1991). Responses were rated on a scale from 1 (*almost never*) to 4 (*almost always*). Cronbach’s alpha in our sample was .94.

Daily Diary

Daily Hassles and Uplifts We assessed daily negative events (“hassles”) and positive events (“uplifts”) based on the methods of Totenhagen et al. (2012). Participants were provided with a list of general life domains and asked to indicate the degree to which they experienced hassles and uplifts in each domain on that day (e.g. “*how much of a hassle and how much of an uplift were each of the following today?*”) on a scale from 0 (*none*) to 3 (*a great deal*). We adapted the original 15 items for use with college students (e.g. removing “your children” and including “your other peers”) and to be more broadly applicable (e.g. replacing “your partner” with “your romantic partner/romantic life/dating life”). Our list included the following 13 life domains: 1) parents and family members, 2) romantic life, 3) close friends, 4) other peers, 5) social events, 6) career, 7) finances, 8) exercise, 9) health, 10) chores, 11) hobbies, 12) online activities, and 13) other. We then computed an average total score for level of uplifts and hassles, respectively. Mean and standard deviation of hassle and uplift domains are presented in Table 1. To compute internal consistency on this and other measures, we split the file by chronological diary day and then separately computed Cronbach’s alphas for each of the fourteen days. Mean Cronbach’s alpha over the 14 days was .84 for uplifts and .83 for hassles.

Daily Positive Affect was assessed using the positive items from the Positive and Negative Affect Schedule (PANAS; Watson et al. 1988), which includes 10 adjectives indicating positive mood (e.g. “*proud*”, “*excited*”) rated on a scale from 1 (*very slightly or not at all*) to 5 (*extremely*). The psychometric properties of the PANAS are well-established (Watson et al. 1988). Mean internal consistency in our sample was .92.

Daily Depressive Symptoms were assessed using a modified version of the depression subscale of the Depression Anxiety Stress Scales (DASS; Antony et al. 1998). The depression subscale includes seven items assessing depressive symptoms rated on a Likert-type scale from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*) and has demonstrated strong psychometric properties (Brown et al. 1997; Clara et al. 2001). We modified the time frame of the original items to indicate the current day (e.g. “*indicate how much the statement applied to you today*”). Mean internal consistency across individual days was .93.

Table 1 Means and standard deviations of hassle and uplift domains

Hassles	Mean	SD
Parents and family members	1.43	.74
Romantic life	1.53	.89
Close friends	1.56	.81
Other peers	1.59	.80
Social events	1.66	.85
Career	1.86	.99
Finances	1.71	.84
Exercise	1.51	.84
Health	1.76	.93
Chores	1.61	.86
Hobbies	1.43	.72
Online activities	1.43	.69
Other	1.37	.72
Uplifts		
Parents and family members	2.36	1.15
Romantic life	1.92	1.14
Close friends	2.68	1.05
Other peers	2.00	.95
Social events	1.92	1.02
Career	1.57	.82
Finances	1.35	.71
Exercise	1.63	1.00
Health	1.53	.89
Chores	1.33	.65
Hobbies	1.99	1.07
Online activities	1.75	.91
Other	1.37	.72

Daily Depressive Rumination and Response to Positive Affect

For daily depressive rumination, the five brooding items from the original RRS were used. The brooding subscale assesses passive pondering of one’s depressed mood (e.g. “Think about a recent situation, wishing it had gone better” and “Think ‘Why do I always react this way?’”) and excludes items representing potentially adaptive reflective rumination as well as items overlapping conceptually with depressive symptoms. Brooding is more predictive of depression than the reflection component of rumination and has been shown to perform similarly to the full RRS scale (Treynor et al. 2003). Wording for items was modified to indicate time frame of the current day (e.g. “*Please tell me if you did any of the following over the course of the day today*”). Responses were rated on the same scale as the baseline measure, although wording was modified to reflect the difference in time frame (1 = *not at all* and 4 = *a whole lot*). In our sample, average within-day Cronbach’s alpha was .86. The intra-class coefficient (ICC) was .59, suggesting that 59% of the variance was between-persons (and 41% was within-persons).

Daily positive rumination and dampening were assessed using a shortened version of the RPA. For positive rumination, two items with the highest factor loadings from each of the three original RPA subscales, as reported by Feldman et al. (2008), were included to produce a scale comprised of six total items. Consistent with our approach with the baseline RPA, we collapsed the EF and SF subscales to create a four-item measure of general positive rumination. Results were comparable when EF and SF scales were examined separately. As with the daily brooding items, wording was adapted to be appropriate for daily assessments. Mean internal consistency was .70 for the dampening subscale and .83 for the positive rumination subscale. ICCs for dampening and positive rumination were .56 and .55, respectively, suggesting that a little more than half of the variance on these measures is due to between-persons differences.

Data Analytic Approach

All hypotheses were tested using multilevel modeling (MLM) in IBM SPSS 22.0 MIXED. MLM accounts for the non-independence inherent in repeated-measures time-series data. Repeated daily measures were nested within individuals. As we were interested in examining effects of daily ruminative responses that reflect deviations of each individual relative to the group on the relationship between daily events and mood, all predictor variables (within- and between-subjects) were grand mean centered to increase interpretability. Grand mean centering predictor variables allows for examination of the incremental effect of the aggregate of the individual level 1 variable in predicting individual level outcomes (Hofmann and Gavin 1998). For each model, level 1 predictors were entered simultaneously along with the two-way interaction term. We also entered all Level 1 variables of interest (including positive

rumination, dampening, brooding, hassles, and uplifts) as random effects. Because very small random effects are difficult to model reliably and can impede model convergence, in rare cases when models did not converge, non-significant effects ($p > .15$) were subsequently dropped. We specified an unstructured covariance matrix (UN) for random effects and a first-order auto-regressive (AR [1]; World Health Organization 2014) model to correct for autocorrelation of residuals. In all moderation models, the interaction term is of primary interest. Significant interactions were decomposed using simple slope tests at one standard deviation above and below the mean of the moderator variable (Aiken et al. 1991). The effects of time were controlled for in all analyses.

Results

Preliminary Analyses

Table 2 presents descriptive data and bivariate correlations among baseline measures and aggregated within-subject variables. Baseline depressive symptoms significantly predicted increased daily depressed mood ($b = .50$, $SE = .05$, $t(152.08) = 9.51$, $p < .001$) and decreased daily PA ($b = -.38$, $SE = .10$, $t(153.60) = -3.81$, $p < .001$). Baseline depressive symptoms did not significantly predict daily uplifts ($b = -.03$, $SE = .09$, $t(151.67) = -.363$, $p = .717$) but significantly predicted greater daily hassles ($b = .34$, $SE = .08$, $t(151.27) = 4.29$, $p < .001$). Uplifts significantly predicted decreased same-day daily depressive symptoms ($b = -.12$, $SE = .04$, $t(40.62) = -3.01$, $p = .004$). Hassles significantly predicted daily depressive symptoms ($b = .33$, $SE = .04$, $t(74.38) = 8.49$, $p < .001$).

Table 2 Pearson's product moment correlations, means, and standard deviations for study variables

	1	2	3	4	5	6	7	8	9	M	SD
Baseline measures											
1. Depressive symptoms										8.9	5.19
2. Depressive rumination	.65**									56.56	15.03
3. Dampening	.51**	.48**								17.87	5.7
4. Positive rumination	-.38**	-.25**	-.38**							23.07	5.53
Daily measures											
5. Positive affect	-.30**	-.18*	-.18*	.48**						24.37	6.86
6. Daily depressive symptoms	.61**	.59**	.43**	-.26**	-.34**					4.00	4.29
7. Daily brooding	.49**	.54**	.44**	-.21*	-.17*	.69**				9.41	3.18
8. Daily dampening	.21*	.32**	.47**	-.12	0.09	.49**	.65**			1.44	0.51
9. Daily positive rumination	-.34**	-.23*	-.21*	.50**	.80**	-.35**	-.09	.20*		1.97	0.56

Daily measures are aggregated within-persons across all observations

* $p < .05$, ** $p < .01$

Supporting the validity of using daily measures to assess responses to PA, self-reported positive rumination and dampening at baseline significantly positively predicted daily positive rumination ($b = .05$, $SE = .01$, $t(150.87) = 7.26$, $p < .001$) and dampening ($b = .04$, $SE = .01$, $t(150.27) = 6.68$, $p < .001$), respectively. Baseline depressive symptoms also significantly predicted daily dampening ($b = .02$, $SE = .01$, $t(151.21) = 2.65$, $p = .009$) and positive rumination ($b = -.04$, $SE = .01$, $t(154.19) = -4.21$, $p < .001$).

For all interactions, results remained significant and in the same pattern when gender and baseline depressive symptoms were included in the model as covariates. To maintain parsimony, we present results below for models without gender and baseline depressive symptoms as covariates.

Depressive Rumination

First, we examined whether daily depressive rumination (brooding) strengthens the association between hassles and daily depressive symptoms. As described above, a model was constructed which included the main effects for daily brooding and daily hassles, their interaction term, and the effects of time. Random effects for daily hassles were non-significant and subsequently dropped from the model. Full results of the model are presented in Table 3. Note that for all subsequent moderation analyses, a similar model was constructed. Both daily brooding ($p < .001$) and hassles ($p < .001$) were significantly associated with depressive symptoms as main effects. Consistent with hypotheses, daily brooding significantly interacted with hassles to predict depressive symptoms ($p = .005$). Simple slope tests revealed that on days when brooding was low ($M - 1\ SD$), hassles were less strongly associated with depressive symptoms ($b = .08$, $SE = .02$, $t(632.41) = 3.56$, $p < .001$) than on days when brooding was high ($M + 1\ SD$) ($b = .16$, $SE = .02$, $t(1578.49) = 7.081$, $p < .001$) (Fig. 1).

Table 3 Results of multilevel model predicting daily depressive symptoms from daily brooding and daily hassles

Fixed effects (intercepts, slopes)	<i>b</i> (<i>SE</i>)	<i>df</i>	<i>t</i>	<i>p</i>
Intercept	3.71 (.25)	235.17	14.59	< .001
Daily brooding	.46 (.04)	147.49	10.72	< .001
Daily hassles	.12 (.02)	1157.5	6.98	< .001
Daily brooding x daily hassles	.01 (.003)	978.55	2.83	0.005
Time	-.05 (.02)	433.95	-2.48	0.014
Random effects (co-variances)	<i>b</i> (<i>SE</i>)	<i>z</i>	<i>p</i>	
Intercept	6.54 (.91)	7.16	< .001	
Daily brooding	.15 (.03)	5.45	< .001	
Intercept and daily brooding	.72 (.13)	5.62	< .001	

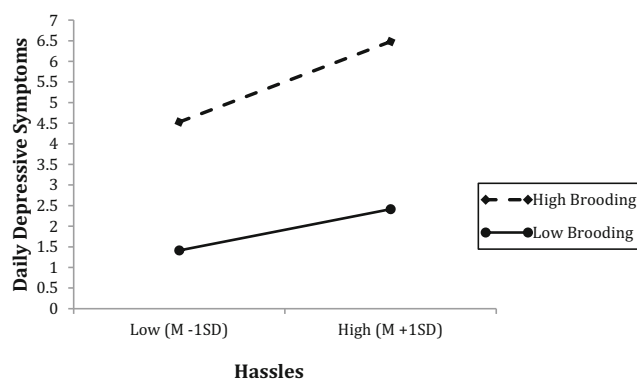


Fig. 1 Interaction between daily hassles and brooding predicting daily depressive symptoms

Response to Positive Affect

Dampening We next examined the effect of dampening on the association between daily uplifts and daily depressive symptoms. A similar model was constructed, with main effects of dampening and uplifts entered along with their interaction and time, with self-reported daily depressive symptoms as the outcome. Main effects were significant for both dampening ($b = 1.01$, $SE = .23$, $t(115.87) = 4.34$, $p < .001$) and uplifts ($b = -.10$, $SE = .02$, $t(125.28) = -4.24$, $p < .001$) in predicting daily depressive symptoms. The interaction between dampening and uplifts was significant ($b = .08$, $SE = .02$, $t(285.60) = 3.49$, $p = .001$). We subsequently decomposed the interaction, revealing results in the expected direction. Uplifts significantly predicted decreased depressive symptoms on days when dampening was low ($b = -.15$, $SE = .03$, $t(185.19) = -5.32$, $p < .001$), but not on days when dampening was high ($b = -.05$, $SE = .03$, $t(163.09) = -1.90$, $p = .059$) (Fig. 2).

We next examined PA as an outcome, entering the main effect of daily dampening and uplifts, as well as their interaction, along with time. Random effects for daily dampening were nonsignificant and subsequently dropped

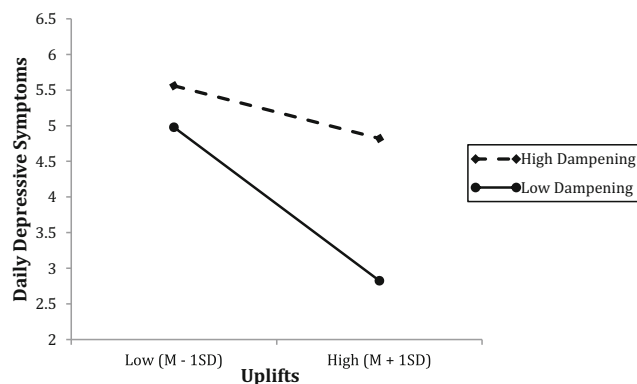


Fig. 2 Interaction between daily uplifts and dampening predicting daily depressive symptoms

from the model. In the resulting model, main effects were non-significant for dampening ($b = -.25$, $SE = .27$, $t(1677.53) = -.91$, $p = .362$) but significant for uplifts ($b = .45$, $SE = .04$, $t(146.19) = 11.69$, $p < .001$). The interaction term was significant ($b = -.10$, $SE = .03$, $t(1008.21) = -3.13$, $p = .002$). Consistent with hypotheses, simple slope tests revealed that increased uplifts were more strongly associated with PA on days when dampening was low ($b = .52$, $SE = .05$, $t(234.77) = 11.34$, $p = .002$) than on days when dampening was high ($b = .39$, $SE = .04$, $t(173.33) = 9.24$, $p < .001$).

Positive Rumination We examined the effect of daily positive rumination on daily PA and depressive symptoms and found it was associated negatively with daily depressive symptoms ($b = -1.59$, $SE = .22$, $t(128.79) = -7.36$, $p < .001$) and positively with PA ($b = 5.40$, $SE = .22$, $t(1677.92) = 24.64$, $p < .001$). We then tested whether either of these effects was qualified by an interaction effect with daily uplifts by evaluating a model that included the main effects of daily positive rumination, uplifts, and their interaction term. We first examined depressive symptoms as an outcome and found that the interaction term was significant ($b = .08$, $SE = .02$, $t(432.56) = 3.71$, $p < .001$), as was the main effect for daily positive rumination ($b = -1.53$, $SE = .21$, $t(125.34) = -7.25$, $p < .001$) but not uplifts ($b = -.03$, $SE = .02$, $t(133.77) = -1.66$, $p = .100$). Decomposing the interaction effect revealed that, contrary to expectations, on days when positive rumination was *low* ($M - 1 SD$), *increased* uplifts were associated with *decreased* depressive symptoms ($b = -.09$, $SE = .03$, $t(241.67) = -3.40$, $p = .001$), and in contrast, on days when positive rumination was *high* ($M + 1 SD$), uplifts were not associated with changes in depressive symptoms ($b = .02$, $SE = .02$, $t(169.56) = .95$, $p = .342$). Visual inspection of this interaction, as shown in Fig. 3a, suggested that an alternative decomposition, in which level of daily uplifting events is treated as the moderating variable instead of positive rumination, may provide more readily interpretable results. As such, we decomposed the interaction by level of uplifts and found that, as shown in Fig. 3b, on days when uplifts were *greater*, positive rumination was *less* strongly associated with decreased depressive symptoms ($b = -.97$, $SE = .26$, $t(191.93) = -3.78$, $p < .001$) than on days when uplifts were *lower* ($b = -2.09$, $SE = .26$, $t(203.91) = -8.02$, $p < .001$). That is, although positive rumination was protective against depressive symptoms at all levels of uplifts, the link between positive rumination and decreases in depressive symptoms appeared to intensify on days when *fewer* uplifts occur.

Finally, looking at daily PA as an outcome, the interaction between positive rumination and uplifts was significant ($b = -.08$, $SE = .03$, $t(447.76) = -2.76$, $p = .006$). Decomposing the interaction resulted in a similar pattern as

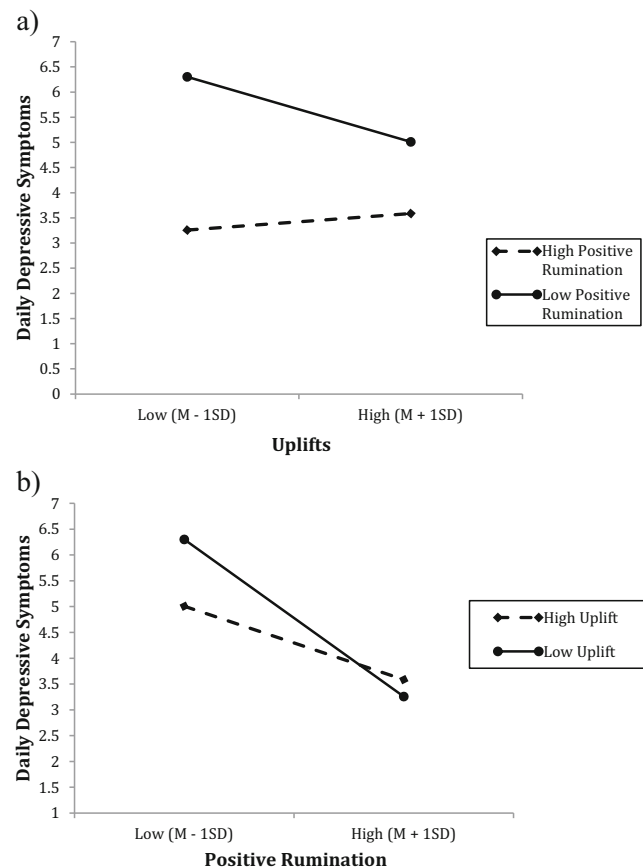


Fig. 3 Interaction between daily uplifts and positive rumination predicting daily depressive symptoms, conceptualized as (a) positive rumination as the moderator of the association between uplifts and depressive symptoms, and (b) uplifts as the moderator of the association between positive rumination and depressive symptoms

those for depressive symptoms, with uplifts more strongly associated with increased PA on days when positive rumination was low ($b = .35$, $SE = .04$, $t(256.43) = 8.18$, $p < .001$) than on days when positive rumination was high ($b = .22$, $SE = .04$, $t(191.52) = 5.41$, $p < .001$). Decomposing the interaction by level of uplifts suggested that on days when uplifts were fewer, positive rumination was more strongly associated with PA ($b = 5.52$, $SE = .38$, $t(215.36) = 14.35$, $p < .001$) than on days when uplifts were greater ($b = 4.24$, $SE = .38$, $t(211.63) = 11.16$, $p < .001$).

Discussion

Researchers have increasingly championed the importance of conducting empirical studies on daily positive events and affective processes (Bolger et al. 2003; Gable and Reis 2010; Nezlek and Gable 2001; Starr and Hershenberg 2017). In particular, examining how individuals respond to positive mood when daily positive experiences take place is critical to enhancing our understanding of emotional trajectories in depression.

Our study is one of the first to examine the association between depressive symptoms and ruminative responses to positive and negative mood in a naturalistic context. Our findings suggest that rumination in response to both negative and positive mood plays a significant role in individuals' daily mood fluctuations, and that they do so in part by modifying the degree to which negative and positive events influence mood.

Depressive Rumination in Daily Life

Consistent with previous research, results suggest that daily depressive rumination was associated with increased depressive symptoms (McIntosh et al. 2010; Starr 2015). In particular, higher levels of brooding appeared to strengthen the relationship between negative events and depressive symptoms, supporting brooding as a moderator between daily experiences and depression. Our findings contribute to this literature by suggesting that, in addition to experiencing a greater number of stressful events, brooding may exacerbate the effect of negative events on same-day depressive symptoms for individuals higher in depressive symptoms. Previous research has supported brooding in response to stress as a vulnerability factor for depression, consistent with a diathesis-stress model (Ciesla et al. 2011; Lo et al. 2008; Skitch and Abela 2008). Our study extends these findings by examining day-level processes and suggests that brooding influences daily mood in interaction with environmental contributors.

Positive Rumination in Daily Life

As one of the first investigations into dampening and positive rumination in daily life, our study reveals several intriguing patterns with important implications for the burgeoning literature on responses to PA. First, the present data suggest that depressive symptoms are associated with increased dampening and decreased positive rumination. Our study is one of the first to examine the interaction between daily positive events and maladaptive responses to PA in influencing daily depressive symptoms (Bijttebier et al. 2012; Carl et al. 2014; Nelis et al. 2016). These results raise a perplexing question: why would depressed individuals dampen their positive mood? Similar to depressive rumination, which has been conceptualized as serving an avoidance function by increasing focus on emotional content rather than active problem-solving (Cribb et al. 2006; Moulds et al. 2007), dampening behaviors may serve a similar function of decreasing positive mood (Beblo et al. 2012; Edge et al. 2013). In addition, individuals experiencing greater depressive symptoms may use dampening strategies because their positive mood conflicts with their negative worldview and self-image, leading to a cognitively dissonant state. The attempts at dampening may help resolve this cognitively dissatisfying state, although

likely at the expense of their affective satisfaction (Giesler et al. 1996; Kwang and Swann 2010; Orth et al. 2008).

Consistent with hypotheses, on days when dampening was high, uplifting events were less closely linked to positive mood, suggesting this type of response to PA may serve to disrupt beneficial emotional aspects of positive events. Further, dampening responses moderated the relationship between uplifts and depressive symptoms. Specifically, uplifts were more strongly associated with decreases in depressive symptoms when dampening responses were low. These results expand upon previous research showing broad associations between baseline levels of depression and trait-level dampening and down-regulation of positive emotions (Carl et al. 2014; Feldman et al. 2008) by delineating day-level processes. Growing research suggests that depression is associated with deficits in reward processing (Gotlib et al. 2010; Pizzagalli et al. 2008; Whitton et al. 2015). Specifically, Baskin-Sommers and Foti (2015) have proposed a profile for depression that is characterized by deficits in “liking”—that is, blunted reactivity and decreased perceived pleasure to rewards. It is possible that dampening plays a role in these reward processes in depression, by reducing the extent to which positive affective experiences are rewarding and have the potential to bolster mood. Additionally, some evidence suggests that individuals who are depressed exhibit a worsening of sad mood following recall of positive memories (Joormann et al. 2007). It may be that dampening plays a role in this process, by decreasing positive mood associated with recalled retroactive experiences as well as current ones. Further prospective research is needed to examine the relationship between dampening in response to PA and other cognitive-affective processes in depression.

Our findings examining the interactive effects of uplifts and positive rumination were somewhat counterintuitive. Although positive rumination is generally associated with decreases in depressive symptoms, our results seem to suggest that positive rumination is linked to *decreased* positive event reactivity. However, further probing of this interaction provided more readily interpretable results by treating uplifts, rather than positive rumination, as the moderating variable in simple slope tests. Specifically, positive rumination appeared to have a much weaker relationship to depressed mood on days when level of uplifts was *high*. In stark contrast, on comparatively *low* uplift days, positive rumination appeared to protect against a relative increase in depressed mood. Similarly, positive rumination was more strongly associated with increases in PA on days when level of uplifts was lower. Our results suggest that positive rumination may be particularly critical on days when people experience fewer positive events in order to sustain positive mood and protect against depressive symptoms. In contrast, on days when uplifts were high, the uplifts themselves may be sufficient for buffering against depressive

symptoms, making positive rumination less crucial for the enhancement or maintenance of positive mood states.

Our results build on previous work examining positive mood outcomes in normative samples that suggest a relationship between recollections of daily savoring behavior and of positive mood following positive daily events (Gentzler et al. 2010, 2014; Jose et al. 2012; Wood et al. 2003). To our knowledge, our study was the first to disentangle the interactive effects between daily events and positive rumination on daily mood. Positive rumination may be protective against depressive symptoms, particularly on days when fewer positive events occur. In addition to experiencing greater negative events as compared to non-depressed individuals, individuals who are depressed have also been shown to endorse fewer positive events and may anticipate fewer positive experiences compared to non-depressed controls (Gard et al. 2006; Muris and van der Heiden 2006). It is possible that positive rumination is particularly beneficial for individuals with depression. Future research should more deeply explore the role of positive rumination in depression within clinical populations.

Our findings have important clinical implications. In a behavioral activation framework, depressed individuals are encouraged to spend time engaging in rewarding activities to improve depressive symptoms (Jacobson et al. 2001). Our findings suggest that dampening has the potential to short-circuit the mood brightening benefits of behavioral activation, and therefore increasing adaptive positive emotion regulation is also critical in promoting positive mood and decreasing depressive symptoms. As individuals who are depressed are more likely to experience more negative than positive events (Peeters et al. 2003), interventions aimed at increasing the use of positive rumination may also be effective in ameliorating depressive symptoms, particularly when positive experiences are sparse. Some evidence does show that interventions that increase use of strategies to enhance PA may reduce depressive symptoms, although effect sizes are generally small (Bolier et al. 2013; Hurley and Kwon 2012). Our results suggest that how an individual responds to experiencing positive mood plays a crucial role in influencing same-day individual fluctuations in mood. Further studies that disentangle the potentially complex relationship between positive rumination behavior and mood may clarify whether maladaptive positive emotion regulation constitute a potentially depressogenic pathway.

A Transdiagnostic Conceptualization of Ruminative Cognitive Style

Researchers are increasingly conceptualizing negative repetitive thinking as a transdiagnostic risk factor across multiple disorders including anxiety and eating disorders, with unique effects above and beyond a negative cognitive style (Harvey 2004; Nolen-Hoeksema et al. 2008). Such perseverative

negative thought patterns have been suggested to impact emotional disorders by interfering with effective problem-solving and disrupting autobiographical memory (Raes et al. 2003, 2005; Watkins and Baracaia 2002). For example, dampening has been found to correlate with multiple anxiety disorders in an undergraduate sample (Eisner et al. 2009), and may promote continued engagement in anxious thoughts. Dampening has also been found to mediate the relationship between high behavioral approach system sensitivity and non-suicidal self-injurious behavior (Burke et al. 2015). It is therefore likely that certain forms of repetitive ruminative focus on positive emotions may similarly act as a risk factor across multiple disorders. Future research should clarify whether dampening similarly disrupts problem solving and formation of positive memories. Additionally, although our findings suggest that positive rumination may be protective against depressive symptoms, excessive application of positive rumination strategies may be detrimental. For example, individuals with bipolar disorder exhibit repetitive positive thinking that may contribute to the maintenance of mania (Gruber et al. 2011; Johnson et al. 2008). Further studies should examine factors that potentially moderate or mediate the influence of positive rumination on mood. Our findings provide preliminary support for a diathesis-positive contingency model of depression, in which responses to PA can contribute to either increased risk (in the case of dampening) or decreased risk (in the case of positive rumination). Overall, our results add to the growing evidence that perseverative thinking about emotional responses to daily events plays an important role in psychopathology.

Limitations and Future Directions

Our findings should be considered in context of several study limitations. First, the disproportionately female composition of our sample prevented us from testing gender as a moderator. Some evidence suggests that gender may play a role in influencing choice of positive emotion regulation strategies, with girls more likely to endorse utilizing dampening responses as compared to boys (Gentzler et al. 2014). Although controlling for the effects of gender did not alter findings in our study, future studies may benefit from examining potential gender effects in positive emotion regulation. In addition, an undergraduate sample is not reflective of the general population due to age and cohort effects, and the symptoms captured in our sample may not generalize to clinical phenomena. Although we oversampled for depressive symptoms in our sample, further research would benefit from examining these processes in a clinically representative sample. However, it should be noted that examining rumination in subclinical samples provides valuable insight into how these processes contribute to the emergence of depression, before disorders are fully developed,

as subthreshold symptoms are both associated with substantial impairment and predictive of later depressive onset (Judd et al. 1998; Klein et al. 2009). Finally, while use of diaries allows for closer examination of daily processes, it may be that individuals who are more depressed are biased toward recall of certain types of negative events, for example interpersonal events. We chose to consolidate multiple types of positive and negative events in an attempt to capture a broader range of situations that may arise in daily life, but it is possible that individuals differentially respond to different types of events. Evidence suggests that individuals may engage in more minimization of positive events and PA for non-interpersonal events than interpersonal events (Gentzler et al. 2010). As interpersonal events appear to have differential effects in eliciting certain behaviors such as support-seeking as compared to non-interpersonal events (Baker and Berenbaum 2007), further research should explore whether event type affects the relationship between choice of ruminative responses and mood, as well as potential next-day effects.

In the current study, we restricted analyses to concurrent associations between events and mood. Examining lagged effects (e.g., effects of positive rumination on later mood) would have provided temporal data and allowed for closer interpretation of direction of causation. Consequently, we could not rule out alternate hypotheses; for example, it is possible that individuals tend to use more positive rumination strategies because they feel less depressed, and not vice versa. Note, however, that spillover effects of daily hassles and uplifts on next-day mood are atypical in daily diary studies (Bolger et al. 1989; Conway et al. 2014; Starr 2015; Stone et al. 1993; van Eck et al. 1998), likely because the affective consequences of most uplifting experiences tend to fade by the following day. Use of multiple assessments in a single day (e.g., using ecological momentary assessments; Shiffman et al. 2008) may allow for closer examination of direct associations between event and subsequent mood, although studies with shorter intervals have also often failed to capture lasting repercussions of positive experiences on mood (Marco and Suls 1993). True demonstration of causal effects will require complementing this daily diary approach with experimental studies, an important direction for future research that could be modeled on existing rumination induction paradigms (Philippot and Brutoux 2008; Watkins and Brown 2002).

Despite these limitations, the results provide preliminary support for the role of daily ruminative processes in the development and maintenance of depression. Our study extends the literature on depressive rumination and presents one of the first explorations into the constructs of positive rumination and dampening using naturalistic methods in daily life. Studies are needed to test models of depression that incorporate positive emotion regulation and dynamic individual and daily-level processes.

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Compliance with Ethical Standards

Conflict of Interest Y. Irina Li, Lisa R. Starr, and Rachel Hershenberg declare that they have no conflict of interest.

Experiment Participants All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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