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Hooked on a Feeling:
Rumination About Positive and Negative Emotion in Inter-episode Bipolar Disorder

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Abstract

Rumination has been consistently implicated in the onset and maintenance of depression. Less work has examined rumination in the context of bipolar disorder, especially rumination about positive emotion. The present study examined rumination about negative and positive emotion in inter-episode bipolar disorder (BD; $n = 39$) and healthy controls (CTL; $n = 34$). Trait rumination (RPA and RRS), as well as experiential and physiological responses to a rumination induction, was measured. Illness course was also assessed for the BD group. Results indicated that the BD group reported greater trait positive and negative rumination compared to the CTL group, but no group differences emerged during the rumination induction. For the BD group, trait negative and positive rumination, as well as increased cardiovascular arousal (i.e., heart rate), were associated with greater lifetime depression frequency; and trait positive rumination was also associated with greater lifetime mania frequency. These findings suggest that inter-episode BD is associated with greater rumination about positive and negative emotion, which in turn is associated with illness course.

Keywords: bipolar disorder, rumination, emotion regulation, positive emotion

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Emotion regulation refers to the process by which individuals consciously or unconsciously modify their emotions (Gross & Thompson, 2007). Bipolar disorder has been conceptualized as involving difficulties in emotion regulation (Gruber, Eidelman, & Harvey, 2008; Johnson et al., 2007; Phillips & Vieta, 2007). Indeed, the core diagnostic criterion for bipolar I disorder (BD) involves disrupted affective functioning, typically including periods of abnormally and persistently elevated mood (i.e., hypomania/mania) (American Psychiatric Association, 2000).

One emotion regulation strategy associated with the onset and maintenance of emotional disorders such as BD is rumination (e.g., Nolen-Hoeksema, 1991). Rumination refers to the repetitive focus on the content, causes, and consequences of one's affective state (Lyubomirsky & Nolen-Hoeksema, 1995). This typically involves adopting a first-person perspective that leads an individual to relive the emotion (e.g., Kross, Ayduk & Mischel, 2005). Research has primarily focused on rumination when in a low mood, referred to as 'rumination about negative emotion.' A well-replicated finding is greater rumination about negative emotion is associated with the onset and recurrence of depression (e.g., Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Findings also suggest that persons with BD endorse using more rumination about negative emotion than healthy controls (Thomas, Knowles, Tai, & Bentall, 2007) and report comparable levels to those with unipolar depression (Johnson, McKenzie, & McMurrich, 2008).

Fewer studies have investigated how individuals think about the causes and consequences of *positive* feelings when in a high mood, referred to here as 'rumination about positive

emotion.' In parallel with rumination about negative emotion, two types of rumination about positive emotion have been conceptualized that would amplify the positive emotions: focusing on the affective sensations (emotion-focused) versus focusing on the positive meaning of the event and for one's confidence and sense of self (self-focused); one type has been conceptualized that dampens positive mood (dampening) (Feldman et al., 2008). Although both self- and emotion-focused rumination types share commonalities with savoring insofar as they both serve to amplify positive emotions, they are distinct. Savoring is a passive process focused on low arousal positive emotions and external conditions, and associated with beneficial health outcomes (Bryant, 2003; Wood, Heimpel, & Michela, 2003). By contrast, rumination about positive emotion is a more active process, often focused on internal sensations and with high-arousal positive emotions, and associated with maladaptive health outcomes (Feldman et al., 2008). Theories regarding cognitive styles in BD suggest that while depressed BD individuals engage in rumination about negative emotion similar to unipolar depression, they also engage in opposing (e.g., overly positive) cognitions during periods of remission that differentiates BD from unipolar depression (Johnson et al., 2008). Rumination about positive emotion is also correlated with increased hypomania in college samples (Feldman et al., 2008; Raes et al., 2009). Another study found that heightened positive emotion in a ruminative compared to reflective (i.e., third-person perspective) induction in BD compared to healthy controls (Gruber, Harvey, & Johnson, 2009).

The present study had the dual goals of clarifying the role of rumination about positive emotion in BD and extending previous research by examining whether it is associated with illness course. The first hypothesis was that BD would be associated with greater positive and negative trait rumination compared to controls, replicating prior research (Johnson et al., 2008;

Thomas et al., 2007). For our second hypothesis, we measured emotional responses to a rumination induction and to assess whether rumination could be observed outside of mood episodes in an inter-episode BD group. We predicted that BD would exhibit greater positive emotion reactivity compared to the control group, based on prior work indicating that BD is associated with greater positive emotional responses across a variety of stimuli (cf. Gruber, in press). The third hypothesis was that rumination about negative emotion would be associated with a greater lifetime depression frequency) and rumination about positive emotion would be associated with greater lifetime mania frequency in BD. This was based on previous work reporting associations between trait rumination about positive and negative emotion and symptom severity in BD (e.g., Johnson et al., 2008).

Method

Participants

Participants were 39 persons diagnosed with bipolar I disorder (BD; 71% female, 70% Caucasian) and 34 healthy controls (CTL; 66% female, 60% Caucasian) who were fluent in English between 18 and 63 years of age (M = 42.50 (±13.79) for BD group; M = 38.20 (±11.12) for CTL group) recruited using online advertisements. Exclusion criteria included history of head trauma, stroke, neurological disease, autoimmune disorder and arrhythmias, or current alcohol and/or substance abuse in the past 6 months.

Diagnoses were confirmed using the Structured Clinical Interview for DSM-IV (SCID-IV; Spitzer, Williams, Gibbon, & First, 1990). Current inter-episode status was verified using the SCID-IV and cutoff scores on the Clinician-Rated Inventory of Depressive Symptoms (IDS-C ≤ 11; Rush et al., 1996; Trivedi et al., 2004) and the Young Mania Rating Scale (YMRS ≤ 7;

Young et al., 1978).

The average age at onset for the BD group was 19.52 years (±12.07) and average illness duration was 16.20 years (±11.10). The lifetime average number of episodes was 8.65 (±11.71) for hypomania/mania and 9.72 (±10.61) for depression. Psychotropic medications included lithium (*n* = 2), anticonvulsants (*n* = 9) antidepressants (*n* = 13), neuroleptics (*n* = 6), and benzodiazepines (*n* = 4). BD participants were not excluded on the basis of comorbid disorders, but BD was verified as the primary diagnosis (Di Nardo et al., 1993). BD participants had an average of 0.87 (± 1.06) current comorbidities, including panic disorder (*n* = 2) agoraphobia (*n* = 2), social phobia (*n* = 4), specific phobia (*n* = 9), obsessive-compulsive disorder (*n* = 3), post-traumatic stress disorder (*n* = 2), generalized anxiety disorder (*n* = 7), hypochondriasis (*n* = 1), pain disorder (*n* = 1), anorexia (*n* = 1), and binge eating disorder (*n* = 1).

The CTL group did not meet criteria for any current or lifetime Axis I disorder using the SCID-IV. CTL participants also scored below YMRS and IDS-C cut-offs.

Clinical Functioning

Diagnostic Evaluation. Trained psychology doctoral candidates and postdoctoral fellows administered the SCID-IV (Spitzer et al., 1990). Fifteen randomly selected audiotapes were rated by an independent reviewer and ratings matched 100% ($\kappa = 1.00$) of primary diagnoses.

Concurrent symptoms. The Young Mania Rating Scale (YMRS; Young et al., 1978) is an 11-item clinician-rated measure of manic symptoms with scores ranging from 0 to 60. The Inventory of Depressive Symptomatology (IDS-C; Rush et al., 1996) is a 30-item clinician-rated measure of depressive symptoms with scores ranging from 0 to 84. Intra-class correlations for absolute agreement (ICC; Shrout & Fleiss, 1979) between the interviewer and an independent rater were strong for the IDS-C (= 0.98) and YMRS (= 0.99).

Illness course. Illness course (i.e., lifetime frequency of manic and depressive episodes per year) was assessed using the National Institute of Mental Health retrospective Life-Charting Methodology which has been well-validated in BD (NIMH-LCMr; Leverich & Post, 1996).

Measures of Rumination

Rumination about negative emotion. Rumination about negative emotion was assessed using the Ruminative Response Scale (RRS; Nolen-Hoeksema & Morrow, 1991; Treynor, Gonzalez & Nolen-Hoeksema, 2003). The RRS is a 22-item, measure rated on a 1 (almost never respond in this way) to 4 (almost always respond in this way) scale that is used to assess typical responses to feeling sad or down. The RRS has three factor-derived subscales, including Depression-related (e.g., "think about how sad you feel"), Brooding (e.g., "think 'what am I doing to deserve this?'"), and Reflection (e.g., "write down what you are thinking and analyze it"). Good internal consistency was obtained for the total score ($\alpha = 0.94$) and the subscales ($\alpha =$ 0.91, 0.82, 0.91 for Depression-related, Brooding and Reflective subscales, respectively).

Rumination about positive emotion. Rumination about positive emotion was assessed using the Responses to Positive Affect Questionnaire (RPA; Feldman, et al., 2008; Raes et al., 2009). The RPA is a 17-item measure modeled after the RRS, and rated on a 1 (almost never respond in this way) to 4 (almost always respond in this way) scale that is used to assess typical responses to feeling happy or up, including those that would amplify or sustain the emotion state and those that would decrease positive emotion states. The RPA has three factor-derived subscales, including Emotion-focused, (e.g., "think about how happy you feel"), Self-focused (e.g., "think about how proud you are of yourself"), and Dampening (e.g., "remind yourself that these feelings won't last"). Participants are asked to rate each item on a scale of 1 (almost never respond in this way) to 4 (almost always respond in this way). Good internal consistency was

obtained for all subscales (α = 0.83, 0.67, 0.83 for Emotion-focused, Self-focused, and Dampening, respectively).

Emotion response to rumination induction. A multi-method approach was used to measure experiential and physiological responses to a well-validated brief rumination induction (Ayduk & Kross, 2010; Gruber et al. 2009; Kross et al., 2005). Change scores were used to calculate emotional responses by subtracting the baseline from the rumination induction (e.g., Rogosa & Willett, 1983).

Self-reported positive affect (PA) and negative affect (NA) were measured using the 10-item short form of Positive and Negative Affect Schedule (PANAS; MacKinnon et al., 1999). Participants rated a list of 10 emotion-related adjectives on a 1 (very slightly) to 5 (extremely) scale, with scores ranging from 10 to 50. Both PA (average α = 0.85) and NA (average α = 0.84) demonstrated good internal consistency in the present study.

Physiological data were acquired and analyzed with AcqKnowledge v3.9.1 software at 1 kHz using a Biopac multichannel device (MP150-BIOPAC Systems Inc., Goleta, CA). Artifacts and recording errors were corrected offline using linear interpolation. Values ± 3.0 standard deviations were Winsorized (< 1.6% of all data) for the following channels:

Heart Rate (HR) was included as a measure of general cardiovascular activity and measured via ECG recordings obtained with two pre-jelled Ag-AgCl snap disposable vinyl electrodes placed in a modified Lead II configuration. A Biopac ECG100C amplifier using a bandpass filter of 35 Hz and 2.0 Hz was converted to R-wave intervals (interbeat intervals [IBIs]), which were converted to beats per minute.

Respiratory Sinus Arrhythmia (RSA) was derived with a Biopac ECG100C amplifier (described above) and a respiration signal using a respiration belt transducer stretched around the

abdominal region and Biopac's RSP100C respiration module. An RSA index was calculated offline following a well-validated peak-valley method (Grossman, van Beek, & Wientjes, 1990), with higher values in milliseconds reflecting greater parasympathetic activity.

Manipulation check. Two items were included to assess: (1) vividness of recalled memory, and (2) task engagement. Both items were rated on a 1 (not at all) to 7 (a lot) scale.

Procedure

After obtaining informed consent, the SCID, YMRS and IDS-C were administered. Participants were then seated in front of a 17" computer monitor, physiological sensors were attached, and participants completing questionnaires (RRS, RPA, demographic items). Audio instructions and questionnaire administration were presented using computerized software (MediaLab v2006, Atlanta, GA).

At the beginning of the experiment, a resting baseline period (60 s) was acquired. Participants read the following message on the computer: "Please relax and watch the screen for the next minute." After this baseline ended, participants completed the PANAS. Next, participants identified a happy autobiographical event. They were guided through a well-validated rumination induction (e.g. Kross et al., 2005; Gruber et al., 2009). Participants were asked to "Go back to the time and place of the same happy event you recalled earlier and see the scene in your mind's eye. Relive the situation as if it were happening to you all over again. Re-experience the situation as it progresses in your mind's eye. As you continue to relive the happy memory, try to understand the emotion that you experienced as the event unfolded. Why did you have those feelings? What were the underlying causes and reasons?" Participants were given 60 seconds to do this. At the end, participants completed the PANAS and manipulation check items.

Results

Demographic and Clinical Characteristics

BD and CTL participants did not differ with respect to age, gender, ethnicity, or years of education (*p*s > .40). Both groups scored below standardized cutoffs on the YMRS (≤ 7) and IDS-C (≤ 11). However, the BD group scored higher on both measures (YMRS: $M = 2.14$ (± 2.11); IDS-C: $M = 6.43$ (± 3.58) compared to the CTL group (YMRS: $M = 2.14$ (±2.11); IDS-C: $M = 2.14$ (±2.11), (*p*s < .05).

Preliminary Analyses

First, we examined gender as a between-subjects variable for the five emotion variables, and no significant main effects or interactions emerged. Second, we examined the manipulation check items and found no significant group differences in memory vividness ($p = 0.81$) or task engagement ($p = 0.21$). Third, two coders blind to diagnostic status coded brief one-sentence descriptions of the memory provided verbally to the experimenter with strong inter-rater reliability estimates ($\kappa_{mean} = 0.80$, $ICC_{mean} = 0.87$) and found no significant differences in the four categorical codes regarding whether the content included social interaction with others, romantic or sexual interaction, outdoors, or vacation; or three thematic codes rated on a 1 (not at all) to 5 (extremely) scale assessing the degree to which the memory was goal-oriented, self-focused, or other-focused (*p*s > .20). Fourth, there were no significant group differences in any of the emotion variables during the baseline period (see Table 1). Finally, correlations between the trait rumination scales with our emotion variables during the induction did not reveal a consistent pattern of findings (i.e., only one of 35 correlations reached significance which no longer held after a Bonferroni adjusted p-value of .001 was applied).

Group Differences in Trait and State Rumination

The BD group reported greater scores on the RRS total score and three RRS subscales

compared to the CTL group. The BD group also reported greater scores on the RPA Self-focused and Dampening subscales compared to the CTL group. Parallel results were obtained when current symptoms were covaried (Table 1).

For the rumination induction, four analyses of variance (ANOVAs) were conducted for each emotion variable (PA, NA, HR, RSA) following convention (e.g., Mauss et al., 2005; Rottenberg et al., 2005). A Greenhouse-Geisser correction was used when assumptions for sphericity were not met and adjusted *F* and *p* values (two-tailed) are reported. As evident in Table 1, the BD and CTL group did not differ in emotion response during the rumination induction ($ps > .05$)[1]. Parallel results emerged when symptoms were covaried.

Associations Between Illness Course and Rumination in BD

Correlations between rumination variables and illness course for the BD group were conducted. As evident in Table 2, all three RPA subscales were associated with greater mania frequency. All RRS subscales scales and two RPA subscales (i.e., emotion-focus, self-focus) were associated with greater depression frequency. Increased cardiovascular arousal (i.e., heart rate) was associated with greater depression frequency.

Discussion

BD has been associated with difficulties regulating emotions (Green, Cahill, & Malhi, 2007; Gruber, Eidelman, & Harvey, 2008; Johnson et al., 2007), yet the precise strategies involved are less clear. The present study examined whether individuals with BD differed from controls in trait-like responses to positive and negative emotions as well as emotional responses to a state rumination induction. Associations between rumination about positive and negative emotion with illness course were examined to ascertain potential mechanisms involved in the maintenance of BD.

The first hypothesis was that BD would be associated with greater rumination associated with amplifying positive and negative emotions compared to controls. Consistent with this prediction, the BD group reported greater trait rumination about positive (RPA) and negative (RRS) emotion compared to the CTL group, replicating prior work (Feldman et al., 2008; Johnson et al., 2007; Johnson et al., 2008; Thomas et al., 2007) rumination. For RPA, this involved greater amplification (e.g., self-focused subscale) dampening (e.g., dampening subscales) of positive emotion, whereas for RRS it involved greater amplification of negative emotion across all subscales. It might be that those with BD use more emotion regulation strategies than do those without mood disorders, perhaps because of their frequently intense mood experiences. The cognitive model of BD (Mansell et al., 2007) proposes that the use of amplification versus dampening strategies largely depends on one's appraisals of changes in one's internal or external state. Additional work confirms the relevance the importance of how internal mood states are appraised in the etiology of BD (Jones, Mansell, & Waller, 2006). It is interesting to note that some of these strategies might even be incompatible or conflicting in their direction – such as amplifying and dampening positive emotion -- and that use may depend one's appraisal of the activating event.

One concern with the current findings is that no group differences in experiential or physiological responses emerged during the rumination induction, contrary to the second hypothesis. Responses to the rumination induction also did not correlate with the RPA and RRS scales. There are several potential interpretations for the lack of group differences in emotion response. First, the time limit imposed on the rumination induction procedure (i.e., 60 seconds) may not have been sufficiently long to elicit group differences, which likely occur over a longer duration or repetitive successions of ruminative thoughts. Other researchers have used

procedures designed to responses to moods rather than emotions, and accordingly, longer time periods (e.g., Nolen-Hoeksema et al., 2008). Second, it is likely that subtle psychophysiological parameters may be less susceptible to potential demand characteristics or may not have been sufficiently activated during a pleasant (versus unpleasant) rumination induction, which is relatively novel.

Our third hypothesis was that greater rumination about negative and positive emotion would be correlated with a more severe illness course in the BD group. Consistent with this prediction, RRS was associated with greater depression, but not mania, frequency. The RPA subscales focused on amplifying positive mood (e.g., emotion- and self-focus**)** were associated with greater depression and mania frequency, consistent with prior work (Feldman et al., 2008; Nolen-Hoeksema et al., 2008). Although rumination may signal underlying emotion dysregulation that precipitates symptom exacerbation, it is also possible that those with more difficult symptom experiences adopt a broader range of emotion regulation strategies. Future work is needed to tease apart the direction of effects.

After the rumination induction, increases in cardiovascular arousal were associated with greater depression frequency. This study is one of the first to suggest that heightened cardiovascular arousal (i.e., HR) is associated with depressive illness course BD. In sum, although both groups did not differ in the magnitude of emotion response to the rumination induction, depression frequency was associated with emotional responding during a rumination induction. Future work is needed to disentangle mechanisms underlying the observed associations.

Limitations and Future Directions

Findings from the present study should be interpreted within the confines of several limitations. For trait rumination, findings were based upon self-reported assessments of the tendency to ruminate. In disorders such as BD with known biases in emotion-based memory (Mansell & Lam, 2004) the accuracy of these estimates may be influenced by current mood state. Second, the rumination induction was based upon a short instructional period in response to a memory of a past emotion event. Although this brief experimental interval is an acceptable and valid index of physiological measures such as RSA (Berntson et al., 1997), longer time duration is ideal in future studies. Third, we did not assess other potential strategies participants may have engaged in during the induction, calling for future work to employ narrative or other open-ended response formats. Fourth, we did not assess the related construct of savoring, so it will be important to isolate mechanisms leading to divergent health outcomes associated with savoring versus rumination about positive emotion. Fifth, strategies employed in response to positive or negative emotions may depend on one's appraisals of emotion's activating event (Mansell et al., 2007), so assessment of appraisals in future work is warranted. Future investigations of rumination in BD may benefit from the inclusion of measures of appraisal. Finally, given the possible confound of psychotropic medication, future studies with random assignment to different medication classes are warranted.

In conclusion, this study represents a next step towards understanding emotion regulation in BD by examining ruminative responses to positive and negative emotions. The results suggest that individuals with BD differ in the frequency in which they ruminate but not in the amplitude of emotional response during a rumination induction. Importantly, both trait rumination and emotional responses to momentary rumination inductions are associated with illness course. Caution is warranted, however, in that parallel group differences were not observed with the

experimental manipulation of rumination. Prospective studies are needed to test the extent to which ruminative processing of emotional material contributes to the development of symptoms.

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Footnote

[1] Although not a central variable of interest, given its relevance in computing our RSA measure we examined potential between-group differences in respiratory rate and none emerged (ps > .30).

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Table 1

Means (and Standard Deviations) for Rumination Variables by Diagnostic Group.

	Group	
	BD (n = 39)	CTL (n = 34)
Trait Rumination		
RRS		
Depression-Related	2.65 (0.70)*	1.96 (0.64)*
Brooding	2.99 (0.67)*	2.07 (0.76)*
Reflection	2.35 (0.68)*	1.81 (0.56)*
Total Score	2.66 (0.64)*	1.95 (0.62)*
RPA		
Emotion-Focus	2.79 (0.67)	2.55 (0.59)
Self-Focus	2.50 (0.65)*	2.06 (0.55)*
Dampening	1.69 (0.47)*	1.43 (0.44)*
State Rumination - Reactivity		
PA	3.52 (4.11)	2.15 (3.05)
NA	-0.19 (2.59)	0.04 (1.43)
HR	1.93 (8.64)	1.27 (3.52)
RSA	12.26 (123.15)	-30.92 (192.05)
State Rumination - Baseline		
PA	10.93 (3.37)	11.33 (4.10)
NA	6.22 (2.15)	5.81 (1.27)
HR	74.63 (11.86)	72.91 (11.62)
RSA	152.17 (188.80)	272.49 (254.47)

Note: BD = Bipolar disorder; CTL = Healthy control; RRS = Ruminative response scale; RPA = Responses to positive affect; PA = Positive affect; NA = Negative affect; HR = Heart rate; RSA = Respiratory sinus arrhythmia.

*$p < .05$

Table 2
Bivariate Correlations between Illness Course and Rumination in the BD Group

	Frequency manic episodes (per year)	Frequency depressive episodes (per year)
Trait Rumination		
RRS		
Depression-Related	0.36	0.48*
Brooding	0.27	0.44*
Reflection	0.23	0.43*
Total Score	0.33	0.47*
RPA		
Emotion-Focus	0.47*	0.49*
Self-Focus	0.48*	0.38*
Dampening	0.47*	0.17
Rumination Induction		
PA	0.16	0.34
NA	0.14	0.00
HR	0.14	0.52*
RSA	0.05	-0.04

Note: BD = Bipolar disorder; RRS = Ruminative response scale; RPA = Responses to positive affect; PA = Positive affect; NA = Negative affect; HR = Heart rate; RSA = Respiratory sinus arrhythmia.

*$p < .05$