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Authors

Johnson, Sheri L
Tharp, Jordan A
Peckham, Andrew D
[et al.](#)

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Emotion in Bipolar I Disorder: Implications for Functional and Symptom Outcomes

Sheri L. Johnson, Jordan A. Tharp, Andrew D. Peckham, and Kaja J. McMaster

University of California at Berkeley

Abstract

Despite the centrality of emotion disturbance in neurobiological models of bipolar disorder, the behavioral literature has not yet clearly identified the most central aspects of emotion disturbance in bipolar disorder. Toward this aim, we gathered a battery of emotion-related measures in 67 persons diagnosed with bipolar I disorder as assessed with SCID and a well-matched control group of 58 persons without a history of mood disorders. Those with bipolar disorder were interviewed monthly until they achieved remission, and then tested on emotion measures. A subset of 36 participants with bipolar disorder completed symptom severity interviews at 12-month follow-up. Factor analyses indicated four emotion factor scores: Negative Emotion, Positive Emotion, Reappraisal and Suppression. Bivariate analyses suggested that bipolar disorder was tied to a host of emotion disturbances, but multivariate analyses suggested that bipolar disorder was particularly tied to elevations of Negative Emotion. High Negative Emotion, low Positive Emotion, and high Suppression were conjointly related to lower functioning. Reappraisal predicted declines in depression over time for those with bipolar disorder. Findings highlight the importance of considering the overall profile of emotion disturbance in bipolar disorder. Emotion and emotion regulation appear central to a broad range of outcomes in bipolar disorder.

Keywords

emotion; bipolar disorder; mania; well-being; social functioning

Bipolar I disorder (BD) is among the most severe of psychological disorders, with high rates of homelessness, suicide, and hospitalization (Mitchell & Malhi, 2004). In the year after hospitalization for mania, fewer than 35% of people return to the workforce (Goldberg, Harrow, & Grossman, 1995; Strakowski et al., 1998), and as a consequence, the disorder is one of the leading causes of medical disability worldwide (World Health Organization, 2012). Bipolar I disorder is defined by at least one lifetime episode of mania, but many have co-occurring syndromes that suggest broader difficulties with emotion-related symptoms: about two-thirds will experience major depressive episodes (see Cuellar, Johnson, & Winters, 2005 for review), and similarly, about two-thirds will meet diagnostic criteria for an anxiety disorder during their lifetime (Isaacs, Stainer, Sensky, Moor, & Thompson, 1988). Also consistent with ongoing difficulties with emotion outside of episodes, large-

scale studies suggest that most people with BD continue to experience subsyndromal manic and depressive symptoms between episodes (Judd et al., 2005).

Almost by definition, BD would seem to involve the dysregulation of emotion. In keeping with this idea, people with BD, even during remission, exhibit greater increases in activity in regions involved in emotion processing, such as the amygdala, than do control participants during the processing of emotional stimuli (Chen, Suckling, Lennox, Ooi, & Bullmore, 2011). Neurobiological models place emphasis on emotion dysregulation as a core facet of the disorder (Green, Cahill, & Malhi, 2007; Keener & Phillips, 2007).

Despite influential theory, the profile of emotion disturbance within BD remains a mystery. Findings of several studies have identified emotion reactivity to positive stimuli such as film clips and positive autobiographical memories among those diagnosed with BD (Gruber, Dutra, Eidelman, Johnson, & Harvey, 2011; Gruber, Harvey, & Purcell, 2011; Gruber, Harvey, & Johnson, 2009). One prominent model integrates these findings with a large body of work on at-risk individuals to indicate that heightened positive affectivity may be core to the etiology of BD (Gruber, 2011a). Other findings, however, suggest that this could be part of a broader profile of emotional reactivity, in that researchers have also observed greater reactivity among those with BD to both success and failure experiences (Pavlova, Uher, Dennington, Wright, & Donaldson, 2011; Gruber, Harvey, & Johnson, 2009; Rich et al., 2010).

Other studies, however, have failed to identify significant group differences in reactivity to standardized stimuli. Mixed findings do not appear to be specific to the nature of the paradigm, as null results have been found for group differences in reactivity to interpersonal challenges (Cuellar, Johnson, & Ruggero, 2009), and with both negative (Edge, Lwi, & Johnson, 2015; Ruggero & Johnson, 2006) and positive stimuli (Farmer et al., 2006; Lemaire, Aguillon-Hernandez, Bonnet-Brilhault, Martineau, El-Gagge, 2014). In the face of the mixed findings, recent work has questioned whether laboratory emotion reactivity paradigms are effective for understanding BD (Edge, Lwi & Johnson, 2015), as the mood inductions employed may be limited in intensity for sound ethical reasons and so may not provide the types of real life challenges to mood that might be more effective in demonstrating emotion dyscontrol.

Given limitations in the laboratory studies, experience sampling and daily monitoring paradigms are important for understanding emotion. In studies that have assessed remitted participants, researchers have identified low positive affect (PA; Havermans, Nicolson, Berkhof, & deVries, 2010) and high negative affect (NA; Gruber, Kogan, Mennin, & Murray, 2013; Havermans, et al., 2010) within BD as compared to controls. In contrast, one study identified comparable NA and PA mean levels, but greater variability in NA and PA over time in BD as compared to control participants (Knowles et al., 2007). Summarizing across the somewhat mixed findings, this literature suggests that BD could involve disturbances in mean levels of PA and NA or variability in PA and NA.

The mixed findings across laboratory and experience sampling studies suggest the need to reconsider the nature of emotion difficulties in BD by measuring a broad array of emotion

dimensions. Questionnaire studies provide a way to assess a broader profile of emotion dysregulation by considering the intensity and frequency of different emotion experiences, and multiple questionnaire-based studies are available. Large-scale studies have suggested that even during remission, people with BD tend to endorse high neuroticism (Heerlein, Richter, Gonzales, & Santander, 1998; Solomon et al., 1996), anger (Ballester et al., 2014; Barrett, Mills, & Teesson, 2013), and harm avoidance (Engström, Brändström, Sigvardsson, Cloninger, & Nylander, 2004; Osher, Cloninger, & Belmaker, 1996; Young et al., 1995). These studies highlight the importance of studying NA. In direct contrast, others have reported high positive affectivity among those with remitted BD (Gruber, Harvey, & Johnson, 2009), suggesting the need to consider both valences of emotion. A series of other studies suggest that overall affective lability is elevated in BD compared to controls (Aas, Pederson et al., 2015; Aminoff et al., 2012; Henry et al., 2008). Taken as a whole, the disparate findings from laboratory, experience sampling, and questionnaire studies suggest that BD is potentially associated with dysregulation of both positive and negative affect, as well as elevated affective lability.

Given that emotion intensity and lability have been repeatedly related to emotion regulation in the broader literature (John & Gross, 2004), it is important to consider whether BD is tied to deficits in emotion regulation. At a broad level, researchers have reported that BD is characterized by a lack of confidence and difficulties regulating negative emotions (Gruber, Eidelman, & Harvey, 2008; Gruber, Eidelman, et al., 2011; Johnson, McKenzie et al., 2008; Rowland, Hamilton, Lino et al., 2013; Rowland, Hamilton, Vella et al., 2013; Thomas, Knowles, Tai, & Bentall, 2007; Van der Gucht, Morriss, Lancaster, Kinderman, & Bentall, 2009; Van Rheenen & Rossell, 2014; Van Rheenen, Murray, & Rossell, 2015). More specific analyses suggest that BD relates to frequent use of maladaptive responses to negative emotion as compared to controls, such as suppression (Gruber, Harvey, & Gross, 2012; Gul & Khan, 2014). Those with BD have also been found to report using reappraisal less frequently than controls do (Gul & Khan, 2014; Kanske, Schönfelder, Forneck, & Wessa, 2015; Rowland, Hamilton, Vella, et al., 2013), although null findings have emerged here (Green, Lino, Hwang, Sparks, James, & Mitchell, 2011; Rowland, Hamilton, Lino, et al., 2013). In short, these studies suggest that BD is characterized by maladaptive responses, and potentially diminished use of adaptive responses, to negative emotion.

Other findings indicate that people with BD tend to endorse elevated efforts to down-regulate positive affect (Edge et al., 2013; Gruber, Eidelman, Johnson, Smith, & Harvey, 2011; although see Johnson, McKenzie, & McMurrich, 2008). Moreover, in one laboratory study, persons with BD reported making more attempts to regulate emotion in response to both positively and negatively valenced film clips (Gruber, Harvey, & Gross, 2012). Collectively, this literature suggests that elevated attempts to regulate both positive and negative affective states may be characteristic of BD.

Surprisingly, these deficits in emotion regulation among those with BD have been studied separately from research on tendencies toward negative or positive reactivity and affective lability. This is noteworthy given that individuals who experience more intense emotion would be expected to engage in more efforts toward emotion regulation; conversely, intense emotions and affective lability may be perpetuated by failures of emotion regulation.

Therefore, it seems important to identify whether problems with emotion regulation can be disentangled from general tendencies toward emotionality when intensity and regulation facets of emotion disturbance are studied conjointly.

In sum, multiple models remain viable concerning emotion disturbance within BD. A prominent model emphasizes elevations of positive affectivity (Gruber, 2011a; 2011b), but other research suggests that BD may best be characterized by negative emotionality. Other findings suggest that overall tendencies toward affective lability (of either valence) are core to the disorder. A growing body of research places emphasis on problems in emotion regulation (studied in isolation from emotion tendencies) as core to the disorder. Differentiating whether BD is most profoundly related to heightened emotion intensity of one or both poles, to affective lability, or to emotion regulation problems requires conjoint assessment of these facets of emotion disturbance. A profile approach is needed given the conceptual and statistical overlap among these constructs.

The first aim of this study was to examine the profile of emotion disturbance among those with remitted bipolar I disorder as compared to a well-matched control group. To do so, we gathered data using a broad array of measures that have been well-validated in BD and cover negative emotionality, positive emotionality, affective lability, and maladaptive and adaptive emotion regulation strategies. We conducted factor analyses to ensure that we were able to adequately distinguish the dimensions of emotion that have all too often been studied independently within this literature. Although the literature provides evidence that each of these dimensions is likely to be impaired within BD, our specific focus was on determining which facets of emotionality might be more specifically and uniquely related to diagnostic status. We hypothesized that experiences of intense and frequent emotions, of both positive and negative valence, would be most closely tied to diagnostic status, and that problems with emotion regulation would not add unique variance after considering these more core aspects of emotional experience.

Given that the mixed findings in this field are consistent with heterogeneity in the emotion profile of those with BD, the second aim of this study was to consider how emotion dimensions relate to functional and symptom outcomes within BD. Basic research suggests that emotion regulation skills are highly important for emotional and social outcomes (John & Gross, 2004), and this finding has been observed in BD as well (Van Rheenen & Rossell, 2014). Researchers have also found that within BD, maladaptive coping with negative emotions is related to more severe depressive symptoms (Green, Lino, Hwang, et al., 2011) or symptom severity more broadly (Gilbert, Nolen-Hoeksema, & Gruber, 2013). As with the literature on the nature of emotion disturbance in BD, however, researchers have not studied a full range of emotion dimensions in relation to outcomes. Thus, our goal was to test a broader array of emotion dimensions in relation to outcomes of symptom severity and functioning within BD. We also examined whether the effects of emotion dimensions on functioning that were observed within BD were comparable to the effects observed within controls. Participants completed measures of symptom severity and functioning at baseline, and a subset of the BD group completed symptom severity assessments at a one-year follow-up. Given a growing literature suggesting that attitudes toward emotion regulation may be important aspects of the emotion landscape (Gyurak, Gross, & Etkin, 2011), we also

included a measure of implicit attitudes toward emotion regulation, a facet of emotion that has not yet been studied within BD.

Method

Study procedures were approved by the university Institutional Review Board. Data for this study were gathered as part of a broader study (Muhtadie & Johnson, 2015).

Participants

Participants were 67 individuals with diagnosed bipolar I disorder and 58 individuals with no lifetime history of mood disorder (bipolar I or II, cyclothymic, major depressive, or dysthymic disorder) between the ages of 18 and 60 and fluent in English. Participants were recruited using online advertisement, flyers, and referrals through providers and support groups. To carefully match control and bipolar groups, flyers were distributed in unemployment centers as well. Participants were paid for participation.

Diagnoses were assessed with the Structured Clinical Interview for DSM-IV (First, Spitzer, Gibbon, & Williams, 1996). Exclusion criteria included a diagnosis of substance abuse or dependence (including alcohol) in the past year, primary psychotic disorder, a general medical condition of the central nervous system (e.g., Alzheimer's or Parkinson's disease), severe head trauma, developmental or learning disabilities that could interfere with the ability to complete informed consent or study measures. Two participants were excluded for incorrectly responding to more than five out of ten "catch" items included in the battery (e.g., "please answer this question with '3.'").

Measures

Participants completed diagnostic interviews, medication interviews, interview and self-report measures of symptom severity, measures of negative and positive emotion experience and regulation, and assessments of well-being and quality of life.

Diagnostic interview—The Structured Clinical Interview for DSM-IV (SCID) is a widely used, well-validated interview for psychiatric diagnosis (First et al., 1996). Clinical psychology graduate students and postdoctoral fellows completed didactic and interactive training before administering the SCID. Inter-rater agreement of our team, as assessed using ten randomly selected audiotaped interviews, was excellent (ICCs = .88 to .89 for current manic episode, lifetime manic episode, lifetime major depressive episode, and .99 for current major depressive episode).

Medication coding—Medication regimens and adherence were assessed using the Somatotherapy Index, a structured interview and coding system specific to BD (Bauer et al., 1997). Within this system, doses for antidepressants were converted to the equivalent dose for imipramine, and those for atypical neuroleptic doses were converted to the equivalent dose for risperidone (Bollini, Pampallona, Tibaldi, Kupelnick, & Munizza, 1999). Forty-nine individuals were taking medications, with 30 on multiple medications (23 were taking atypical antipsychotics, 21 taking antidepressants, 20 taking lithium, 15 taking lamotrigine, and 12 taking anticonvulsants).

Young Mania Rating Scale (YMRS)—The YMRS is an 11-item interview designed to assess current mania severity. Scores range from 0-60 (Young et al., 1978). The YMRS has been validated against other mania rating scales and clinician ratings (Gruber, Harvey, & Johnson, 2009; Young et al., 1978). In the current sample, internal consistency was adequate ($\alpha = .82$), and inter-rater agreement, as assessed using four randomly selected tapes, was high ($ICC > .99$).

Modified Hamilton Rating Scale for Depression (MHRSD)—The MHRSD is a 17-item semi-structured interview to assess current depression severity (Miller et al., 1985). Scores range from 0 to 52. The MHRSD is sensitive to changes in depression severity (Keitner, Ryan, Miller, & Norman, 1992) and has been validated against other measures of depression, including the SCID, in BD samples (Johnson et al., 2000; 2008). In the current study, inter-rater agreement was high ($ICC = .99$ for four randomly selected tapes) and internal consistency was adequate ($\alpha = .84$). Training for the MHRSD and YMRS mirrored procedures employed for the SCID interview, and reliability meetings were held intermittently throughout the study to prevent rater drift.

Altman Self-Rating Mania (ASRM)—The ASRM is a 5-item self-report measure of manic symptom severity (Altman, Hedeker, Peterson, & Davis, 1997). Items assess happiness, self-confidence, talkativeness, activity, and decreased sleep using a five-point Likert scale. The ASRM has been validated against clinician ratings of mania severity (Altman, Hedeker, Peterson, & Davis, 2001; Edge et al., 2013). In the current sample, internal consistency was acceptable ($\alpha = .76$).

Beck Depression Inventory-Short Form (BDI-SF)—The BDI-SF is a widely used 13-item self-report measure of depressive symptom severity (Beck & Beck, 1972) that is highly correlated with the original version of the BDI (Love, Grabsch, Clarke, Bloch, & Kissane, 2004), as well as interview-based measures of depression (Luty & O’Gara, 2006), and has strong reliability (Beck, Steer, & Carbin, 1988). The BDI-SF has been validated in BD (Holmes et al., 2011; Johnson & Fulford, 2009). The BDI-SF attained good internal consistency in the current sample ($\alpha = .85$).

Emotion Regulation Questionnaire (ERQ)—The ERQ is a widely used instrument designed to assess how frequently individuals use emotion regulation strategies of reappraisal and suppression (Gross & John, 2003). Reappraisal involves thinking about a potentially emotion-eliciting situation in a way that reduces its emotional impact (six items). Suppression is a response that involves inhibiting emotion-expressive behaviors (four items). The Reappraisal subscale is related to more favorable outcomes for emotion experience, social function, and well-being, whereas Suppression scores are related to unfavorable outcomes in these domains (John & Gross, 2004). The ERQ exhibited high internal reliability in this sample ($\alpha = .90$ and $.76$ for Reappraisal and Suppression, respectively) and has been validated previously in BD (Gruber et al., 2012). Six questions were added to assess Suppression and Reappraisal of the specific emotions of anger, sadness, and anxiety.

Responses to Positive Affect (RPA)—The RPA (Feldman, Joormann, & Johnson, 2008) is a 17-item scale modeled after the Ruminative Responses Scale (Nolen-Hoeksema & Morrow, 1991), with items re-written to capture typical responses to positive emotion states. The RPA includes three factor-analytically derived subscales: the Dampening subscale assesses the tendency to respond to positive affect with thoughts that are likely to reduce these feelings (8 items, alpha in the current study = .85, e.g., “think ‘my streak of luck is going to end’”), the Self-Focused subscale assesses the tendency to respond to positive affect with positive thoughts about one’s self and goals (4 items, alpha = .78, e.g., “think ‘I am achieving everything’”), the Emotion-Focused subscale assesses the tendency to focus on positive affect (5 items, alpha = .81, e.g., “think about how happy you feel”). Responses are rated on Likert scales ranging from 1 = *almost never* to 4 = *almost always*. The RPA shows expected correlations with other mood measures (Feldman, et al., 2008) and has been validated in BD (Edge et al., 2013; Johnson, McKenzie, & McMurrich, 2008).

Bryant Aggression Questionnaire (BAQ)—The BAQ is a 12-item measure that assesses various forms of anger and aggression (Bryant & Smith, 2001). It is based on the 29-item Buss-Perry Aggression questionnaire (Buss & Perry, 1992). In the original validation work, the BAQ showed consistent convergent and discriminant validity with self-report measures of aggression and anger and stable test-retest reliability across five studies (Webster et al., 2014). The BAQ subscales are highly correlated with the Buss-Perry Aggression questionnaire (*r*'s from .87 to .96), and with behavioral measures of aggression, including physical assault, verbal hostility, irritability, resentment, and suspicion (Webster, et al., 2014). BAQ scores have been found to correlate with a measure of risk for BD (Fulford, Johnson, & Carver, 2008). The four subscales are Verbal Aggression, Physical Aggression, Anger, and Hostility (alphas in the current study = .82, .74, .77 and .80, respectively). Each subscale contains 3 items rated on Likert scales ranging from 1 = *extremely uncharacteristic of me* to 5 = *extremely characteristic of me*.

Affect Lability Scale Short Form (ALS-SF)—The ALS-SF is an 18-item self-report measure of affective variability (e.g. “I frequently switch from being able to control my temper very well to not being able to control it very well at all”; Oliver & Simons, 2004). The short form, comprised of items with the highest factor loadings on the 54-item ALS, correlates highly with the original ALS (Harvey, Greenberg, & Serper, 1989), has adequate test-retest reliability (Oliver & Simons, 2004), and has been found to be elevated within BD (Aas et al., 2015). For each item, participants rate the degree to which they shift between mood states using a Likert scale ranging from 1 = *very uncharacteristic* to 4 = *very characteristic*. The three subscales capture shifts from normal mood to anger, between depression and elation, and between anxiety and depression (alphas in the current study = .90, .91 and .91, respectively)

Emotion Regulation Implicit Association Task (ER-IAT)—The ER-IAT is an adaptation of the Implicit Association Test developed to measure the implicit value placed on emotion regulation (Mauss, Evers, Wilhelm, & Gross, 2006). The measure is a categorization task that uses response latencies to index the strength of associations between pairs of concepts (Greenwald, Mcghee, & Schwartz, 1998).

Participants were asked to simultaneously categorize words representing the two target concepts of *emotion regulation* (regulation vs. expression) and *valence* (positive vs. negative words) on a computer screen by using two computer keys to indicate whether each word fits better on the left or right side of the computer screen. For example, participants were asked on some trials to categorize words representing either *emotion regulation* (e.g., controlled, suppressed) or *positive* words (e.g., pleasant, lucky) to the left and words representing the concept *emotion expression* (e.g., expressive, reveal) or *negative* words (e.g., bad, gloom) to the right. Participants were instructed to respond as rapidly as possible without making errors.

The task is comprised of five blocks. Blocks 1, 2, and 4 consist of 20 practice trials each to familiarize the participant with the task. Blocks 3 and 5 are test blocks consisting of 40 trials each. In Block 1, participants practice sorting *emotion regulation* words to either side of the screen. In Block 2, participants practice sorting *valence* words. In Block 3, these tasks are combined and participants categorize emotion regulation words and positive valence words on one side of the screen, and emotion expression words and negative valence words on the other side of the screen. In Block 4 (practice trials) and 5, pairings are switched, and participants are asked to categorize emotion expression words with positive valence words versus emotion regulation words and negative valence words.

Faster associations between emotion regulation and positive items (relative to emotional expression and negative items) are interpreted as an index of the implicit positive evaluation of emotion regulation. That is, a participant who has a positive valuation of emotion regulation will more quickly categorize positive words to the same category as emotion regulation words, but more slowly categorize negative words to the same category as emotion regulation words.

ER-IAT scores are computed using D , a standardized difference score, which has demonstrated good validity, stability, and the greatest resistance against artifacts (Greenwald, Nosek, & Banaji, 2003; Mierke & Klauer, 2003). The ER-IAT D score is derived as the difference between mean response times on the two test blocks, divided by the standard deviation of response times in the two test blocks. An ER-IAT D score of zero indicates equal association between positive and negative items and emotion regulation. Higher scores indicate more positive implicit evaluation of emotion regulation relative to emotion expression.

The ER-IAT has been shown to have a high internal consistency ($\alpha = .84$) and to correlate with self-report measures of emotion regulation (Hopp, Troy, & Mauss, 2011; Mauss et al., 2006). Data was missing for 12 control participants and 18 participants with BD because the task was added after the study began; data was missing for an additional three control participants due to technological difficulties.

Scale of Psychological Well-Being-Short Form (SPWB-SF)—The SPWB-SF is a widely used, 18-item self-report scale designed to measure psychological well-being (Ryff & Keyes, 1995). Sample items include “In general, I feel I am in charge of the situation in which I live” and “When I look at the story of my life, I am pleased with how things have

turned out.” Participants responded to each item using Likert scales (1 = *strongly disagree*, 6 = *strongly agree*). The instrument is comprised of six subscales: Life Purpose, Personal Growth, Positive Relationships with Others, Autonomy, Environmental Mastery, and Self-Acceptance. The SPWB-SF has been shown to correlate positively with measures of happiness and life satisfaction and negatively with measures of depression (Ryff & Keyes, 1995). Subscales on the short form version correlate highly with those on the original form, (r 's = .70 to .89; Ryff & Keyes, 1995).

Brief Quality of Life in Bipolar Disorder (Brief QOL-BD)—The Brief QOL-BD is a 12-item scale index of quality of life within BD that has achieved factor analytic support, strong internal consistency, and large correlations with established quality of life measures (Michalak & Murray, 2010). Whereas the SPWB-SF assesses the individual's subjective sense of achieving core values and fulfilling self-potential, the Brief QOL-BD assesses the individual's satisfaction with several behavioral and interpersonal domains. Participants are asked to respond to each item (e.g., “kept my home tidy,” “been interested in my social relationships”) on a Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. In this sample, internal reliability was good (α = .87).

Procedure

Preliminary screening of potential participants was conducted via phone interviews. Potentially eligible participants were invited to the university to complete written informed consent procedures and a SCID interview. Then, telephone interviews were conducted monthly with the bipolar group until symptoms remitted according to previously validated cut-offs (Chengappa et al., 2003; Thompson et al., 2005) of scores six or lower on the Modified Hamilton Rating Scale for Depression (Miller, Bishop, Norman, & Maddever, 1985) and the Young Mania Rating Scale (Young, Biggs, Ziegler, & Meyer, 1978). Telephone assessments have been shown to be reliable and valid for evaluating symptom severity (Simon, Revicki, & VonKorff, 1993). Remission was verified in the two days before participants returned to the university to complete emotion measures (as well as other measures not described here).

After the in-person sessions, the BD group completed a follow-up assessment at 12-months. That is, 36 participants completed telephone interviews of symptom severity using the MHRSD and YMRS, and were then asked to complete the QOL-BD by self-report. Data was missing for 22 participants at the 12-month follow-up for several reasons: many had moved or no longer had the same phone numbers, one passed away, and one was no longer interested in participating. An additional 5 participants did not complete the QOL-BD self-report forms at follow-up. Participants who did and did not complete the 12-month interview, as well as those who did and did not complete the QOL-BD at 12 months, did not differ in gender, age, years of education, or baseline symptoms ratings (all t 's < 1.50, chi-square < .01, p 's > .30). As shown in the sample characteristics (Table 1), symptom severity levels were slightly elevated at follow-up as compared to baseline. Nonetheless, it is important to note that only 6 persons reported MHRSD symptoms of 10 or higher at follow-up, with only 2 of those reporting symptoms above a score of 17, a traditional threshold for demarcating clinical severity (Miller et al., 1985). Similarly, only 5 participants reported a

score that was within a hypomanic range on the YRMS at follow-up (≥ 12), and none reported symptoms in the manic range (≥ 21 ; Suppes et al., 2005).

Results

Data were missing for less than 2% of self-report emotion measures at baseline. As data appeared to be missing at random, modern imputation methods were applied using the SPSS missing data algorithm, for fully conditional specification method using linear regression imputation. After imputation, 125 cases were available for self-report measures. Alpha was set to .05.

Factor Analysis of Emotion Scales

To examine the structure of self-reported emotion-relevant scales, we conducted an exploratory factor analysis of the emotion-relevant subscale scores (ERQ, RPA, BAQ, and ALS). Factors were extracted using principal component analysis. Oblimin rotation with Kaiser normalization was used to allow for the expected correlations among emotion experience and regulation. Four factors surpassed criteria of an Eigenvalue greater than 1 and Horn's parallel analysis thresholds for Eigenvalues (O'Connor, 2000). BAQ Hostility was omitted from factor scores due to low communality. Together, the four factors accounted for 69% of variance.

As shown by factor loadings (Table 2), Factor 1 *Negative Emotion* includes subscales relevant to both negative emotion and emotional lability, including the BAQ Anger, Physical Aggression, and Verbal Aggression subscales; the ALS Anger, Depression & Elation, and Depression & Anxiety subscales; and the RPA Dampening subscale. Of note, the lability scales and anger scales loaded on the same factor as other negative emotion scales. Factor 2 *Reappraisal* is comprised of ERQ Reappraisal subscales, in general and for Anxiety, Sadness, and Anger. Factor 3 *Suppression* is comprised of ERQ Suppression, in general and for Anxiety, Sadness, and Anger. Factor 4 *Positive Emotion* is comprised of RPA Emotion Focus and RPA Self-Focus subscales, both of which cover tendencies to amplify experiences of positive emotion.

Correlations of the factor scores were modest, $|r|s < .15$, with the exceptions of negative correlations of the Negative Emotion factor score with the Reappraisal factor score ($r(123) = -.24, p = .02$) and with the Positive Emotion factor score ($r(123) = -.20, p = .02$).

Factor Analysis of Quality of Life and Well-Being

Quality of Life (QoL) and Well-being were highly correlated, $r(123) = .55, p < .001$. Parallel factor analyses were conducted to identify the number of separable dimensions of QoL and Well-being subscales. The communality estimate for SPWB Autonomy was low, and so this variable was not included. All other variables loaded on a single factor that accounted for 55.30% of the variance. A factor score was computed using regression weights.

Descriptive Data by Diagnostic Group

Demographic and clinical characteristics of the sample are shown in Table 1. The groups were well matched in that the bipolar and control groups did not differ in age, years of education, gender, current employment, or current manic symptom level. The bipolar group was significantly more likely to have anxiety or past substance use disorder, as well as higher current depressive symptom level than controls.

Analyses of Potential Confounds

Five separate Analyses of Variance were conducted to examine the effects of anxiety diagnoses (SCID), lifetime substance use diagnoses (SCID), and their interaction on the four emotion factor scores and the QoL/Well-being factor scores (with diagnostic status included in the model). These ANOVAs revealed no significant effects of anxiety or substance use. Age was also not significantly correlated with QoL/Well-being or emotion factor scores, all r 's < |.15|. T-tests indicated that emotion factor scores did not differ by gender. Medication scores were only relevant within the bipolar group. Within the bipolar group, Negative Emotion scores were correlated with lower lamotrigine dose, $r(61) = -.27, p = .04$, but no other medication dose scores were significantly correlated with any of the four emotion factor scores. Because lamotrigine dose was not significantly correlated with QoL/Well-being ($r = .17, p = .18$), or with change in mania (YMRS) or depression (MHRSD), controlling for baseline scores (partial r 's < .20), no variables were controlled for as potential confounds in analyses of hypotheses.

Comparison of Emotion Scores by Diagnostic Group

Preliminary analyses describe each emotion subscale by diagnostic group for comparison with the literature, but analyses of hypotheses focus on the emotion factor scores. As shown in Table 3, Negative Emotion and Positive Emotion factor scores were higher in the bipolar group compared to the control group, and Reappraisal was significantly lower. There was a nonsignificant trend toward greater use of Suppression in the bipolar as compared to the control group. Groups did not differ significantly on the ER-IAT, despite a nonsignificant tendency for the bipolar group to pair emotion regulation with positive words more rapidly than the control group did.

To examine the conjoint relationship of emotion factor scores to diagnostic status, diagnostic status was regressed on the emotion factor scores, using a logistic multiple regression model with simultaneous entry of the four factors. As shown in Table 4, Negative Emotion scores were higher in the bipolar as compared to the control group, whereas Positive Emotion, Suppression, and Reappraisal were not significantly tied to diagnostic group when considered conjointly, $\text{Chi-square}(4) = 61.14, p < .001$.

Emotion Factor Scores as Correlates of QoL/Well-Being

A linear regression model was computed to examine the effects of the four emotion factor scores on QoL/Well-Being factor scores using simultaneous entry. As shown in Table 5, three of the four emotion factor scores were uniquely related to the QoL/Well-being factor score. Negative Emotion was robustly related to poorer QoL/Well-being, and Suppression

was more modestly related to poor QoL/Well-being. Positive emotion was related to higher QoL/Well-being.

To consider whether emotion factor scores accounted for diagnostic group differences in QoL/Well-being, diagnostic group was entered in a second block of this model. After controlling for the emotion factor scores in block 1, diagnostic group status remained significantly related to QoL/Well-Being. To consider whether emotion factor scores were related to QoL/Well-being with the same magnitude for those with bipolar disorder as compared to controls, interactions of diagnostic group \times factor scores were examined using forward selection in the third block. No interaction terms were significant.

Although QOL was not assessed at follow-up among control participants, QOL-BD scores (without Well-being) were available at 12-month follow-up for 31 of the participants diagnosed with bipolar disorder. Partial correlations of the emotion factor scores with QOL-BD scores at 12-month follow-up, controlling for baseline QOL-BD scores were not significant, partial $r_{\text{negative emotion}} = .10$, partial $r_{\text{reappraisal}} = .27$, partial $r_{\text{suppression}} = -.21$, partial $r_{\text{positive emotion}} = .13$, all p 's $> .15$.

Emotion Factor Scores as Longitudinal Predictors of Symptoms within Bipolar Group

Bivariate correlations were computed to assess whether emotion factors scores were related to baseline symptom scores. As shown in Table 6, none of the emotion factor scores significantly correlated with baseline mania (YMRS). Suppression correlated significantly with higher depression, while the other three emotion factor scores were not significantly correlated with baseline depression.

To assess if emotion factor scores predicted symptoms over time, partial correlations were computed of emotion factor scores with the MHRSD and YMRS at 12-month follow-up, controlling for baseline symptom scores. As at baseline, emotion factor scores were not significantly related to mania (YMRS) at follow-up. Reappraisal scores, but not the other factor scores, predicted lower depression (MHRSD) at 12 months after controlling for baseline depression.

Discussion

Findings concerning the nature of emotion disturbances in BD remain mixed, and one potential issue is that researchers have often studied a limited set of emotion dimensions. In the current study, we considered an extensive array of emotion-related dimensions among persons diagnosed with remitted bipolar I disorder compared to a control sample. We examined which emotion dimensions were most robustly and uniquely related to BD, and how these dimensions related to functional and symptom outcomes within BD. Strengths of the study included the large, carefully diagnosed sample and well-matched control group, the use of a broad set of well-validated emotion measures, and the one-year follow-up data for a subset of the bipolar sample.

Factor analyses identified four emotion factor scores, largely confirming the domains that have been most frequently studied within bipolar disorder can be statistically separated:

Negative and Positive Emotion, and the use of Reappraisal and Suppression as emotion regulation strategies. Of note, the Negative Emotion factor included anger, suggesting that it may be important for future studies on anger in bipolar disorder to consider anger within the context of other emotion disturbances (Ballester, Goldstein, Goldstein, et al., 2014). The Negative Emotion factor score also integrated tonic tendencies toward negative emotionality, as well as tendencies toward affective lability, indicating that persons who endorse high levels of negative emotionality may also experience greater fluctuations in their mood state.

BD was related to a broad range of emotion-related disturbances in bivariate analyses, although groups did not differ in implicit attitudes toward emotion regulation on the ER-IAT. Regression analyses, which assessed the unique relationships of emotion factors with diagnostic status, indicated that BD was uniquely related only to negative emotion, and not to positive emotion, suppression or reappraisal after controlling for negative emotion.

Lower negative emotion and use of suppression, and higher positive emotion related to better functional outcomes across both the bipolar and control group, and these factors accounted for 36% of the variance in quality of life/well-being. Nonetheless, diagnostic status remained related to a lower quality of life/well-being after accounting for the emotion factor scores, consistent with the idea that well-being and quality of life are driven by a range of symptomatic, neurocognitive, and emotion-relevant variables (Fulford, Peckham, Johnson, & Johnson, 2014; Martinez-Aran et al., 2004; van Rheenen & Rossell, 2014). Emotion factor scores also did not predict changes in quality of life among a smaller number of participants at follow-up. This may reflect the range of variables that influence Quality of Life, coupled with our low level of statistical power for this analysis.

We also examined how emotion dimensions predicted symptom change at one year follow-up. At baseline, individuals with bipolar disorder who were experiencing heightened depression reported more frequent use of suppression; this may reflect some attempt to escape from the affect associated with ongoing subsyndromal depressive symptoms. An important facet of these findings is that baseline correlations did not mirror the prospective effects, indicating the need to disentangle the effects of current depression from the skills that help shift depression over time. Frequent use of reappraisal at baseline was related to relatively lower depressive symptoms one year later, consistent with other findings (van Rheenen & Rossell, 2014).

Although many diagnosed with BD experience heightened positive emotionality (Gruber, 2011b) and theory has suggested that this might help explain poor outcomes, little empirical data has been available about how positive emotions predict outcomes within BD. To date, one study has found that positive emotionality can predict increases in mania (Gruber & Johnson, 2009), but we did not replicate this pattern. It may be that prediction would be improved by assessing interactions of positive emotionality with life events involving goal attainment (Johnson, Carver, & Gotlib, 2011). Alternatively, mania may be driven by more biologically-based risk factors. Findings regarding mania may have been limited by the relatively low range of manic symptoms observed at follow-up, with no participants reporting symptoms of full-blown mania. Beyond the absence of effect on predicting

changes in mania, we also did not find that positive emotionality related to worse functional outcomes at baseline or follow-up. Replicating one previous cross-sectional finding (Edge et al., 2013), positive emotionality was related to better functioning within the bipolar and control groups at baseline. Previous research on the deleterious consequences of positive affect for functioning within BD has focused on tendencies to become impulsive in the context of positive emotions (Victor, Johnson, & Gotlib, 2011), which was not assessed here. Taken together, these findings suggest that positive emotionality may be of concern only when it reaches a level extreme enough to promote problems of control and inhibition.

Before considering implications, it is worth noting several limitations. First, the sample size is small for conducting the factor analyses of emotion scales, and as a result we were unable to test the invariance of the factor structure across the two diagnostic groups. Second, the current study does not include tendencies to ruminate about negative emotions, which have been shown to be related to depression within bipolar disorder (Johnson, McKenzie et al., 2008; Thomas, Knowles, Tai, & Bentall, 2007; Van der Gucht, Morriss, Lancaster, Kinderman, & Bentall, 2009). Third, it will be important to bolster understanding of emotion dimensions through studies of standardized responses to emotion stimuli. Fourth, it will be important to integrate the study of emotion with broader understanding of biological, cognitive, and life event variables that are related to the course of disorder (Berk et al., 2011; Johnson et al., 2000; 2008; Tabares-Seisdedos et al., 2008), as well as with cognitive appraisals of emotion states (Mansell et al., 2007).

Notwithstanding limitations, several facets of the current findings are relatively novel and might help shape research and clinical work in BD. First, findings indicate that multiple aspects of emotion disturbance are present in BD, but the dimension that is most powerfully and uniquely tied to the diagnosis is difficulty with negative emotion. This provides some counterpoint to a growing emphasis on positive emotionality (Gruber, 2011; Victor et al., 2011), but dovetails with findings that negative emotionality may be elevated among unaffected siblings of those with BD (Almeida et al., 2011). The current findings also emphasize that multiple emotion dimensions are important to functional outcomes, in that higher Negative Emotionality and Suppression, and lower Positive Emotionality were each uniquely related to lower scores on the composite quality of life/well-being index at baseline. Finally, current findings indicate that use of adaptive emotion regulation strategies, such as reappraisal, predicts less depression over time, suggesting that emotion regulation interventions developed to address emotionality in anxiety and depressive disorders (Farchione et al., 2012; Mennin & Fresco, 2009) could help reduce the significant burden of depression observed within BD. On the whole, the findings indicate the need for a more nuanced appreciation of how different facets of emotion might be relevant for understanding different processes within BD.

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Summary

Emotion disturbance has been seen as a hallmark feature of bipolar disorder, but findings about the exact nature of that disturbance are surprisingly mixed. The current study provides the first large-scale study of persons with remitted bipolar disorder on a broad set of emotion dimensions: tendencies to experience extremely positive emotion, extremely negative emotion, variability in emotion, and disturbances in emotion regulation. When considered together, bipolar disorder was most closely linked to negative emotionality, but the other dimensions had important effects on social functioning and the course of symptoms over time.

Table 1
Descriptive Data by Diagnostic Group

	Bipolar I (n = 67) Mean (SD)	Control (n = 58) Mean (SD)	p
Age	35.93 (12.00)	33.29 (13.30)	.28
Percent female	54.2	47.1	.29
Years education	15.23 (1.96)	15.29 (1.92)	.86
Percent employed	42.4	54.9	.25
Percent with anxiety disorder	55.9	3.9	<.001
Percent with past substance use disorder	57.6	9.8	<.001
Manic symptom level (ASRM)	3.15 (2.25)	2.75 (2.39)	.37
Depressive symptom level (BDI-SF)	4.23 (3.49)	0.96 (1.28)	<.001
Manic symptom level (YMRS)			
Baseline	1.65 (1.50)	n/a	n/a
12-month follow-up	5.44 (5.11)	n/a	n/a
Depressive symptom level (MHRSD)			
Baseline	2.91 (2.15)	n/a	n/a
12-month follow-up	7.23 (6.02)	n/a	n/a
Age of first manic episode	21.22 (7.18)	n/a	n/a
Number of previous manic episodes	7.10 (7.34)	0	n/a
Previous hospitalizations for mania	1.71 (2.49)	0	n/a
Age of first MDE	17.96 (6.78)	n/a	n/a
Number of previous MDEs	8.34 (8.68)	0	n/a
Previous hospitalizations for MDE	0.65 (1.42)	0	n/a
Lithium dose (mg)	742.61(464.46)	0	n/a
Imipramine equivalency dose (mg)	145.62 (97.98)	0	n/a
Risperidone equivalency dose (mg)	4.19 (4.08)	0	n/a
Lamotrigine dose (mg)	198.52 (72.71)	0	n/a
Anticonvulsant dose (mg)	0.53 (0.64)	0	n/a

Note. ASRM= Altman Self-Rating Mania scale; BDI-SF = Beck Depression Inventory-Short Form; MDE = Major Depressive Episode; MHRSD = Modified Hamilton Rating Scale of Depression; YMRS = Young Mania Rating Scale.

n/a = not applicable.

n = 36 for 12-month follow-up YMRS and MHRSD

Table 2
Factor Loadings of Emotion Scales

	Factor 1: Negative Emotion	Factor 2: Reappraisal	Factor 3: Suppression	Factor 4: Positive Emotion
ALS Anger	.86	-.25	.07	.21
BAQ Anger	.83	-.14	-.05	.18
ALS Depression & Elation	.81	-.18	.17	.35
ALS Anxiety & Depression	.78	-.30	.24	.25
BAQ Physical Aggression	.76	-.15	-.01	.24
BAQ Verbal Aggression	.69	-.20	-.08	-.19
RPA Dampening	.59	-.28	.31	.34
ERQ Reappraisal Sadness	-.25	.89	-.17	.14
ERQ Reappraisal Anxiety	.02	.84	-.08	.14
ERQ Reappraisal Anger	-.30	.82	.04	.09
ERQ Reappraisal	-. .38	.81	-.11	.26
ERQ Suppression Sadness	.10	-.10	.86	-.04
ERQ Suppression Anxiety	.15	-.18	.82	.08
ERQ Suppression	.05	.00	.77	.09
ERQ Suppression Anger	-.17	-.04	.70	-.24
RPA Self-focus	.24	.19	-.11	.86
RPA Emotion-focus	.16	.19	-.03	.86

Note. ALS=Affective Liability Scale; BAQ=Brief Aggression Questionnaire; ERQ=Emotion Regulation Questionnaire; RPA=Responses to Positive Affect.

Table 3
Comparisons of Bipolar and Control Groups on Emotion, Quality of Life, and Well-Being scales

	Bipolar (<i>n</i> = 67) Mean (SD)	Control (<i>n</i> = 58) Mean (SD)	<i>t</i>	<i>p</i>
Factor 1: Negative Emotion	.56 (0.98)	-.64 (0.53)	-8.66	<.001
Factor 2: Reappraisal	-.17 (1.08)	.19 (0.87)	2.04	.04
Factor 3: Suppression	.16 (0.93)	-.18 (1.05)	-1.90	.06
Factor 4: Positive Emotion	.19 (0.97)	-.22 (1.00)	-2.33	.02
ALS Anger	9.65 (4.04)	5.96 (1.74)	-6.79	<.001
ALS Depression & Anxiety	10.73 (4.02)	6.14 (1.89)	-8.33	<.001
ALS Depression & Elation	19.55 (5.97)	12.23 (4.03)	-8.12	<.001
BAQ Anger	7.57 (3.37)	4.94 (2.53)	-4.97	<.001
BAQ Hostility	8.02 (3.22)	5.37 (2.22)	-5.41	<.001
BAQ Physical Aggression	6.23 (3.18)	3.95 (1.66)	-5.13	<.001
BAQ Verbal Aggression	7.87 (2.99)	6.01 (2.75)	-3.60	<.001
ER-IAT <i>D</i> score	.09 (0.37)	-.04 (0.36)	-1.66	.10
ERQ Reappraisal	28.34 (8.20)	32.28 (5.89)	3.08	.003
ERQ Reappraisal Anger	4.64 (1.77)	5.12 (1.52)	1.63	.11
ERQ Reappraisal Anxiety	5.16 (1.80)	5.10 (1.48)	-0.20	.84
ERQ Reappraisal Sadness	4.60 (1.76)	5.19 (1.39)	2.10	.04
ERQ Suppression	12.50 (5.25)	12.38 (5.11)	-0.13	.90
ERQ Suppression Anger	3.41 (1.86)	3.48 (1.78)	0.24	.81
ERQ Suppression Anxiety	4.46 (1.87)	3.47 (1.76)	-3.04	.003
ERQ Suppression Sadness	4.25 (2.00)	3.72 (1.88)	-1.50	.14
RPA Dampening	16.17 (4.91)	11.10 (2.95)	-7.09	<.001
RPA Emotion Focus	13.92 (2.87)	13.09 (3.45)	-1.46	.15
RPA Self-Focus	9.75 (2.32)	8.90 (2.94)	-1.82	.07
QOL-BD	42.59 (6.89)	48.48 (5.52)	5.30	<.001
SPWB Autonomy	13.29 (3.03)	14.01 (2.39)	1.48	.14
SPWB Environmental Mastery	11.78 (3.07)	14.33 (2.01)	5.55	<.001
SPWB Positive Relationships	12.49 (3.00)	15.20 (2.39)	5.61	<.001
SPWB Self-Acceptance	11.41 (3.54)	14.65 (2.22)	6.22	<.001

Note. ALS=Affective Liability Scale; BAQ=Brief Aggression Questionnaire; ER-IAT=Emotion Regulation Implicit Association Task; ERQ=Emotion Regulation Questionnaire; QOL-BD= Quality of Life in Bipolar Disorder scale; RPA=Responses to Positive Affect; SPWB= Scale of Psychological Well-Being.

ER-IAT data was missing for 15 persons in the control group and 18 in the bipolar group.

Table 4
Emotion Factor Scores Regressed on Diagnostic Group Status (N = 125)

	Final β	p (Final β)
Negative Emotion	.55	<.001
Reappraisal	-.07	.39
Suppression	.13	.09
Positive Emotion	.12	.12

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Table 5
Emotion Factor Scores as Predictors of QoL/Well-Being Factor Score (N = 125)

	Adjusted r^2	F change	p	Final β	p (Final β)
Block 1	.36	18.52	< .001		
Negative Emotion				-.33	< .001
Reappraisal				.14	.06
Suppression				-.15	.04
Positive Emotion				.22	.003
Block 2	.41	11.36	.001		
Diagnostic group				-.31	.001

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Table 6
Correlations of Emotion Factor Scores with Symptom Severity and QOL within Bipolar Group

	MHRSD baseline	YMRS baseline	MHRSD ¹ 12-month follow-up	YMRS ² 12-month follow-up
Factor 1:Negative Emotion	.23	.19	.13	.09
Factor 2: Reappraisal	.21	-.02	-.37*	-.07
Factor 3: Suppression	.26*	.15	.15	-.11
Factor 4:Positive Emotion	.06	.20	.13	.14

Note. MHRSD = Modified Hamilton Rating Scale of Depression; YMRS = Young Mania Rating Scale.

n = 63 for MHRSD & YMRS baseline; *n* = 36 for MHRSD & YMRS 12-month follow-up.

¹Partial correlations, controlling for baseline MHRSD scores.

²Partial correlations, controlling for baseline YRMS scores.

* *p* < .05.