Journal of Abnormal Psychology
2013, Vol. 122, No. 4, 971–983

0021-843X/13/$12.00 DOI: 10.1037/a0034425

Real-World Emotion? An Experience-Sampling Approach to Emotion Experience and Regulation in Bipolar I Disorder

June Gruber
Yale University

Aleksandr Kogan
University of Cambridge

Douglas Mennin
City University of New York, Hunter College

Greg Murray
Swinburne University of Technology

Laboratory studies suggest that bipolar disorder is characterized by emotion dysregulation, yet emotion disturbance has not been systematically described using more ecologically valid methods. Using an experience-sampling approach, we therefore sought to investigate positive and negative emotionality, emotion regulation strategies, and functioning among remitted individuals with bipolar I disorder (BD; $n = 31$) compared with both healthy controls (CTL; $n = 32$) and remitted individuals with major depressive disorder (MDD; $n = 21$). Hierarchical linear modeling analyses of self-report data spanning a 6-day consecutive period revealed that the BD group aligned with the CTL group in reporting greater positive emotionality than the MDD group, but aligned with the MDD group in reporting greater negative emotionality than the CTL group. Furthermore, the BD and MDD groups reported greater general use of emotion regulation strategies than the CTL group. These findings suggest that BD is characterized by amplified emotionality as well as increased efforts to regulate emotions in everyday life. Discussion focuses on implications for BD, as well as identification of unique (disorder-specific) and shared (transdiagnostic) features of emotion disturbance.

Keywords: emotion, emotion regulation, affect, experience sampling, bipolar disorder, depression

Bipolar disorder (BD) is a severe and chronic psychiatric condition associated with functional and social impairment even during remission (Fagiolini et al., 2005; Michalak et al., 2007), and has been ranked as one of the top 10 causes of worldwide disability (e.g., Murray & Lopez, 1996). Recent laboratory-based models stress the importance of emotion regulation difficulties in BD (Gruber, 2011a; Gruber, Harvey, & Gross, 2012; Phillips & Vieta, 2007). A critical next step is to characterize emotion disturbance in BD using rigorous and ecologically valid methods, including concurrent measurement of emotion experience and efforts to regulate emotions.

Heightened Emotionality in BD

Recent models suggest that individuals with BD experience heightened and persistent elevations in positive emotionality across contexts (Gruber, 2011a), consistent with psychosocial models implicating heightened reward seeking and goal striving in the etiology of BD (e.g., Alloy et al., 2009; Johnson, 2005). For example, individuals at risk for, and diagnosed with BD, self-report greater positive affect in response to emotionally evocative films (Gruber, Johnson, Oveis & Keltner, 2008; Gruber, Harvey & Purcell, 2011), static photos (M'Bailara et al., 2009), and at the prospect of earning rewards (Meyer, Johnson, & Winters, 2001). People with BD also exhibit prolonged durations of self-reported positive affect during laboratory studies relative to controls (Farmer et al., 2006). In addition, BD individuals exhibit increased psychophysiological correlates of emotional responding (e.g., respiratory sinus arrhythmia) in response to positive and negative stimuli, including films, photos, and autobiographical memories (Gruber et al., 2008; Gruber, Harvey, & Johnson, 2009; Sutton & Johnson, 2002). Neuroimaging studies further suggest that individuals with BD exhibit increased activity in brain regions typically associated with emotional salience and reward (i.e., amygdala, putamen, ventral striatum, and orbitofrontal cortex) to positive stimuli (Hassel et al., 2008) and during an emotional go/no-go task (Wessa et al., 2007). Heightened positive emotionality further differentiates BD from other mood disorders, such as major depressive disorder (MDD; Kring & Bachorowksi, 1999; Gruber, Oveis, Keltner & Johnson, 2011; Watson, Clark, & Carey, 1988), and has important clinical implications for psychosocial treatments aimed at reducing positive emotionality (Johnson, 2005).

Abnormalities in negative emotionality might also be expected in BD given frequent and recurrent bouts of depression (Judd et al.,

June Gruber, Department of Psychology, Yale University; Aleksandr Kogan, Department of Psychology, University of Cambridge, Cambridge, UK; Douglas Mennin, Department of Psychology, City University of New York, Hunter College; Greg Murray, Department of Psychology, Swinburne University of Technology, Melbourne, Australia.

We thank Amanda Purcell, Elizabeth Reeves, Adam Fields, and Whitney Quackenbush for special assistance.

Correspondence concerning this article should be addressed to June Gruber, Department of Psychology, Yale University, P.O. Box 208205, New Haven, CT 06520. E-mail: june.gruber@yale.edu

2003). Empirical research, however, generates mixed findings. On the one hand, people diagnosed with and at risk for BD do not appear to differ from healthy controls in their emotional responses to negative stimuli, including failure feedback (e.g., Ruggero & Johnson, 2006), interpersonal criticism (Cuellar, Johnson, & Ruggero, 2009), or negative photos (Sutton & Johnson, 2002). Neuroimaging studies in BD also do not provide conclusive evidence of heightened negative emotionality (e.g., Malhi et al., 2007; Yurgelun-Todd et al., 2000). On the other hand, work tapping into more chronic negative mood (as opposed to briefer emotional) states suggests that heightened negative emotionality is characteristic of BD and other mood disorders such as MDD. Compared with healthy controls, individuals at risk for, and diagnosed with, BD report higher mean levels of NA over repeated mood assessments in daily diary or ESM studies. (Hofmann & Meyer, 2006; Lovejoy & Steuerwald, 1995; Myin-Germeys et al., 2003), as also seen in MDD (e.g., Bylsma, Taylor-Clift & Rottenberg, 2011; Myin-Germeys et al., 2003). Moreover, a growing body of work suggests that individuals with BD and MDD report increased behavioral inhibition, associated with negative affective responses (e.g., Alloy et al., 2009; Kasch et al., 2002; Meyer, Johnson, & Winters, 2001). Finally, tendencies toward neuroticism and depression proneness—associated with negative emotionality—are observed in BD and MDD (Murray, Goldstone, & Cunningham, 2007).

In sum, BD is related to heightened positive emotionality that differentiates it from other mood disorders. It also appears that BD shares with MDD a more chronic negative emotionality profile not evident in laboratory emotion-eliciting paradigms. Systematically sampling both positive and negative emotionality in BD outside of the laboratory, and comparing it directly with MDD, is needed to isolate unique versus shared affective features of BD.

Increased Emotion Regulation Effort in BD

Difficulties effectively regulating emotion is a fundamental feature of BD (Johnson, Gruber, & Eisner, 2007; Phillips & Vieta, 2007). For example, individuals with BD exhibit difficulty down-regulating or decreasing positive emotion intensity, as evidenced by prolonged elevations in self-reported positive emotion following a reward performance task (Farmer et al., 2006), and attenuated physiological response magnitude after viewing pleasant images compared with healthy controls (Forbes et al., 2005). Furthermore, individuals with BD amplify and sustain positive feelings compared with individuals with MDD and controls (Gruber, Eidelman, Johnson, Smith, & Harvey, 2011; Gruber, Harvey, & Johnson, 2009; Johnson, McKenzie, & McMurrich, 2008). BD individuals in remission also amplify and sustain negative emotions at comparable levels to those with MDD (e.g., Johnson et al., 2008). Moreover, such BD individuals with BD also report greater efforts to engage in both adaptive (i.e., reappraisal) and maladaptive (i.e., suppression and rumination) regulatory strategies (e.g., Gruber et al., 2011, 2012). These findings are consistent with work in MDD that also endorses greater use of maladaptive regulatory strategies compared with healthy controls (John & Gross, 2004; Joormann, 2010).

In sum, these findings highlight BD individuals' tendencies to engage in greater emotion regulation efforts—a characteristic shared with MDD—despite known difficulties with emotion-related functioning. No study to date, however, has examined emotion regulation efforts, including the utilization of specific emotion regulation strategies, in the daily life of remitted individuals with BD compared directly with MDD.

Experience-Sampling Methodology as an Entry Point

A growing body of work reveals that those with BD exhibit disturbances in emotion-related functioning, yet it is less clear whether these patterns are evident in everyday life. A promising strategy for addressing this question is the experience-sampling methodology (ESM) that provides a critical complementary perspective to findings obtained in more traditional laboratory or experimental settings (e.g., Bolger, Davis, & Rafaeli, 2003; Conner, Tennen, Fleeson, & Feldman Barrett, 2009; Myin-Germeys et al., 2009). ESM also provides multiple and repeated intraindividual assessments of emotionality across time bolstering the reliability of obtained findings, and situates emotion within naturally occurring everyday contexts. A small handful of studies have examined emotions in BD using ESM approaches. For example, Myin-Germeys and colleagues (2003) found that remitted patients with BD (Type I and II) reported lower PA, but not NA, relative to a healthy control group. Subsequent work found that remitted BD (Type I and II) patients also reported lower PA, but higher NA, relative to healthy controls (Havermans, Nicolson, Berkhof, & de Vries, 2010). In addition, one study reported increased PA, but not NA, in college students at risk for BD (Hofmann & Meyer, 2006). Another study similarly reported increased PA and NA in young adults with subthreshold BD spectrum disorders (i.e., cyclothymia) relative to a remitted depressed and health control groups (Lovejoy & Steuerwald, 1995). Although these initial findings are critical in establishing naturalistic differences in emotionality in BD, they can be empirically advanced in three major ways. First, prior research has typically examined BD patient groups in isolation of other mood disorders such as MDD. This leaves unclear whether observed features of emotionality are specific to BD or represent a shared (i.e., transdiagnostic) feature of mood disorders. Second, existing research has not examined specific emotion regulation strategies leaving unclear to what extent, and in what specific ways, individuals with BD implement regulation efforts naturalistically. Finally, it has not been established how emotionality relates to emotion regulation efforts in everyday life in BD. This is critical to begin to tease apart the bidirectional and complex relationship between emotionality and its regulation.

The Present Investigation

The present investigation adopted an ecologically valid and rigorous ESM approach (e.g., Csikszentmihalyi & Larson, 1987) to characterize naturalistically occurring reports of emotionality and emotion regulation efforts in remitted individuals diagnosed with BD as compared with both individuals diagnosed with MDD (also remitted) and healthy community controls. A within-subjects ESM design was employed measuring positive and negative emotionality, emotion regulation, and daily indices of satisfaction and functioning across a consecutive 6-day sampling period. This approach enabled us to examine emotion disturbance and regulation independent of the more phasic influences of mood symptoms, and represents a first step toward understanding which aspects of

emotion disturbance represent trait markers versus mood-state specific qualities. Given the relative dearth of work investigating emotionality in BD, and our a priori and empirically driven BD-centered hypotheses, we focused primarily on implications of results for BD participants and used the MDD group as a point of comparison. This enabled us to address the following aims:

Aim 1: Group Differences in Positive Emotionality

The first aim was to compare the BD group with the MDD and CTL groups in self-reported positive emotionality, as measured by experience sampling ratings of PA and daily ratings of life satisfaction. We tested two competing hypotheses regarding positive emotionality in BD. The first hypothesis (referred to as the 'positive emotion persistence' hypothesis) predicts that increased positive emotionality would be a unique feature of BD, as observed in higher PA and daily life satisfaction in the BD relative to both CTL and MDD groups. This hypothesis is based on a) the laboratory finding that individuals with BD self-report greater positive emotionality across positive, negative and neutral contexts compared with healthy controls (Gruber, 2011a; Gruber et al., 2008) and b) evidence suggesting MDD is uniquely characterized by lower positive emotionality relative to healthy controls and individuals with BD (e.g., Gruber et al., 2011; Kring & Bachorowski, 1999; Watson et al., 1988). An alternative hypothesis (referred to as the 'positive emotion attenuation' hypothesis) predicts that decreased positive emotionality would be a transdiagnostic or shared feature of the BD and MDD groups, as observed by lower PA and daily life satisfaction in both the BD and MDD groups relative to the CTL group. This hypothesis is based on ESM findings that that remitted individuals with BD and MDD self-report lower positive emotionality in everyday life (Bylsma, Taylor-Clift, & Rottenberg, 2008; Myin-Germeys et al., 2003; Havermans et al., 2010).

Aim 2: Group Differences in Negative Emotionality

The second aim was to compare the BD with MDD and CTL groups in self-reported negative emotionality and functional impairment, as measured by experience sampling ratings of NA and daily ratings of functioning difficulties. For NA, we predicted that the BD group would report greater NA and increased daily functioning difficulties compared with the CTL group but similar levels compared with the MDD group, suggesting that chronic negative emotionality in everyday life is a transdiagnostic feature of mood disorders (e.g., Bylsma et al., 2008; Hofmann & Meyer, 2006; Myin-Germeys et al., 2003). For functioning difficulties, we also predicted that the BD group would report greater daily functioning difficulties compared with the CTL group but similar levels compared with the MDD group, suggesting impaired functioning is also a transdiagnostic feature of mood disorders (e.g., Fagiolini et al., 2005; Judd et al., 1996).

Aim 3: Group Differences in Emotion Regulation Efforts

The third aim was to compare the BD with the MDD and CTL groups in self-reported naturalistic efforts to regulate emotions, or emotion regulation strategy use. Based on prior work indicating that individuals with BD and MDD report greater engagement in emotion regulation efforts (e.g., Gruber et al., 2011, 2012), we predicted increased emotion regulation efforts across all strategy types in the BD and MDD groups compared with the CTL group.

Aim 4: Exploring Associations Between Emotionality and Emotion Regulation Efforts

The final aim was to compare two contrasting perspectives regarding emotionality and regulation effort in BD. One perspective suggests that BD is characterized by a failure to regulate emotions appropriately, perhaps through dysfunction in a regulatory system that ineffectively maps emotion regulation efforts in proportion to the degree of experienced emotion (e.g., Phillips & Vieta, 2007). We operationalized this perspective in the prediction that the association between emotionality and emotion regulation would be relatively weak in the BD relative to the CTL and MDD groups. A second perspective suggests that the intense emotionality expected in BD would motivate elevated emotion regulation efforts in BD relative to the CTL and MDD groups (e.g., Gruber et al., 2011, 2012). We operationalized this perspective in the prediction that the association between emotionality and emotion regulation would be relatively strong in the BD relative to the CTL and MDD groups. To test these two alternative perspectives, we modeled individual emotion regulation strategy efforts as a consequence of reported PA and NA, and tested Group as a moderator of these relationships.

Method

Participants

Participants between the ages of 18 and 60 years were recruited via flyers posted around the community or an online advertisement (e.g., www.craigslist.org) from the greater New Haven, Connecticut community. Participants responded to one of three separate study advertisements: a study on "emotion and mood" for healthy controls, on "bipolar disorder and emotion" for the BD group, and on "history of depression and emotion" for the MDD group. Interested participants completed a brief phone screen with a trained researcher, and were invited to the laboratory for a diagnostic evaluation to determine final study eligibility (see below). Of the 120 participants invited for a diagnostic evaluation, 111 were eligible for the broader study protocol, and 84 were included in ESM study analyses.

Of the final ESM study participants, 31 were participants diagnosed with BD Type I in remission (for an average of 23.61 months, $SD = 52.01$). The healthy control (CTL) group comprised 32 participants not meeting current or past criteria for any *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition, text revision (*DSM–IV–TR*; American Psychiatric Association, 2000) Axis I disorder (First, Spitzer, Gibbon, & Williams, 1996). The MDD clinical comparison group comprised 21 participants with MDD in remission (for an average of 43.57 months, $SD = 52.60$). Both BD and MDD groups were currently remitted (i.e., not in a current manic, depressed, or mixed mood phase) to examine more trait-like patterns of emotion control independent of current mood episode. Exclusion criteria for all groups included reports of a history of severe head trauma, stroke, neurological disease, severe medical illness (e.g., autoimmune disorder, cardio-

vascular disease, HIV/AIDS), or current alcohol or substance abuse in the past six months.

Measures of Clinical Functioning

Diagnostic evaluation. Diagnoses of BD, MDD, and CTL status were confirmed using the Structured Clinical Interview for *DSM–IV* (SCID-IV; First, Spitzer, Gibbon, & Williams, 1996). Trained clinical psychology faculty, psychology doctoral candidates, or postbaccalaureate research fellows administered the SCID-IV. A subset ($n = 29$) of videotaped interviews from the general protocol including participants in the ESM study were rated by another reviewer, and ratings matched 100% ($\kappa = 1.00$) of primary diagnoses. During the SCID-IV, additional information concerning illness duration and lifetime number of depressive and manic mood episodes was collected (see Table 1).

Mood symptoms. Current symptoms of mania were measured using the Young Mania Rating Scale (YMRS; Young, Biggs, Ziegler, & Meyer, 1978). Current symptoms of depression were measured using the Inventory of Depressive Symptomatology (IDS-C; Trivedi et al., 2004). The YMRS is an 11-item, clinician-rated measure of current manic symptoms with scores ranging from 0 to 60, and the IDS-C is a 30-item, clinician-rated measure of current depressive symptoms with scores ranging from 0 to 84. Current remitted mood status (i.e., neither manic, depressed, nor mixed mood state) for all groups was verified according to both current SCID-IV criteria and cutoff scores on the YMRS (≤ 7), and IDS-C (≤ 11). Intraclass correlations (ICCs) for absolute agreement between the original interviewer and an independent rater for approximately one third of participants ($n = 23$) were strong for both the YMRS ($= 0.98$) and IDS-C ($= 0.98$).

Global functioning. The Global Assessment of Functioning (GAF; *DSM–IV Axis V*) Scale was used to assess general functioning in the past week. The GAF assesses overall psychological, social, and occupational functioning on a scale from 1 (lowest level of functioning) to 100 (highest level of functioning). ICCs for a subset of study participants ($n = 11$) was high ($= 0.94$).

Experience-Sampling Methods

Participants were provided with an electronic Palm Pilot M500 handheld device to use during the experience sampling protocol. The Palm Pilot was preprogrammed using the open-source Experience Sampling Program (ESP; http://www.experience-sampling.org) which automatically records participant responses and response times using the palm pilot touch screen, uploaded later to a computer for offline analysis. The first day (Day 0) was used as a training and acclimatization period, during which par-

Table 1
Demographic and Clinical Characteristics

	BD ($n = 31$)	MDD ($n = 21$)	CTL ($n = 32$)	Statistic
Demographic				
Age, y	31.58 (10.52)	31.45 (11.73)	31.39 (8.83)	$F = 0.002$
Female, %	57.7%	66.7%	66.7%	$\chi^2 = 0.59$
Caucasian, %	96.2%	90.5%	92.1%	$\chi^2 = 4.24$
Education, y	15.02 (2.11)	15.55 (2.58)	16.02 (2.42)	$F = 1.26$
Employed, %	50.0%	47.6%	68.9%	$\chi^2 = 13.64$
Partnered, %	34.6%	14.3%	24.1%	$\chi^2 = 2.58$
Number children	0.58 (1.03)	1.31 (0.71)	0.14 (0.36)	$F = 2.54$
Annual income				$\chi^2 = 8.65$
<$10K	11.5%	14.3%	10.3%	
$10K–$25K	15.4%	14.3%	13.8%	
$26K–$50K	34.6%	47.6%	27.6%	
$51K–$75K	3.8%	14.3%	20.7%	
$76K–$100K	19.3%	0.00%	13.8%	
>$100K	15.4%	9.5%	13.8%	
Clinical				
YMRS	2.10 (2.23)	1.81 (2.11)	1.13 (1.07)	$F = 2.29$
IDS-C	4.74 (5.26)	5.48 (2.77)	1.84 (1.80)	$F = 7.81^{a,c}$
GAF	75.73 (6.89)	79.14 (6.61)	88.06 (3.30)	$F = 38.49^{a,b,c}$
Age at onset, y	15.84 (7.11)	15.12 (6.84)	—	$F = 0.13$
Illness duration, y	13.86 (11.85)	21.44 (13.73)	—	$F = 1.84$
# Comorbid disorders	0.68 (1.11)	0.67 (1.02)	—	$F = 0.001$
# Medications	1.92 (1.52)	0.50 (0.76)	—	$F = 14.63^{b}$
# Depressive episodes	14.41 (23.28)	4.31 (2.76)	—	$F = 2.51$
# Manic episodes	12.26 (20.58)	—	—	—

Note. BD = Bipolar I disorder group; MDD = Major depressive disorder group; CTL = Healthy control group; Employed = Employed full-time or part-time; Partnered = Married or Live-in-Partner; YMRS = Young Mania Rating Scale; IDS-C = Inventory to Diagnose Depression; GAF = Global Assessment of Functioning; SILS = Shipley Institute of Living Scale; Age at Onset = Age of first depressive or manic episode; # Comorbid Disorders = the number of current DSM-IV-TR Axis I comorbidities; # Medications = the number of psychotropic medications currently taken (including anticonvulsants, lithium, neuroleptics, anxiolytics, stimulants, antidepressants, and sedative-hypnotics). Mean values are displayed with standard deviations in parentheses where applicable.
[a] $p < 0.05$ for BD and CTL. [b] $p < 0.05$ for BD and MDD. [c] $p < 0.05$ for MDD and CTL.

ticipants were trained on use of the Palm Pilot in the lab and completed up to 3 practice trials outside the lab. Data from the subsequent six consecutive days (Day 1 through Day 6) were used in final analyses. During this time, participants were prompted via tone signal that occurred at quasi-random times within 4 epochs each day between 9:00 a.m. and 9:00 p.m. (i.e., 9:00 a.m. – 12:00 p.m., 12:00 – 3:00 p.m., 3:00 – 6:00 p.m., and 6:00 – 9:00 p.m.) for a total of 24 experience-sampling events. Participants were given up to 15 minutes to respond to the tone, after which the Palm Pilot device would no longer accept responses. It was decided that participants who responded at less than 25% (i.e., less than 6 of the 24 total experience-sampling events) would be excluded from analyses ($n = 0$). On average, participants completed 18.38 total trials ($SD = 3.83$), with no significant differences between the BD ($M = 18.77$, $SD = 3.77$), CTL ($M = 18.41$, $SD = 3.69$), and MDD ($M = 18.00$, $SD = 4.22$) groups in response rates, $F(2, 81) = 0.26$, $p = .78$.

Event Ratings

Each experience-sampling event sampled three broad domains of emotional functioning, including activities and social context, positive and negative emotionality, and associated emotion regulation efforts described below in the order presented to the participant.

Positive and negative emotionality. Self-reported PA and NA were assessed using the modified differential emotion scale (mDES; Cohn, Fredrickson, Brown, Mikels, & Conway, 2009) consisting of 10 individual positive emotions (i.e., amusement, awe, compassion, contentment, gratitude, hope, interest, joy, love, pride) and 8 negative emotions (i.e., anger, contempt, disgust, embarrassment, fear, guilt, sadness, shame) terms rated on a 1 (*not at all*) to 5 (*extremely*) with a time frame of 'Right now.' From these, a mean PA and NA score was created for each experience-sampling event. Internal consistency scores were calculated using established multilevel methods (Nezlek, 2011) and were adequate for PA (= 0.68) and NA (= 0.72). We also separately analyzed three individual emotions—joy (from the PA scale) and anger and sadness (from the NA scale) given their particular relevance to BD (e.g., Gruber et al., 2008).

Emotion regulation efforts. Four distinct types of emotion regulation efforts, or strategies, were measured immediately after participants completed the PA and NA items above, and in direct reference to how they reacted to or managed the same emotional state. Two of these were putatively adaptive regulation strategies, namely reappraisal ("Thinking about a situation differently") and calming ("Trying to calm body by taking deep breaths or relaxing muscles"). Two putatively maladaptive regulation strategies were also measured, namely suppression ("Trying not to show emotions on the outside") and distraction ("Turning my attention away from what is making me feel emotional"). After completing the PA and NA items, participants were asked to indicate "how much were you doing each of the following" on a 1 (*not at all*) to 5 (*extremely*) scale. Given divergent effects on well-being and emotion intensity represented by these strategies, we examined each individually, consistent with a low internal reliability estimate (= 0.30) when forming an aggregate regulation composite across the four items.

Daily Ratings

The experience-sampling event within the final epoch for each day (i.e., 6:00 – 9:00 p.m.) contained additional daily ratings of two indices of well-being: daily life satisfaction and functioning difficulties (see below). The six daily ratings (from Day 1–6) were analyzed separately from the 24 experience-sampling event ratings (four ratings per day for Day 1–6, as described above).

Life satisfaction. Daily life satisfaction was measured using the Life Satisfaction Assessment Scale (Goldberg & Harrow, 2005). Four items assessed how satisfied participants were across work, economic security, social activities/relationships, and living arrangement domains on a 1 (*very satisfied*) to 5 (*very dissatisfied*) scale. An additional fifth item assessed satisfaction with current self-perceived mental health on a 1 (*much better than the average person*) to 5 (*much worse than the average person*) scale. This measure is highly correlated with other established measures of quality of life (Goldberg & Harrow, 2005). Items were reverse-scored in final analyses such that higher scores reflected greater daily life satisfaction.

Functioning difficulties. Daily functioning was measured using a modified version of the widely used 36-item Short-Form Mental Health Survey (SF-36; Ware & Sherbourne, 1992). Specifically, section 5 was adapted to reflect functioning over the last day (changed from the "last 4 weeks"). Participants completed four Yes/No items in this section to reflect whether they had "problems with work or other regular daily activities as a result of your feelings or moods" including "cut down on the amount of time spent on work or other activities," "accomplishing less than you would like," "limited in the kind of work or activities," and "had difficulty performing work or other activities." These four items were summed to reflect a composite functioning score from 0 to 4, with higher scores reflecting greater daily functional impairment.

Procedure

The study procedure had four stages. First, participants arrived at the laboratory and provided written and verbal informed consent. Participants then underwent a diagnostic assessment interview to confirm diagnosis and remitted mood status using the YMRS (≤7) and IDS-C (≤11). Second, after completing an unrelated set of laboratory tasks, participants were invited to participate in the ESM study protocol over the subsequent week (e.g., Monday through the following Monday). Interested participants went through a training and acclimatization session (Day 0) including review of ESM items, use of the Palm Pilot, and a full practice trial. Participants were encouraged to contact the experimenter if any questions arose during practice trials outside the lab on Day 0. Third, participants completed six consecutive days of the ESM protocol (Day 1–6). Fourth, participants came back to the lab to return equipment and be debriefed and current symptoms were reassessed to ensure remitted mood was maintained.

Data Analytic Approach

Hierarchical Linear Modeling (HLM). Analyses were conducted using HLM, a statistical technique that accounts for within-person (Level 1) and between-person (Level 2) variance in longi-

tudinal data, allows for nonindependence of observations, provides more precise parameter estimates than ANOVA, and accommodates missing data (e.g., Raudenbush & Bryk, 2001).[1] Aims 1 and 2 (group differences in PA and NA) were investigated using the 24 experience sampling scores for PA (and the individual item *joy*) and NA (and the items *sadness*, *anger*) respectively, along with the 6 daily ratings of life satisfaction (expected to parallel PA) and functioning difficulties (expected to parallel NA). Aim 3 was investigated by comparing groups in relation to the four individual emotion regulation strategies. To Test Aim 4 (group moderation of the relationship between emotionality and emotion regulation), groups were first collapsed to investigate overall relationships between emotionality (PA and NA) and emotion regulation efforts. Subsequently, Group status was added to these models as a hypothesized moderator. Effect sizes for each of the effects across Aims 1–4 were computed using a pseudo R square—that is, how much variance at either level 1 or level 2 a variable (or set of variables) explained (Peugh, 2010). We calculated a pseudo R square for the effect of group rather than the specific differences between each of the pairs of groups. For effect sizes of group differences, the effect size represented a measure of how much between-subjects variability group differences explain, whereas the effect size of PA and NA on emotion regulation represented the amount of within-subject variation the positive and negative emotions explain. All explained variances for Aims 1–3 were of the between-person component of the variance of each outcome and for Aim 4 all explained variances were of the within-person component of the variance of each outcome.

Results

Demographic and Clinical Characteristics

As shown in Table 1, BD, MDD, and CTL participants did not differ significantly with respect to age, gender, or ethnicity. All groups also scored well below standardized cutoffs on the YMRS (≤7) and IDS-C (≤11) and did not differ in YMRS scores. The BD and MDD groups both scored higher than the CTL groups on subsyndromal depressive symptoms (IDS-C), but did not differ from each other.[2] The BD group scored lower on global functioning (GAF) than the MDD and CTL groups, and the MDD group also scored lower than the CTL group on GAF scores.

Preliminary Analyses

Preliminary analyses investigated missing data patterns and study compliance rates, and contextual factors. Rates of missing data did not differ across the four event epochs (i.e., 9:00 a.m. – 12:00 p.m.: 22.8%; 12:00 – 3:00 p.m.: 24.0%; 3:00 – 6:00 p.m.: 22.8%; 6:00 – 9:00 p.m.: 23.0%; $p = .98$). All participants met the minimum criterion of 25% response rate to the 24 experience-sampling events. Missing data were also similar for Day 1–5 (18.5–24.7% missing). Day 6 showed slightly higher rates of missing data (33.6%). We note that no group differences in missing data patterns emerged (BD: 21.8%; MDD: 25.0%; CTL: 23.2%) ($p = .78$).

Second, we examined potential group differences in context activities and social context reported at each experience-sampling event (see Table 2). In the sample as a whole (i.e., groups collapsed), a highly endorsed activity was "recreation" (34.8%), a moderately endorsed activity was "socializing" (18.0%), while "bathing" (2.3% was rarely endorsed. Across groups, a highly endorsed social context was "alone" (46.8%), moderately endorsed social context was "family" (19.5%), and rarely endorsed social context was "stranger" (7.3%). Overall, the pattern of endorsed activities and contexts suggested the categories were broadly successful in capturing participants' daily activities. Investigation of group differences in activities or social context found no systematic evidence of a group effect (3 of 51 comparisons reached significance; see Table 2).

Hypothesis Testing

Aim 1: Group differences in positive emotionality. Neither the persistence (BD > CTL and MDD) nor the attenuation (CTL > BD and MDD) hypotheses of group differences in positive emotion were fully supported. The BD group was reported higher PA than the MDD group, but the BD and CTL groups did not differ in PA (see Table 2). This pattern of the BD group associating with the CTL group for positive emotionality (i.e., BD and CTL > MDD) was paralleled in the secondary analyses of the discrete PA item *joy* and daily reports of life satisfaction. As with PA, the BD group was higher than the MDD group on these two measures, but showed a trend to be lower than CTL group (the difference between CTL and BD groups reached significance in the case of daily reports of satisfaction). Effect size calculations revealed that group differences accounted for 7% of the variance in PA, 13% of the variance in joy, and 22% of the variance in life satisfaction (see Figure 1).

Aim 2: Group differences in negative emotionality. The hypothesis that NA and related variables would be elevated in the two mood disorder groups (BD and MDD) compared with the CTL group was supported. Also in line with expectations, the BD and MDD groups did not differ significantly (see Table 2; Figure 2). The pattern of BD associating with the MDD group for NA was paralleled in the secondary analyses of discrete NA items *sadness* and *anger* and in daily reports of functional impairment. Specifically, the BD and MDD groups reported greater sadness, anger and daily functioning difficulties than the CTL group (see Figure 2). The two clinical groups did not differ significantly from one another on sadness or daily functioning difficulties, but reports of anger were higher in the MDD than the BD group. Effect size calculations revealed that differences in groups accounted for 17% of the variance in NA, 21% of the

[1] For completeness, analyses were also conducted using a more traditional aggregating approach. Given that findings with the traditional aggregating approach were effectively identical to those from HLM, only the latter are presented.

[2] We note that we reran all models looking at group differences in our main outcomes with IDS-C as a control variable. No theoretically meaningful pattern of changes resulted as a function of including IDS-C as a control. We thus present here findings without IDS-C in the models.

Table 2
Descriptive Statistics for Experience-Sampling Variables by Diagnostic Group

Domain	Measure	Group BD (n = 31)	Group MDD (n = 21)	Group CTL (n = 32)
Emotionality				
Positive Emotionality	PA	2.41 (0.03)[b]	2.08 (0.04)[a,b]	2.59 (0.04)[a]
	Joy	2.70 (0.11)[a]	2.21 (0.14)[a,b]	2.95 (0.16)[b]
	Satisfaction	3.34 (0.05)[a]	2.84 (0.08)[a]	3.65 (0.07)[a]
Negative Emotionality	NA	1.28 (0.02)[a]	1.39 (0.02)[b]	1.14 (0.01)[a,b]
	Anger	1.53 (0.07)[a,c]	1.83 (0.10)[b,c]	1.39 (0.06)[a,b]
	Sadness	1.48 (0.08)[a]	1.67 (0.09)[b]	1.20 (0.04)[a,b]
	Functioning Difficulties	7.09 (0.05)[a]	6.70 (0.08)[b]	7.54 (0.07)[a,b]
Emotion regulation effort	Reappraisal	1.53 (0.04)	1.39 (0.04)	1.25 (0.03)
	Calming	1.96 (0.05)[a]	1.70 (0.05)[b]	1.40 (0.03)[a,b]
	Suppression	1.79 (0.05)[a]	1.81 (0.06)[b]	1.40 (0.03)[a,b]
	Distraction	1.77 (0.04)[a]	1.84 (0.06)[b]	1.29 (0.03)[a,b]
Context				
Event	Recreation	32.4%	39.3%	34.20%
	Working	19.1%	24.1%	26.00%
	Errands	17.9%	19.1%	22.10%
	Eating	13.0%[a]	11.1%[b]	18.4%[a,b]
	Socializing	17.3%	17.4%	19.20%
	Resting	16.2%	14.4%	13.90%
	Exercising	3.8%	2.8%	6.40%
	Shopping	3.0%	2.4%	3.80%
	Other	11.7%	14.9%	13.80%
	Bathing	2.6%	1.2%	2.60%
Social activity	Alone	46.4%	49.3%	45.6%
	Family	23.4%	19.8%	15.6%
	Friend	13.4%	16.8%	15.4%
	Worker	8.4%	10.5%	12.5%
	Partner	13.6%	7.6%	10.8%
	Stranger	4.1%[a]	10.1%[a]	8.6%

Note. BD = Bipolar I disorder group; MDD = Major depressive disorder group; CTL = Healthy control group; PA = Positive Affect; NA = Negative Affect. Means and standard error values are in parentheses where applicable. Event-related ratings (i.e., PA, NA, Emotion regulation and context variables) reflect average values across the 24 individual experience-sampling events. Daily ratings (i.e., satisfaction and functioning difficulties) reflect values averaged across the six daily reports. Means sharing a superscript letter (a, b, or c) were significantly different in specific group comparisons ($p < .05$). Percentages for context represent the percent of all beeps that these events were reported on. Standard error values (between-group) are included in parentheses.

variance in sadness, 14% of the variance in anger, and 13% of the variance in functional impairment.

Aim 3: Group differences in emotion regulation efforts. For this aim, we examined emotion regulation efforts for each of our four individual emotion regulation strategies. As predicted, both BD and MDD groups reported greater overall emotion regulation efforts compared with the CTL group across individual strategies for calming, distraction, and suppression items, and trended in this direction for reappraisal ($p = .07$; see Table 2; Figure 3). Effect size calculations revealed that differences in groups accounted for 15% of the variance in calming, 14% of the variance in distraction, and 7% of the variance in suppression, and 3% of the variance for reappraisal.

Aim 4: Exploring associations between emotionality and emotion regulation efforts. We tested for evidence in favor of either of the two competing perspectives (viz., BD having a weaker link between emotionality and emotion regulation vs. a stronger link between emotionality and emotion regulation). Both PA and NA (group-mean centered) were entered into the model as predictors. When the groups were collapsed and the four specific emotion regulation strategies were used as dependent variables in a model with PA and NA as predictors, a range of significant main effects were found (see Table 3). Across all participants, NA was positively associated with all four individual regulation strategies; namely, reappraisal, calming, suppression, and distraction (ps $< .05$). Across all participants, PA was positively related to reappraisal, negatively related to calming, and not significantly related to suppression or distraction. Investigation of the potential moderating effect of Group found no systematic evidence of group effects on the link between emotionality (PA and NA) with the emotion regulation items.

[3] We note that of the five significant findings, trends suggested that the BD group engaged in more suppression as a function of NA compared with the CTL ($b = -0.33$, $t(1,434) = -2.13$, $p < .05$) and MDD ($b = -0.35$, $t(1,434) = -2.33$, $p < .05$) groups, and exhibited trends toward engaging in less suppression as a function of PA compared with the CTL ($b = 0.17$, $t(1,524) = 1.92$, $p = .055$) and MDD ($b = 0.20$, $t(1,434) = 1.85$, $p = .065$) groups. Furthermore, the BD group engaged in more distraction as a function of PA relative to the MDD group ($b = -0.24$, $t(1,434) = -2.24$, $p < .05$) and NA relative to the MDD group ($b = -0.29$, $t(1,434) = -1.94$, $p = .053$).

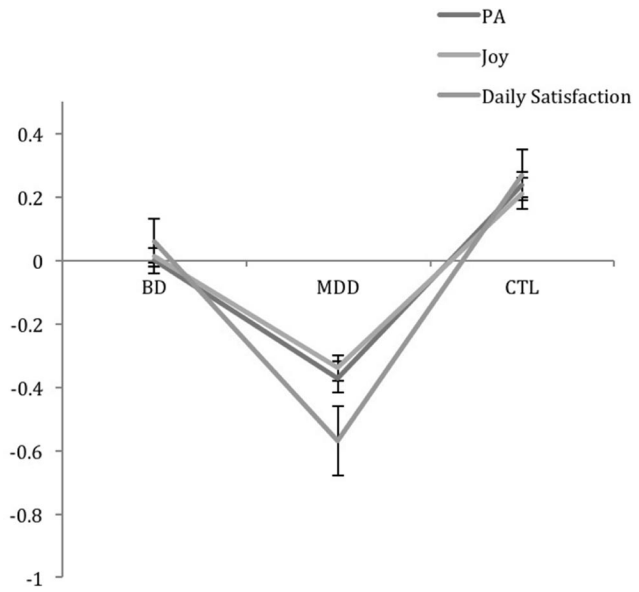

Figure 1. Group differences in positive emotionality. Values reflect standardized z-scores (with standard error bars). Higher values reflect greater self-reported positive emotionality.

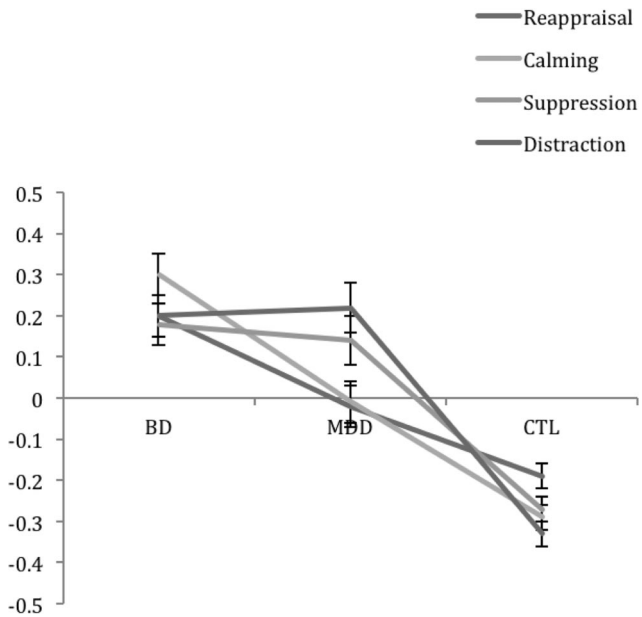

Figure 3. Group differences in emotion regulation effort. Values reflect standardized z-scores (with standard error bars). Higher values reflect greater self-reported emotion regulation efforts.

Specifically, only five out of 30 models reached conventional significance levels, but small effect sizes in the context of a large number of tests precluded definitive conclusions.[3] Effect size calculations revealed that within-person differences accounted for 2% of the variance in reappraisal, 6% of the variance in calming, 4% of the variance in suppression, and 2% of the variance in distraction.[4,5]

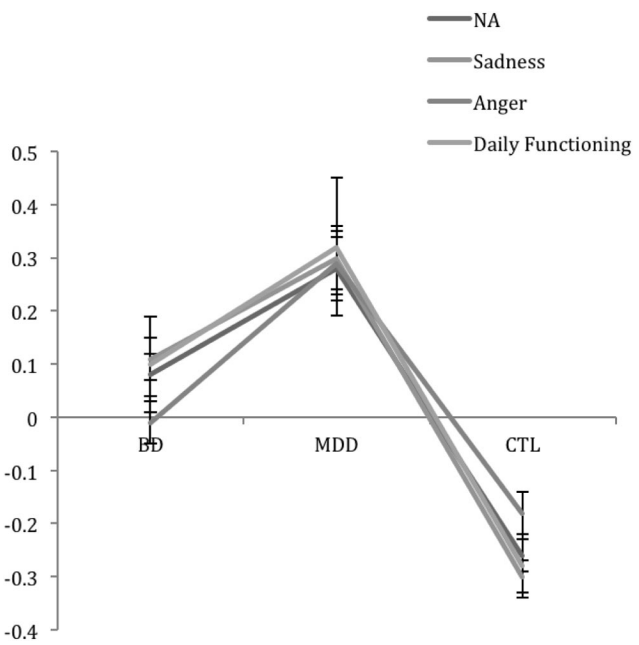

Figure 2. Group differences in negative emotionality. Values reflect standardized z-scores (with standard error bars). Higher values reflect greater self-reported negative emotionality.

Discussion

The present investigation adopted an ecologically valid and rigorous approach to characterize positive and negative emotionality, as well as emotion regulation efforts, in remitted individuals with BD, as compared with remitted individuals with MDD and healthy controls. The study was unique in combining a real-world

[4] Given literature suggesting affect instability in bipolar spectrum disorders (Lovejoy & Steuerwald, 1995), we conducted preliminary investigations of group differences for variability in NA and PA. Results were not suggestive of group differences for variability in NA ($ps > .93$) or variability in PA ($ps > .33$).

[5] The repeated measures nature of our data invites the exploration of lagged effects of emotion regulation and affect (particularly NA) on one another, as well as the potential moderating role of Group status. However, such analyses were likely to be uninformative for a number of reasons: (1) The sample size restrictions indicated that any such investigation would likely be underpowered to detect these complex interaction effects; (2) There was a relatively low density of experience sampling events (4 per day), and events were randomly sampled within 3-hr epochs, meaning that the temporal relationship between any two sequential elements is tenuous at best; and (3) The specific design of the momentary self-reports did not lend itself to interpretation in terms of time-lagged relationships insofar as participants were asked to report on the activities/context when prompted, rate the emotions they felt at that time, and report on any emotion regulation strategies they were employing at that time. Notwithstanding these limitations, a provisional investigation was conducted. Unsurprisingly given the points above, we did not detect significant moderation by Group of either lagged NA for emotion regulation composite, or the emotion regulation composite for NA ($ps > .10$). Such findings are not indicative of an absence of differences in lagged relationships generally but instead call for future work that can overcome the methodological limitations necessary to conduct a definitive test of these questions.

Table 3
Emotionality Predicting Emotion Regulation Efforts Across Participants

	Within-subject		Between-subject	
Emotion regulation strategy	PA (*b*)	NA (*b*)	PA (*b*)	NA (*b*)
Reappraisal	0.09*	0.26**	0.28*	.97**
Calming	−0.10**	0.58**	0.16	1.02**
Suppression	−0.07	0.52**	0.08	1.08**
Distraction	0.04	0.33**	0.02	0.98**

Note. Values represent unstandardized beta weights.
* $p < .05$. ** $p < .01$.

perspective with a broad, theoretically driven conceptualization of emotionality and testing for both disorder-specific and transdiagnostic features of emotion disturbance in BD. Findings provide an important complement to laboratory investigations that have thus far dominated our understanding of emotionality in BD.

Aim 1: Group Differences in Positive Emotionality

The first aim tested whether the remitted BD group self-reported greater positive emotionality relative to both remitted MDD and CTL groups (positive emotion persistence hypothesis) or decreased positive emotionality relative to MDD and CTL groups (positive emotion attenuation hypothesis). Consistent with the positive emotion persistence hypothesis, the remitted BD group reported higher positive emotionality, as well as increased daily satisfaction, compared with the remitted MDD group. Such findings converge with previous laboratory and questionnaire studies suggesting that heightened and persistent positive emotionality distinguish individuals with BD from those with MDD (e.g., Gruber, 2011a, 2011b). The fact that group differences emerged in the remitted BD sample provides suggestive evidence that heightened positive and reward-relevant states may represent an important marker of vulnerability for BD (Gruber, 2011a; Johnson, 2005). At the same time, these results diverge from two previous ESM studies in remitted BD adults that reported decreased levels of positive emotionality relative to controls (Myin-Germeys et al., 2003; Havermans et al., 2010). Several methodological differences may account for the observed discrepancy. First, the present study used a diverse assessment of 10 positive emotion items sampling from both high and low arousal affective domains. By contrast, Havermans and colleagues' positive affect items were more heavily weighted toward high-arousal positive states specifically (i.e., enthusiastic, strong and energetic) and psychomotor activity independent of affective experience (i.e., talkative, strong), whereas Myin-Germeys and colleagues included a more narrow sampling of three specific positive items (i.e., happy, cheerful, satisfied). We note, however, that our results generalized across both broader positive emotionality composites and specific positive emotion items, bolstering the validity of the present findings. Second, the present study focused exclusively on remitted BD Type I participants whereas both earlier studies included a combination of remitted BD Type I II participants. Given BD type II is typically associated with a more severe and recurrent depressive symptom course (Judd et al., 2003), it is plausible that this subgroup may have dampened overall levels of positive emotionality for the BD group. Finally, BD participants in the earlier studies were older on average than in the present sample, perhaps leading to decreased levels of positive emotionality resulting from greater illness progression over time in the earlier samples (e.g., Gruber, Culver, Johnson, Nam, Keller, & Ketter, 2009). Future examination of the influence of these methodological differences on emotionality in BD is an important next step.

Inconsistent with either hypothesis, the remitted BD group did not report different levels of positive emotionality and daily satisfaction compared with the CTL group. This finding diverges from laboratory studies suggesting that individuals at risk for, and diagnosed with, BD self-report greater positive emotionality (both at the composite level and for the individual emotion of joy) compared with healthy control or low-risk comparison groups (e.g., Gruber et al., 2008; Gruber, Harvey & Purcell, 2011). How might prior laboratory findings be reconciled with the present ESM data? One key distinction is that controlled laboratory environments minimize the influence of everyday emotional triggers and life events on positive emotionality, while the present reports of positive emotionality were open to the real-world impact of everyday life events and stressors during the ESM study period. Prior work has documented increased rates of life stress in BD (Johnson & Roberts, 1995) and associations between life stress and distress as well as decreased positive emotionality in mood disorders (e.g., Ellicott et al., 1990; Myin-Germeys et al., 2003). Consistent with this reasoning, in the present study elevated rates of negative emotionality were found in the BD group compared with the CTL group (see Aim 2 below). People with BD may have a propensity toward heightened positive emotionality compared with healthy adults, all else being equal (e.g., Gruber, 2011a). Future research could usefully explore the hypothesis that laboratory studies control for stressful stimuli, thereby masking a tendency toward NA in BD and exposing elevated propensity for PA relative to the general population.

Aim 2: Group Differences in Negative Emotionality

We predicted that individuals with remitted BD would self-report greater negative emotionality and daily functional impairment compared with healthy controls, but at comparable levels to the remitted MDD group. Consistent with our predictions, both the BD and MDD groups reported greater negative emotionality and daily functioning difficulties compared with healthy controls but did not themselves differ. These findings suggest that both clinical groups are characterized by heightened negative affectivity using long-term measurement tools such as trait questionnaires and repeated-assessments of emotion (e.g., Bylsma et al., 2008; Hofmann & Meyer, 2006; Myin-Germeys et al., 2003), as well as reports of impaired functioning in both clinical groups (e.g., Fagiolini et al., 2005). Such findings point to a common feature shared across mood-disordered individuals in everyday life. This shared substrate of subjective distress across mood disordered individuals is likely reflective of a more general transdiagnostic feature across disorders. Heightened negative emotionality observed in the BD group in particular is also consistent with clinical observations of the frequent and severe depressive course common in BD (e.g., Judd et al., 2003; Judd et al., 2005; Perlis et al., 2005). The fact that these group differences emerged in the present

remitted samples suggests that heightened more chronic negative states may represent a trait marker shared across mood disorders.

It is important to note that these findings are again not consistent with laboratory-based assessments. Laboratory investigations typically find comparable levels of negative emotionality among those diagnosed with BD and healthy controls (for review, see Johnson, Gruber & Eisner, 2007). It is likely that laboratory paradigms typically reflect more short-term assessments of negative emotion *reactivity*, measured as the magnitude of change in negative emotion from an individual's baseline state (Gross, Sutton, & Ketalaar, 1998), whereas the present ESM study design may have tapped into other sources of negative affectivity, reflecting a possible combination of higher basal levels of negative emotionality and a greater occurrence of stressful life events (e.g., Johnson & Roberts, 1995; Judd et al., 2003; Murray & Goldstone, 2007). The one exception consistent with laboratory research is the finding here that the BD group reported increased anger compared with the CTL group, consistent with prior laboratory studies reporting elevated anger in BD and BD-prone individuals (e.g., Carver & Harmon-Jones, 2009; Gruber et al., 2008). In sum, one of the outcomes of the present study is a reminder that although not specific to BD, heightened negative emotionality shared with MDD is important in people with BD.

Aim 3: Group Differences in Emotion Regulation Efforts

Investigation of the study's third aim provided one of the first descriptive accounts of specific regulation strategies reported by individuals with BD outside of the laboratory. Consistent with our predictions, we found greater emotion regulation efforts in the two clinical groups compared with the CTL group across distinct individual strategies. These findings dovetail with literature on BD suggesting greater self-reported effort and engagement across adaptive (i.e., reappraisal) and maladaptive (i.e., suppression, rumination) strategies, and across state-level reports during laboratory experiments and trait-level questionnaires (e.g., Gruber et al., 2012; Gruber, 2011a, 2011b). Such work is consistent with the idea that those suffering from mood disorders may engage in greater emotion regulation efforts in an attempt to combat intense mood states (e.g., Gruber, Eidelman, & Harvey, 2008; Mansell et al., 2007).

These findings raise several intriguing questions for future experimental studies to address. First, it is unclear whether the heightened regulation efforts observed in BD are in response to heightened negative emotionality observed in BD, or whether these heightened efforts to (perhaps unsuccessfully) regulate and manage intense emotions themselves are a source of distress for individuals with BD. In other words, could a constant battle to manage one's heightened emotions in everyday life in BD create a constant and chronic source of distress itself, rather than heightened negative emotionality reflecting a feature of an underlying affective vulnerability? Or might the negative emotionality observed in everyday life in BD reflect a secondary response to, or internal appraisal of, positive mood states observed in BD (e.g., Mansell et al., 2007)? Second, it is unclear precisely *why* those with BD engage in a greater degree of regulation strategies. Do they recruit multiple regulation strategies because they do not accurately appraise the intensity of their current state to use emotion regulation strategy choices suited for high versus low arousal emotions, for example (Sheppes et al., 2011)? Independent of mechanistic questions, it is clear from the present study that BD patients engage in heightened and broad-ranging emotion regulation efforts in everyday life, supporting the focus of psychosocial treatments on improving emotion regulation expertise in such patients (e.g., Mennin & Fresco, in press).

Aim 4: Exploring Associations Between Emotionality and Emotion Regulation

The final aim was to explore naturalistic associations between emotionality and emotion regulation efforts, and ascertain the degree to which diagnostic group (specifically BD) moderated this relationship. These analyses must be seen in the context of the complex bidirectional (and some would say unparsable) relationship between emotionality and emotion regulation, and inferences are provisional (e.g., Gross & Barrett, 2011). Existing literature suggested two contrasting relations might obtain, namely, the emotionality-emotion regulation link would be weaker in the BD relative to the MDD and healthy control groups because of an underlying regulation deficit in BD, and the emotionality-emotion regulation link would be stronger in the BD relative to the MDD and healthy control groups because of increased efforts to regulate (Gruber et al., 2011, 2012). Results did not provide support for either perspective. Although we found that NA was related to greater emotion regulation efforts overall, as would be expected a priori (e.g., Gross, 1998), we did not find consistent evidence that this relationship was moderated by diagnostic group. Although it is possible that our data were statistically underpowered to detect the moderating effect of diagnostic group on the association between emotionality and emotion regulation, we cannot rule out the possibility that the diagnostic groups did not differ in the associations between emotionality and emotion regulation as measured under naturalistic conditions. This negative finding perhaps motivates a return to more tightly controlled laboratory studies as an approach to investigate the clinically important three-way associations that were predicted here.

Limitations and Future Directions

Our findings should be interpreted within the confines of several limitations. First, the present findings relied exclusively on participant's subjective reports of emotionality and emotion regulation. Although this represents an important advance in understanding the nature of emotion disturbance from the patient's perspective, it will be important for future research to augment this data with observational ratings, particularly given the illness-related insight difficulties of BD (e.g., Ghaemi & Rosenquist, 2004; Gruber & Persons, 2010). We are thus unable to infer whether estimates of heightened emotionality in the clinical groups reflect an instantiation of heightened emotion reactivity, difficulty down-regulating an existing emotion state, or some combination of both. Similarly, concurrent measurement of emotion functioning using laboratory and ESM methods would throw light on the relationship between dispositions and their interactions with everyday life. Second, the present study did not explicitly assess the role of contextual factors in influencing the obtained findings. Future studies are thus warranted to investigate these critical interactions between context and

emotion-related functioning in mood disorders. Measurement of the directionality of regulation efforts (i.e., focused on increasing or decreasing emotion intensity) as well as the inclusion of additional regulation strategies gaining increasing attention in the field and shown to be effective in reducing distress and symptom severity—such as acceptance in mindfulness traditions (e.g., Chambers, Gullone, & Allen, 2009) or acting opposite to one's emotional state (e.g., Linehan, 1993)—should also be incorporated in future studies. Third, we note that the present sample sizes and compliance rates are impressive given the severe nature of the psychiatric groups recruited and complexity of the measured variables. Nonetheless, it will be important to replicate these findings in a larger sample. Fourth, both BD and MDD participants in the present study were currently remitted at the time of testing. In many ways, this represents a relative strength insofar as it enables the identification of vulnerability factors during the remission period that may predict sustained impairment during the remission period and subsequent symptom recurrence. Nonetheless, it will be critical to examine the relative influence of manic and depressive mood state to isolate trait versus more state-related features of emotion disturbance and regulation. Fifth, we did not include a comparison clinical group with heightened positive emotionality (e.g., pathological gambling; Vachon & Bagby, 2009) or a comparison group with elevated affective instability (e.g., borderline personality disorder; Coifman et al., 2012; Trull et al., 2008). However, the fact that the present study included a third clinical comparison group to examine emotion difficulties within the mood disorder family represents a strength and important first step in this transdiagnostic mission to identify shared and dimensional features across individuals (e.g., Insel et al., 2010). Sixth, given the challenges of accessing an unmedicated BD sample, we were unable to investigate the influence of medication effects on results. However, future studies with larger sample sizes, assessment of blood serum levels, and random assignment of individuals on different medication classes are warranted. Finally, this study was cross-sectional and thus could not address hypotheses regarding how emotionality in everyday life predicts the course of relapse and recurrence in MDD hastening the need for longitudinal designs.

Despite these limitations, the present study provided an important and novel insight into the landscape of emotion disturbance in individuals with BD. Such investigations are an important step forward in identifying potential vulnerability factors that predict impairment and relapse in BD and emotional disorders more generally. The present study underscores the importance of understanding the complexity of emotion-related functioning parameters in individuals suffering from BD, and urges future research to consider the ecological validity of the context in which emotion is studied.

References

Alloy, L. B., Abramson, L. A., Urosevic, S., Bender, R. E., & Wagner, C. A. (2009). Longitudinal predictors of bipolar spectrum disorders: A behavioral approach system (BAS) perspective. *Clinical Psychology: Science and Practice, 16,* 206–226. doi:10.1111/j.1468-2850.2009.01160.x

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., Text Revision). Washington, DC: Author.

Bolger, N., Davis, A., & Rafaeli, E. (2003). Diary methods: Capturing life as it is lived. *Annual Review of Psychology, 54,* 579–616. doi:10.1146/annurev.psych.54.101601.145030

Bylsma, L. M., Morris, B. H., & Rottenberg, J. (2008). A meta-analysis of emotional reactivity in major depressive disorder. *Clinical Psychology Review, 28,* 676–691. doi:10.1016/j.cpr.2007.10.001

Bylsma, L. M., Taylor-Clift, A., & Rottenberg, J. (2011). Emotional reactivity to daily events in major and minor depression. *Journal of Abnormal Psychology, 120,* 155–167. doi:10.1037/a0021662

Carver, C. S., & Harmon-Jones, E. (2009). Anger is an approach-related affect: Evidence and implications. *Psychological Bulletin, 135,* 183–204. doi:10.1037/a0013965

Chambers, R., Gullone, E., & Allen, N. B. (2009). Mindful emotion regulation: An integrative review. *Clinical Psychology Review, 29,* 560–572. doi:10.1016/j.cpr.2009.06.005

Cohn, M. A., Fredrickson, B. L., Brown, S. L., Mikels, J. A., & Conway, A. M. (2009). Happiness unpacked: Positive emotions increase life satisfaction by building resilience. *Emotion, 9,* 361–368. doi:10.1037/a0015952

Coifman, K. G., Berenson, K. R., Rafaeli, E., & Downey, G. (2012). From negative to positive and back again: Polarized affective and relational experience in borderline personality disorder. *Journal of Abnormal Psychology, 121,* 668–679. doi:10.1037/a0028502

Conner, T. S., Tennen, H., Fleeson, W., & Barrett, L. F. (2009). Experience sampling methods: A modern idiographic approach to personality research. *Social and Personality Psychology Compass, 3,* 292–313. doi:10.1111/j.1751-9004.2009.00170.x

Csikszentmihalyi, M., & Larson, R. (1987). Validity and reliability of the experience-sampling method. *Journal of Nervous and Mental Disease, 175,* 526–536. doi:10.1097/00005053-198709000-00004

Cuellar, A. K., Johnson, S. K., & Ruggero, C. (2009). Affective reactivity in response to criticism in remitted bipolar disorder: A laboratory analog of Expressed Emotion. *Journal of Clinical Psychology, 65,* 925–941. doi:10.1002/jclp.20596

Ellicott, A., Hammen, C., Gitlin, M., Brown, G., & Jamison, K. (1990). Life events and the course of bipolar disorder. *The American Journal of Psychiatry, 147,* 1194–1198.

Fagiolini, A., Kupfer, D., Masalehdan, A., Scott, J. A., Houck, P. R., & Frank, E. (2005). Functional impairment in the remission phase of bipolar disorder. *Bipolar Disorders, 7,* 281–285. doi:10.1111/j.1399-5618.2005.00207.x

Farmer, A., Lam, D., Sahakian, B., Roiser, J., Burke, A., O'Neill, N., . . . McGuffin, P. (2006). A pilot study of positive mood induction in euthymic bipolar subjects compared with healthy controls. *Psychological Medicine, 36,* 1213–1218. doi:10.1017/S0033291706007835

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. W. (1996). *Structured Clinical Interview for DSM–IV Axis I Disorders (SCID).* New York, NY: Biometrics Research, New York State Psychiatric Institute.

Forbes, E. E., Miller, A., Cohn, J. F., Fox, N. A., & Kovacs, M. (2005). Affect-modulated startle in adults with childhood-onset depression: Relations to bipolar course and number of lifetime depressive episodes. *Psychiatry Research, 134,* 11–25. doi:10.1016/j.psychres.2005.01.001

Ghaemi, S. N., & Rosenquist, K. J. (2004). Is insight in mania state-dependent? A meta-analysis. *Journal of Nervous and Mental Disease, 192,* 771–775. doi:10.1097/01.nmd.0000145036.76435.c3

Goldberg, J. F., & Harrow, M. (2005). Subjective life satisfaction and objective functional outcome in bipolar and unipolar mood disorders: A longitudinal analysis. *Journal of Affective Disorders, 89,* 79–89. doi:10.1016/j.jad.2005.08.008

Gross, J. J. (1998). Antecedent- and response-focused emotion regulation: Divergent consequences for experience, expression, and physiology. *Journal of Personality and Social Psychology, 74,* 224–237. doi:10.1037/0022-3514.74.1.224

Gross, J. J., & Barrett, L. F. (2011). Emotion generation and emotion regulation: One or two depends on your point of view. *Emotion Review, 3,* 8–16. doi:10.1177/1754073910380974

Gross, J. J., Sutton, S. K., & Ketelaar, T. (1998). Relations between affect and personality: Support for the affect-level and affective reactivity views. *Personality and Social Psychology Bulletin, 24,* 279–288. doi:10.1177/0146167298243005

Gruber, J. (2011a). When feeling good can be bad: Positive emotion persistence (PEP) in bipolar disorder. *Current Directions in Psychological Science, 20,* 217–221. doi:10.1177/0963721411414632

Gruber, J. (2011b). A review and synthesis of positive emotion and reward disturbance in bipolar disorder. *Clinical Psychology & Psychotherapy, 18,* 356–365. doi:10.1002/cpp.776

Gruber, J., Culver, J. L., Johnson, S. L., Nam, J. Y., Keller, K. L., & Ketter, T. A. (2009). Do positive emotions predict symptomatic change in bipolar disorder? *Bipolar Disorders, 11,* 330–336. doi:10.1111/j.1399-5618.2009.00679.x

Gruber, J., Eidelman, P., & Harvey, A. G. (2008). Transdiagnostic emotion regulation processes in bipolar disorder and insomnia. *Behaviour Research and Therapy, 46,* 1096–1100. doi:10.1016/j.brat.2008.05.004

Gruber, J., Eidelman, P., Johnson, S. L., Smith, B., & Harvey, A. G. (2011). Hooked on a feeling: Rumination about positive and negative emotion in inter-episode bipolar disorder. *Journal of Abnormal Psychology, 120,* 956–961. doi:10.1037/a0023667

Gruber, J., Harvey, A. G., & Gross, J. J. (2012). When trying is not enough: Emotion regulation and the effort-success gap in bipolar disorder. *Emotion, 12,* 997–1003. doi:10.1037/a0026822

Gruber, J., Harvey, A. G., & Johnson, S. L. (2009). Reflective and ruminative processing of positive emotional memories in bipolar disorder and healthy controls. *Behaviour Research and Therapy, 47,* 697–704. doi:10.1016/j.brat.2009.05.005

Gruber, J., Harvey, A. G., & Purcell, A. (2011). What goes up can come down? A preliminary investigation of emotion reactivity and emotion recovery in bipolar disorder. *Journal of Affective Disorders, 133,* 457–466. doi:10.1016/j.jad.2011.05.009

Gruber, J., Johnson, S. L., Oveis, C., & Keltner, D. (2008). Risk for mania and positive emotional responding: Too much of a good thing? *Emotion, 8,* 23–33. doi:10.1037/1528-3542.8.1.23

Gruber, J., Oveis, C., Keltner, D., & Johnson, S. L. (2011). A discrete emotions approach to positive emotion disturbance in depression. *Cognition and Emotion, 25,* 40–52. doi:10.1080/02699931003615984

Gruber, J., & Persons, J. B. (2010). Unquiet treatment: Handling treatment refusal in bipolar disorder. *Journal of Cognitive Psychotherapy, 24,* 16–25. doi:10.1891/0889-8391.24.1.16

Hassel, S., Almeida, J. R. C., Kerr, N., Nau, S., Ladoceur, C. D., Fissell, K., . . . Phillips, M. L. (2008). Elevated striatal and decreased dorsolateral prefrontal cortical activity in response to emotional stimuli in euthymic bipolar disorder: No associations with psychotropic medication load. *Bipolar Disorders, 10,* 916–927. doi:10.1111/j.1399-5618.2008.00641.x

Havermans, R., Nicolson, J., Berkhof, J., & de Vries, M. W. (2010). Mood reactivity to daily events in patients with remitted bipolar disorder. *Psychiatry Research, 179,* 47–52. doi:10.1016/j.psychres.2009.10.020

Hofmann, B. U., & Meyer, T. D. (2006). Mood fluctuations in people putatively at risk for bipolar disorders. *British Journal of Clinical Psychology, 45,* 105–110. doi:10.1348/014466505X35317

Insel, T., Cuthbert, B., Garvey, M., Heinssen, R., Pine, D. S., Quinn, K., . . . Wang, P. (2010). Research domain criteria (RDoC): toward a new classification framework for research on mental disorders. *The American Journal of Psychiatry, 167,* 748–751. doi:10.1176/appi.ajp.2010.09091379

John, O. P., & Gross, J. J. (2004). Health and unhealthy emotion regulation: Personality processes, individual differences, and life span development. *Journal of Personality, 72,* 1301–1333. doi:10.1111/j.1467-6494.2004.00298.x

Johnson, S. L. (2005). Mania and dysregulation in goal pursuit: A review. *Clinical Psychology Review, 25,* 241–262. doi:10.1016/j.cpr.2004.11.002

Johnson, S. L., Cuellar, A. K., Ruggero, C., Winett-Perlman, C., Goodnick, P., White, R., & Miller, I. (2008). Life events as predictors of mania and depression in bipolar I disorder. *Journal of Abnormal Psychology, 117,* 268–277. doi:10.1037/0021-843X.117.2.268

Johnson, S. L., Gruber, J., & Eisner, L. (2007). Emotion in bipolar disorder. In J. Rottenberg and S. L. Johnson (Eds.), *Emotion and psychopathology: Bridging affective and clinical science* (pp. 123–150). Washington, DC: American Psychological Association. doi:10.1037/11562-006

Johnson, S. L., McKenzie, G., & McMurrich, S. (2008). Ruminative responses to positive and negative affect among students diagnosed with bipolar disorder and major depressive disorder. *Cognitive Therapy and Research, 32,* 702–713. doi:10.1007/s10608-007-9158-6

Johnson, S. L., & Roberts, J. E. (1995). Life events and bipolar disorder: Implications from biological theories. *Psychological Bulletin, 117,* 434–449. doi:10.1037/0033-2909.117.3.434

Joormann, J. (2010). Cognitive inhibition and emotion regulation in depression. *Current Directions in Psychological Science, 19,* 161–166. doi:10.1177/0963721410370293

Judd, L. L., Akiskal, H. S., Schettler, P. J., Coryell, W., Endicott, J., Maser, J. D., . . . Keller, M. B. (2003). A prospective investigation of the natural history of the long-term weekly symptomatic status of bipolar II disorder. *Archives of General Psychiatry, 60,* 261–269. doi:10.1001/archpsyc.60.3.261

Judd, L. L., Akiskal, H. S., Schettler, J., Endicott, J., Leon, A. C., Solomon, D. A., . . . Keller, M. B. (2005). Psychosocial disability in the course of bipolar I and II disorders: A prospective, comparative, longitudinal study. *Archives of General Psychiatry, 62,* 1322–1330. doi:10.1001/archpsyc.62.12.1322

Judd, L. L., Paulus, M. P., Wells, K. B., & Rappaport, M. H. (1996). Socioeconomic burden of subsyndromal depressive symptoms and major depression in a sample of the general population. *The American Journal of Psychiatry, 153,* 1411–1417.

Kasch, K. L., Rottenberg, J., Arnow, B., & Gotlib, I. H. (2002). Behavioral activation and inhibition systems and the severity and course of depression. *Journal of Abnormal Psychology, 111,* 589–597. doi:10.1037/0021-843X.111.4.589

Kring, A., & Bachorowski, J. (1999). Emotions and psychopathology. *Cognition and Emotion, 13,* 575–599. doi:10.1080/026999399379195

Linehan, M. M. (1993). *Cognitive-behavioral treatment for borderline personality disorder*. New York, NY: Guilford Press.

Lovejoy, M. C., & Steuerwald, B. L. (1995). Subsyndromal unipolar and bipolar disorders: Comparisons on positive and negative affect. *Journal of Abnormal Psychology, 104,* 381–384. doi:10.1037/0021-843X.104.2.381

Malhi, G. S., Lagopoulos, J., Owen, A. M., Ivanovski, B., Shnier, R., & Sachdev, P. (2007). Reduced activation to implicit affect induction in euthymic bipolar patients: An fMRI study. *Journal of Affective Disorders, 97,* 109–122. doi:10.1016/j.jad.2006.06.005

Mansell, W., Morrison, A., Reid, G., Lowens, I., & Tai, S. (2007). The interpretation of, and responses to, changes in internal states: An integrative model of mood swings and bipolar disorders. *Behavioural and Cognitive Psychotherapy, 35,* 515–539.

M'Bailara, K. M., Demotes-Mainard, J., Swendsen, J., Mathieu, F., Leboyer, M., & Henry, C. (2009). Emotional hyper-reactivity in normothymic bipolar patients. *Bipolar Disorders, 11,* 63–69. doi:10.1111/j.1399-5618.2008.00656.x

Mennin, D. S., & Fresco, D. M. (in press). Emotion regulation therapy. In J. J. Gross (Ed.), *Handbook of emotion regulation* (2nd ed.). New York, NY: Guilford Press. doi:10.1002/cpp.389

Meyer, B., Johnson, S. L., & Winters, R. (2001). Responsiveness to threat and incentive in bipolar disorder: Relations of the BIS/BAS scales with symptoms. *Journal of Psychopathology and Behavioral Assessment, 23,* 133–143. doi:10.1023/A:1010929402770

Michalak, E. E., Murray, G., Young, A. H., & Lam, R. W. (2007). Quality of life impairment in bipolar disorder. In M. Ritsner (Ed.), *Quality of life impairment in schizophrenia, mood and anxiety disorders: From brain functions to clinical practice*. New York, NY: Springer. doi:10.1007/978-1-4020-5779-3_13

Murray, C. J. L., & Lopez, A. D. (1996). *The global burden of disease: A comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020*. Boston, MA: Harvard University Press.

Murray, G., Goldstone, E., & Cunningham, E. (2007). Personality and the predisposition(s) to bipolar disorder: Heuristic benefits of a two-dimensional model. *Bipolar Disorders, 9,* 453–461. doi:10.1111/j.1399-5618.2007.00456.x

Myin-Germeys, I., Oorschot, M., Collip, D., Lataster, J., Delespaul, L., & Os, J. (2009). Experience sampling research in psychopathology: Opening the black box of daily life. *Psychological Medicine, 39,* 1533–1547. doi:10.1017/S0033291708004947

Myin-Germeys, I., Peeters, F., Havermans, R., Nicolson, N. A., de Vries, M. W., Delespaul, P., & Van Os, J. (2003). Emotional reactivity to daily life stress in psychosis and affective disorder: An experience sampling study. *Acta Psychiatrica Scandinavica, 107,* 124–131. doi:10.1034/j.1600-0447.2003.02025.x

Nezlek, J. B. (2011). Multilevel modeling in research on personality. In R. Robins, R. C. Fraley, & R. Krueger (Eds.), *Handbook of research methods in personality psychology* (pp. 502–523). New York, NY: Guilford Press.

Perlis, R. H., Delbello, M. P., Miyahara, S., Wisniewski, S. R., Sachs, G. R., & Nierenberg, A. (2005). Revisiting depressive-prone bipolar disorder: Polarity of initial mood episode and disease course among bipolar I systematic treatment enhancement program for bipolar disorder participants. *Biological Psychiatry, 58,* 549–553. doi:10.1016/j.biopsych.2005.07.029

Peugh, J. L. (2010). A practical guide to multilevel modeling. *Journal of School Psychology, 48,* 85–112. doi:10.1016/j.jsp.2009.09.002

Phillips, M. L., & Vieta, E. (2007). Identifying functional neuroimaging biomarkers of bipolar disorder: Toward *DSM–IV*. *Schizophrenia Bulletin, 33,* 893–904. doi:10.1093/schbul/sbm060

Raudenbush, S. W., & Bryk, A. S. (2001). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Thousand Oak, CA: Sage.

Ruggero, C. J., & Johnson, S. L. (2006). Reactivity to a laboratory stressor among individuals with bipolar I disorder in full or partial remission. *Journal of Abnormal Psychology, 115,* 539–544. doi:10.1037/0021-843X.115.3.539

Sheppes, G., Scheibe, S., Suri, G., & Gross, J. J. (2011). Emotion-regulation choice. *Psychological Science, 22,* 1391–1396. doi:10.1177/0956797611418350

Sutton, S. K., & Johnson, S. J. (2002). Hypomanic tendencies predict lower startle magnitudes during pleasant pictures. *Psychophysiology, 39,* S80.

Trivedi, M. H., Rush, A. J., Ibrahim, H. M., Carmody, T. J., Biggs, M. M., Suppes, T., . . . Kashner, T. M. (2004). The Inventory of Depressive Symptomatology, Clinician Rating (IDS-C) and Self-Report (IDS-SR), and the Quick Inventory of Depressive Symptomatology, Clinician Rating (QIDS-C) and Self-Report (QIDS-SR) in public sector patients with mood disorders: A psychometric evaluation. *Psychological Medicine, 34,* 73–82. doi:10.1017/S0033291703001107

Trull, T. J., Solhan, M. B., Tragesser, S. L., Jahng, S., Wood, P. K., Piasecki, T. M., & Watson, D. (2008). Affective instability: Measuring a core feature of borderline personality disorder with ecological momentary assessment. *Journal of Abnormal Psychology, 117,* 647–661. doi:10.1037/a0012532

Vachon, D. D., & Bagby, M. R. (2009). Pathological gambling subtypes. *Psychological Assessment, 21,* 608–615. doi:10.1037/a0016846

Ware, J. E. Jr., & Sherbourne, C. D. (1992). The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Medical Care, 30,* 473–483. doi:10.1097/00005650-199206000-00002

Watson, D., Clark, L. A., & Carey, G. (1988). Positive and negative affectivity and their relation to anxiety and depressive disorders. *Journal of Abnormal Psychology, 97,* 346–353. doi:10.1037/0021-843X.97.3.346

Wessa, M., Houenou, M., Paillere-Martinot, M., Berthoz, S., Artiges, E., Leboyer, M., & Martinot, J. (2007). Front-striatal over-activation in euthymic bipolar patients during an emotional go/nogo task. *The American Journal of Psychiatry, 164,* 638–646. doi:10.1176/appi.ajp.164.4.638

Young, R. C., Biggs, J. T., Ziegler, V. E., & Meyer, D. A. (1978). A rating scale for mania: Reliability, validity and sensitivity. *The British Journal of Psychiatry, 133,* 429–435. doi:10.1192/bjp.133.5.429

Yurgelun-Todd, D. A., Gruber, S. A., Kanayama, G., Killgore, W. D., Baird, A. A., & Young, A. D. (2000). fMRI during affect discrimination in bipolar affective disorder. *Bipolar Disorders, 2,* 237–248. doi:10.1034/j.1399-5618.2000.20304.x

Received September 4, 2012
Revision received February 25, 2013
Accepted March 5, 2013 ■