

BRIEF REPORT

Emotional Cascades as Prospective Predictors of Dysregulated Behaviors in Borderline Personality Disorder

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People with borderline personality disorder (BPD) frequently engage in behaviors that may result in negative consequences. These behaviors can include binge eating, using substances, fighting, yelling, self-injuring, verbal aggression, or impulsive shopping. These behaviors frequently occur in the context of negative emotion, and they may serve to reduce it. The emotional cascade model (Selby & Joiner, 2009) asserts that people engage in these behaviors because the resulting physical sensations short-circuit emotional cascades, intense cycles of rumination, and negative emotion that are extremely painful. The purpose of the present study was to examine the potential for emotional cascades to prospectively predict the occurrence of dysregulated behaviors in daily life. Forty-seven behaviorally dysregulated participants completed 3,118 recordings of real-time emotions, thoughts, and behaviors on hand-held computers over 2 weeks. Results indicated that a 3-way interaction between elevated rumination, elevated negative emotion, and elevated BPD symptoms prospectively predicted the occurrence of a dysregulated behavior within the next 2 to 3 hr. In contrast, for those with elevated BPD symptoms, negative emotion at low levels of rumination was not predictive of a dysregulated behavior occurring, and neither was rumination at low levels of negative emotion. These findings suggest that the emotional cascade model may have important clinical implications, and future research should examine the specific facets of rumination and negative emotion involved in dysregulated behaviors.

Keywords: emotional cascades, borderline personality disorder, impulsivity, rumination, emotion regulation

A major symptom of borderline personality disorder (BPD) involves dysregulated behaviors, which have been defined as behaviors that are difficult to control and result in harm to the individual or impairment in functioning, especially when engaged in on a chronic basis (Selby & Joiner, 2009). These behaviors, although not restricted to those with diagnoses of BPD, have been found to be prevalent in BPD psychopathology and can include nonsuicidal self-injury (NSSI; Brown et al., 2002), bingeing and purging (Cassin & von Ranson, 2005), substance use (Bornoalova, Lejuez, Daughters, Rosenthal, & Lynch, 2005), shop-

lifting (Selby, Bulik, et al., 2010), reckless driving (Sansone, Lam, & Wiederman, 2010), and impulsive spending (Selby, Bulik, et al., 2010). Dysregulated behaviors in BPD may also be interpersonal, such as quarrelsome behavior toward others (Russell, Moskowitz, Zuroff, Sookman, & Paris, 2007), aggressive behaviors such as throwing objects or hitting someone (Critchfield, Levy, Clarkin, & Kernber, 2008), and excessive reassurance seeking (Selby, Anestis, & Joiner, 2008). Other interpersonal behaviors that may be dysregulated in BPD include begging, threatening, or pleading with someone; verbal fights; and risky sexual behaviors.

Many of these behaviors have been found to have emotion-regulating properties (among many different motivations for different behaviors) and people often report engaging in these behaviors as a method of reducing or avoiding the experience of negative emotion (Selby & Joiner, 2009). Understanding the role that emotions play in these behaviors is particularly important because people with BPD also exhibit emotional lability, where the valence and magnitude of emotions fluctuate frequently throughout the day (Trull et al., 2008). This experience is often referred to as *emotion dysregulation*.

Emotional Cascade Model

Emotion dysregulation and dysregulated behaviors are two important components of BPD psychopathology, yet each component is often studied independent from the other. A recent

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model, called the *emotional cascade model* (Selby et al., 2008; Selby & Joiner, 2009), has attempted synthesize these two facets of psychopathology. This model proposes that people can experience extreme fluctuations in negative emotion via a process called an “emotional cascade.” In an emotional cascade, people ruminate intensely about an event that initiates feelings of negative emotion. Rumination is a cognitive process that refers to repetitively thinking about an upsetting situation, how it relates to past problems, and the future problems associated with a situation (Nolen-Hoeksema, 1991). Importantly, rumination and negative emotion have been found to reciprocally aggravate each other over time (Moberly & Watkins, 2008). The result of an emotional cascade is thought to be a self-amplifying positive feedback loop of intense rumination and negative emotion, which creates an emotional state that is extremely aversive, painful, and difficult to tolerate.

Dysregulated behaviors, in this model, may then be used to distract from rumination through shifting attention to intense physical sensations. These physical sensations may vary according to the behavior, but examples could include feelings of pain or the sight of blood in NSSI (Nock, Joiner, Gordon, Lloyd-Richardson, & Prinstein, 2006), or the tastes or textures of food or feeling of fullness in binge eating (Mitchell et al., 1999). These sensations may short-circuit the emotional cascade, decrease rumination and negative emotion, and result in subsequent, immediate feelings of relief. Importantly, it may be the potency of the sensations from these dysregulated behaviors that is crucial to stopping an emotional cascade, because once an emotional cascade is in a full self-generating cycle, it may be difficult to stop due to the intensity of rumination, and less effective distractions may not pull attention away from the problem enough to bring emotional relief.

Regarding BPD, Selby and Joiner (2009) posit that it is a disorder where much of the psychopathology may be tied to emotional cascades, which may occur more frequently and perhaps more intensely than in other disorders exhibiting behavioral dysregulation (i.e., substance use disorders, eating disorders). However, because BPD is highly characterized by a wide range of dysregulated behaviors and frequent lability of emotion, BPD may be viewed as the extreme continuum of emotional cascades. At present, some evidence has been found for emotional cascades in dysregulated behaviors such as alcohol use, binge eating and purging, NSSI, suicide attempts, and seeking reassurance excessively (Selby et al., 2008; Selby, Anestis, Bender, & Joiner, 2009; Selby, Connell, & Joiner, 2010). Selby et al. (2009) have also demonstrated, with structural equation modeling, that emotional cascades fully mediated the relationship between symptoms of BPD and a behavioral dysregulation latent variable (comprised of excessive reassurance seeking, bulimic behaviors, drinking to cope, NSSI, and suicidal symptoms). In this study, the authors also conducted a rumination induction in which all subjects were instructed to ruminate for 5 min about something in their life that was upsetting to them. Results indicated that people diagnosed with BPD demonstrated greater reactivity and intensity of negative emotion than control subjects, even after controlling for current depression. Additional studies on the emotional cascade model are needed, however, to clarify the temporal relationship between emotional cascades and dysregulated behaviors, especially outside the laboratory and with samples beyond college students.

Experience Sampling Methodology and the Current Study

The use of experience sampling methodology may be one way to provide incremental testing of components of the emotional cascade model in BPD. This methodology involves daily monitoring of participants in their natural lives (Stone & Shiffman, 1994), and it often includes the use of digital devices such as palm pilots (PDAs). Participants are prompted to record their thoughts, feelings, and behaviors throughout the course of multiple days; using such data, the momentary and temporal relationships between variables can be tested with reduced recall bias. Importantly, experience sampling is feasible in people diagnosed with BPD (Coifman, Berenson, Rafaali, & Downey, in press; Trull et al., 2008).

The purpose of the current study was to use experience sampling methodology to test the predictive validity of the emotional cascade model in everyday life. A sample of people endorsing problems with dysregulated behaviors, a portion diagnosed with BPD, were recruited and engaged in a 2-week experience sampling protocol. In order to investigate the tenet of the emotional cascade model that emotional cascades would prospectively predict the occurrence of dysregulated behaviors, we hypothesized that a three-way interaction would exist. For this interaction, we predicted that, at any given momentary assessment, those who endorsed high levels of negative emotion (lag-negative emotion) along with high levels of rumination (lag-rumination) at one assessment would have a significantly higher prospective probability of reporting the occurrence of a dysregulated behavior at the subsequent assessment (which occurred 2 to 3 hr later), and that this probability would be even higher in those with elevated BPD symptoms. We made this hypothesis based on the premise of the emotional cascade model that an emotional cascade arises when rumination and negative emotion reciprocally aggravate each other; it may be this interaction between rumination and negative emotion that motivates dysregulated behaviors (potentially for the distraction qualities of the behavior). In contrast, high levels of rumination in combination with low levels of negative emotion would not constitute an emotional cascade, as such rumination may be more akin to problem solving (Treyner, Gonzalez, & Nolem-Hoeksema, 2003).

Method

Participants

Participants were 47 (66% female) students and community participants who were recruited based on self-reported problems with behavioral dysregulation, some with diagnoses of BPD. Criteria for inclusion to participate in the current study applied to all participants and included (a) a report of four or more dysregulated behaviors (any combination), which were “difficult to control” over the last 2 weeks (NSSI, arguments, physical fights, binge eating, marijuana use, alcohol binges, impulsive shopping, throwing things, reckless driving), and (b) no imminent risk of suicide, as indicated by absence of suicidal intent and a suicide plan in a clinical assessment. The racial and ethnic make-up of the participants was diverse, with 8.5% reporting Hispanic ethnicity, and a racial composition of 68.1% White/European, 19.1% Black/African American, 6.4% Asian, 2.1% Native American, and 4.3% multiracial. This study was institutional review board-approved.

Screening and Recruitment Procedures

Student participants. Over 2,500 undergraduate students were first screened using modified items yes/no items from the *Structured Clinical Interview for DSM-IV Axis II Personality Disorders* (SCID-II; First, Spitzer, Gibbon, & Williams, 1997). Only those students reporting at least four dysregulated behaviors in the last 2 weeks (at the time of this screening) and endorsing at least five BPD symptoms were invited by e-mail to participate in the study. Student participants ($N = 20$) were offered course credit for their participation in the study. In order to enhance compliance with the daily monitoring, students were offered the opportunity to receive additional course credit for completing at least 80% of the random daily assessments.

Community participants. Community participants ($N = 27$) were recruited through local advertisements and flyers placed in community mental health centers. Flyers and advertisements listed examples of dysregulated behaviors and symptoms of BPD, indicating that anyone who experienced difficulties with any of these problems was eligible to undergo screening to participate in the study. Community participants were compensated \$50 for completing the study. In order to enhance compliance with the daily monitoring, however, community participants were offered an additional \$50 if they completed at least 80% of the assessments.

Procedure

All participants were first brought in for an initial screening session, where they were assessed for dysregulated behaviors engaged in over the last 2 weeks and current level of suicidality. Level of suicidality was assessed with the Beck Suicide Scale (BSS; Beck & Steer, 1993) and a clinical interview; no participants in this study met criteria for imminent risk. Participants included in the study then completed structured clinical interviews for Axis I diagnoses and BPD, and they were also trained on using the hand-held computers (PDAs; Palm Zire 31 model). All participants who participated in the experience sampling portion of the study carried the PDA for 2 practice days, followed by 2 consecutive weeks of actual monitoring.

Baseline Assessment Measures

Demographics form. All participants reported their age, sex, race, and whether they were currently seeking treatment or being prescribed any psychotropic medications.

Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski, Kraaij, & Spinhoven, 2001). This is a trait measure of cognitive emotion regulation processes, including rumination, which was used to assess convergent validity for the experience sampling rumination assessment. For these analyses, both the Rumination and Catastrophizing subscales were combined into one index of rumination, consistent with previous studies and supported by strong internal consistency ($\alpha = .89$) in this sample (Selby et al., 2008, 2009).

Beck Scale for Suicide Ideation (BSS; Beck & Steer, 1993). This is a commonly used self-report measure of suicidal ideation and intent over the past week.

Assessment of Axis I Diagnoses: Mini International Neuropsychiatric Interview (MINI; Sheehan, Lecrubier, & Sheehan, 1998). All participants were assessed with the MINI to diagnose potential Axis I psychopathology. Axis I diagnoses had adequate interrater reliability (most over $\kappa = .80$).

Assessment of BPD. All participants were administered the SCID-II (First et al., 1997) module for BPD. For a diagnosis of BPD, a participant had to have endorsed least five out of nine diagnostic criteria. The interrater reliability estimate for BPD diagnosis was $\kappa = .81$. In the current study, 16 participants (34%) met criteria for BPD. The average number of endorsed symptoms was 5.50 ($SD = 1.85$). For the subsequent analyses of the study, a continuous measure of BPD was generated such that the symptom ratings from the SCID-II (1 = absent, 2 = subthreshold, 3 = threshold) were summed into one score, due to evidence that BPD symptoms may be continuous, rather than taxonic, in nature (Clifton & Pilkonis, 2007; Rothschild, Cleland, Haslam, & Zimmerman, 2003).

Momentary Assessments

The PDAs were programmed to alert participants five times, at random, between 9:00 a.m. and 9:00 p.m. every day, approximately every 2 to 3 hr. Each time, participants completed a momentary assessment, which generally took under 3 min to complete. Participants had 1 hr to respond to the signal for the record to count toward the compliance incentive.

Emotion assessment. Participants were asked to rate their experience of positive and negative emotions "RIGHT NOW." The questions asked participants to rate each emotion from 1 (*low*) to 10 (*high*). For the current study, only negative emotions (angry, sad, worried, ashamed, and numb) were summed into a scale. These items demonstrated adequate internal consistency ($\alpha = .73$) when averaged across momentary signals across participants.

Rumination assessment. At each signal, questions were answered about what the participant was thinking and included "a currently upsetting problem," "upsetting memories," "the emotions that I am feeling," and "negative future situations." These questions were summed into a single rumination scale. The items for this scale were derived from preexisting measures for trait rumination, including the CERQ and Ruminative Responses Scale (RRS; Nolen-Hoeksema, 1991). Each question was prefaced with, "Please rate how much you are CURRENTLY thinking about the following from 1 (*not at all*) to 10 (*very much so*)," and higher responses indicated a more intense level of thought being applied to that subject matter.

Dysregulated behaviors assessment. Participants were asked whether they had engaged in any of the following since the previous signal: NSSI, alcohol use, marijuana use, physical fights, reckless driving, impulsive shopping, binge eating, yelling, throwing something, slamming a door, hanging up on someone, and insulting someone. Participants were provided with common definitions of each behavior during training and it was emphasized that these behaviors were "difficult to control." All behaviors were coded such that the presence of *any* dysregulated behavior at each momentary assessment was coded with "1" and no dysregulated behaviors were reported as "0." Combining dysregulated behaviors was justified by (a) previous research indicating many dysregulated behaviors load onto one latent variable (Selby et al., 2008, 2009); (b) previous experience sampling research on BPD, which has combined dysregulated behaviors into one scale (Coifman et al., in press); and (c) the current study, in which combining baseline dysregulated behaviors indicated adequate internal consistency ($a = .78$). Furthermore, when behaviors were coded as to whether each participant reported that behavior over monitoring, adequate internal consistency was again obtained ($a = .67$).

Data Analytic Strategy

Following preliminary analyses, generalized hierarchical linear modeling (GHLM) was then used to examine the main study hypothesis, using cross-lagged variables for rumination and negative emotion. Lag variables allow data from one assessment to predict the subsequent assessment. The GHLM analyses consisted of three levels: within-individual observations each day (Level 1), day of signaling within each participant (Level 2), and comparisons between each individual (Level 3). For these analyses the response distribution for engaging in a dysregulated behavior at any given signal was a Bernoulli distribution, which refers to a dichotomous outcome for an individual case ($N = 1$), and a logit link function was used. Level 1 predictors included lag-rumination, lag-negative emotion, and their interaction. Day of monitoring was included as a Level 2 predictor. Level 3 predictors were BPD symptoms, current major depressive disorder (MDD), sex, age, treatment status, community versus student status, the cross-level interactions of BPD symptoms with lag-rumination and lag-negative emotion, and the hypothesized three-way interaction (BPD symptoms by lag-rumination by lag-negative emotion). Controlling for depression was particularly important, given that rumination is linked to depression (Nolen-Hoeksema, 1991) and those with BPD frequently have comorbid depression (Koenigsberg et al., 1999). All effects were fixed with

a random Level 3 intercept using Mplus version 5.3 (Muthén & Muthén, 2004).

Results

Baseline Preliminary Analyses

Table 1 displays the basic demographic, diagnostic, and baseline data according to BPD diagnosis. Those with BPD were older and more frequently women, in treatment, and on psychotropic medication. The BPD group also had more people meeting criteria for MDD, dysthymia, posttraumatic stress disorder (PTSD), generalized anxiety disorder (GAD), and social anxiety disorder (SAD), and those with BPD also reported higher levels of baseline trait rumination, higher levels of suicidality, and more dysregulated behaviors reported over the previous 2 weeks. An analysis of covariance (ANCOVA) analysis was conducted on baseline trait rumination, as measured by the CERQ, to determine if those with BPD demonstrated elevated trait rumination. This analysis controlled for current MDD, dysthymia, GAD, PTSD, and SAD. The BPD group reported higher levels of baseline trait rumination ($F_{1,40} = 9.96, p < .01, d = 1.86$), replicating the findings of Selby et al. (2009). The only significant difference in demographic variables and diagnostic rates between the student and community samples was that the

Table 1
Participant Characteristics

Variable	No BPD diagnosis ($N = 31$) n (%)	BPD diagnosis ($N = 16$) n (%)	$\chi^2(df)$	ϕ
Female	17 (55)	14 (88)	5.01* (1)	.33
Hispanic ethnicity	2 (6)	2 (12)	.50 (1)	—
Race	3.52 (4)	—		
White/European	22 (71)	10 (63)		
Black/African American	5 (16)	4 (25)		
Asian	1 (3)	2 (13)		
American Indian	1 (3)	0 (0)		
Multiracial	2 (6)	0 (0)		
Community participant	15 (48)	12 (75)	3.06 (1)	—
Seeking treatment	2 (6)	9 (56)	11.95* (1)	.50
Psychotropic medication	2 (6)	6 (38)	7.20* (1)	.39
Low socioeconomic status	9 (29)	4 (25)	.09 (1)	—
Psychiatric diagnoses				
Major depression current	3 (10)	11 (69)	17.61* (1)	.61
Dysthymia current	2 (6)	6 (38)	7.20* (1)	.39
Past manic episode	3 (10)	5 (31)	4.48 (1)	—
Panic disorder lifetime	5 (16)	3 (19)	.82 (1)	—
PTSD current	1 (3)	7 (44)	12.27* (1)	.51
GAD current	5 (16)	12 (75)	15.84* (1)	.58
OCD current	1 (3)	1 (6)	.24 (1)	—
Bulimia current	2 (6)	1 (6)	.01 (1)	—
SAD current	1 (3)	4 (25)	5.26* (1)	.33
AUD current	12 (39)	4 (25)	.88 (1)	—
SUD current	13 (42)	6 (38)	.09 (1)	—
	M (SD)	M (SD)	$F(1, 46)$	d
Indices of Psychopathology				
Baseline behaviors	9.81 (5.22)	19.19 (10.24)	17.49*	1.15
Baseline rumination	18.64 (5.34)	29.31 (6.10)	38.20*	1.86
Baseline BSS	.65 (1.84)	7.31 (7.85)	20.61*	1.17

Note. AUD = alcohol use disorder; BPD = borderline personality disorder; BSS = Beck Suicide Scale; GAD = generalized anxiety disorder; OCD = obsessive-compulsive disorder; PTSD = posttraumatic stress disorder; SAD = social anxiety disorder; SUD = substance use disorder.

* $p < .05$.

Table 2
Prospective Prediction of a Dysregulated Behavior Occurring

Variable	Behavior occurred		
	γ	$SE(\gamma)$	OR
Within level	$R^2 = .10^{**}$ ($SE = .03$)		
Day	-.14**	.06	.87
Lag-Rum	.16**	.04	1.17
Lag-NE	.13	.08	—
Between level	$R^2 = .28^{**}$ ($SE = .09$)		
BPD symptoms	.06*	.02	1.06
Major depressive disorder	-.33*	.14	.72
Age	.02*	.01	1.02
Female	.29*	.12	1.34
Community	.26	.18	—
Treatment seeking	-.16	.12	—
2-Way interactions			
Lag-Rum * Lag-NE	.20**	.10	1.22
BPD * Lag-Rum	.10*	.06	1.11
BPD * Lag-NE	-.03	.04	—
3-Way interactions			
BPD * Lag-Rum * Lag-NE	.13*	.06	1.14
Model variance component	.50**	.13	

Note. BPD = borderline personality disorder; Lag-NE = lag-negative emotion; Lag-Rum = lag-rumination; OR = odds ratio; SE = standard error.

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

student group ($M = 22.0$ years, $SD = 8.1$) was younger than the BPD group ($M = 28.7$, $SD = 11.4$; $F_{1,46} = 10.6$, $p < .05$); there were no group differences in number of BPD symptoms, baseline or average momentary rumination/negative emotion, or number of behaviors reported at baseline or over monitoring. These findings indicate that combining both groups for subsequent analyses was appropriate.

Experience Sampling Preliminary Analyses

A total of 3,118 scheduled random assessments (average of 65 signals per participant) were completed. Compliance indices indicated both participant samples completed over 90% of signals, indicating good adherence to the protocol. A total of 491 behaviors were reported. The average participant reported 10 dysregulated behaviors ($SD = 15$). The most commonly reported behaviors were using marijuana (116 instances, $M = 2.56$, $SD = 5.2$; 34% of sample endorsed), yelling at someone (77 instances, $M = 1.68$, $SD = 2.27$; 60% of sample), binge eating (62 instances, $M = 1.36$, $SD = 2.71$; 37% of sample), and excessive alcohol use (50 instances, $M = 1.0$, $SD = 1.4$; 45% of sample). The least common was physical fighting (9 instances, $M = .18$, $SD = .04$; 4% of sample). The other behaviors were also adequately represented: self-injury (25 instances, $M = .56$, $SD = 1.98$; 14% of sample), impulsive shopping (21 instances, $M = .47$, $SD = 1.12$; 26% of sample), reckless driving (14 instances, $M = .31$, $SD = .69$; 20% of sample), throwing an object (20 instances, $M = .42$, $SD = .81$; 29% of sample), slamming a door (22 instances, $M = .49$, $SD = 1.04$; 30% of sample), hanging up on someone (17 instances, $M = .37$, $SD = .81$; 24% of sample), and insulting someone (28 instances, $M = .28$, $SD = .45$; 28% of sample). Baseline behaviors were correlated with total monitoring behaviors ($r = .45$, $p < .001$). When the most severe behaviors (NSSI, binge episodes, physical fights, impulsive shopping, reckless driving, and throwing something) were summed together, those with

BPD diagnoses ($M = 5.96$, $SD = 6.64$) reported more severe dysregulated behaviors ($M = 2.80$, $SD = 2.64$; $F_{1,46} = 355.36$, $p < .001$), as would be expected.

Because the rumination measure in this study had not been previously validated, we examined the reliability and preliminary validity of the measure. Items demonstrated adequate internal consistency when averaged across recordings ($\alpha = .79$), and baseline levels of trait rumination (CERQ) were positively correlated with average level of individual rumination across monitoring ($r = .42$, $p < .001$). Regarding divergent validity, momentary rumination was significantly inversely correlated with momentary positive emotion ($r = -.20$, $p < .01$). Thus, the momentary measure of rumination used in this study appeared to have preliminary validity.

Prospective Prediction of Dysregulated Behaviors

The results of the HGLM analysis with predictors and covariates¹ can be found in Table 2. Lag-rumination was a significant predictor ($\gamma = .16$, $SE = .04$, $OR = 1.17$, $p < .001$), whereas lag-negative emotion was not ($\gamma = .13$, $SE = .08$, $p = .08$). The

¹ A preliminary base GHLM model was run to assess whether a three-level structure was appropriate. Furthermore, hierarchical analyses have to account for autocorrelation within a model, which refers to the problems often caused by high correlation between variables that are measured closely in time. To account for the potential concerns regarding autocorrelation, lag time was included as a predictor at Level 1 of the model to account for time between observations. The mean intercept was significant ($\gamma_{00k} = 2.17$, $SE = 1.96$, $p < .001$), with a significant random intercept variance ($\tau_{00}^3 = .50$, $SE = .12$, $p < .001$). The structure of the model was appropriate, as indicated by a significant Day effect ($\gamma = -.14$, $SE = .04$, $OR = .87$, $p < .05$). Regarding autocorrelation, lag time between observations was not a significant predictor of dysregulated behavior (lag time = $-.004$, $SE = .004$, $p = .37$) and thus not a major issue.

nonsignificant negative emotion term may have been masked by the presence of rumination, so we examined the predictive value of lag-negative emotion in the absence of lag-rumination; doing so revealed a significant lag-negative emotion term ($\gamma = .10$, $SE = .02$, $p < .01$, $OR = 1.11$). There was also an interaction between lag-rumination and lag-negative emotion ($\gamma = .20$, $SE = .10$, $OR = 1.22$, $p < .001$).

The hypothesized three-way interaction between BPD symptoms, lag-rumination, and lag-negative emotion prospectively predicting the occurrence of a dysregulated behavior was significant ($\gamma = .13$, $SE = .06$, $OR = 1.14$, $p < .05$). As demonstrated in Figure 1, those with high levels of BPD symptoms, rumination, and negative emotion at one signal had the highest probability of a subsequent behavior. Tests of simple slopes indicated that BPD symptoms, at high lag levels of lag-rumination and lag-negative emotion, significantly predicted increased probability of a behavior occurring ($t = 3.39$, $p < .001$). When the interaction was examined at high BPD symptoms, with high levels of negative emotion and low levels of rumination, the interaction was not significant ($t = 1.44$, $p = .15$). The interaction for high BPD symptoms with low negative emotion and high rumination also was not significant ($t = 1.62$, $p = .11$).

Discussion

Consistent with our predictions, a significant three-way interaction was found, which indicated that at high levels of negative emotion and rumination, those with BPD had an elevated probability of engaging in a dysregulated behavior beyond those with low levels of BPD symptoms. Importantly, this three-way interaction maintained significance even when controlling for key covariates. Findings provide support for an important part of the emotional cascade model and warrant further research on emotional cascades and dysregulated behaviors.

There were some limitations to note. First, these data were only able to address temporal precedence of the model-relevant variables and cannot be used to test the potential causal effects of emotional cascades on dysregulated behavior. Similarly, these data are self-reported and subject to the biases and perceptions of the participants, particularly with regard to whether the behaviors were difficult to control. Further, momentary measures of rumination and dysregulated behaviors used here need additional validation studies. Future studies should also examine the distinct behaviors in this study to determine if the behavior is actually difficult to control, and to determine specific aspects of negative emotion and rumination that may be involved in the behavior. We also did not assess the aspect of the emotional cascade model that addresses whether these behaviors reduce the experience of negative emotion through distraction. The goal of the current study was to examine the momentary predictive value of emotional cascades on dysregulated behaviors, and with the signals occurring hours apart, it would be difficult to examine potential distraction or relief effects immediately following behavior, particularly because many behaviors may result in subsequent shame or further rumination (Selby & Joiner, 2009). Experimental methods may be more appropriate for examining the potential for these behaviors, or proxies for them, to reduce the negative emotion and rumination. Other limitations included small sample size and low reports of some behaviors. In addition, combining community and student participants may have been problematic, although no major group differences were found in key study variables.

Regarding clinical applications, in therapy, patients are often encouraged to engage in potentially distracting behaviors, such as taking a walk or talking with a friend; however, research has not established whether these behaviors may be distracting enough to reduce an emotional cascade in the way that dysregulated behaviors

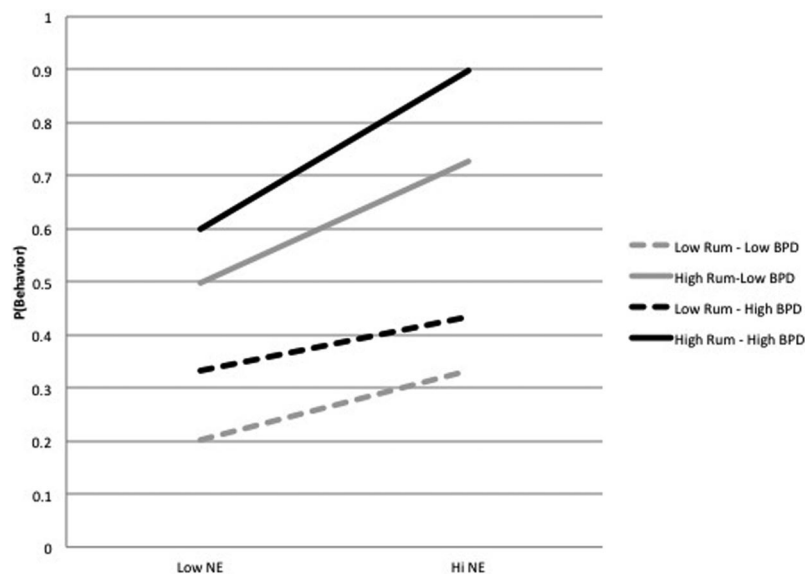


Figure 1. Three-way interaction between borderline personality disorder (BPD) symptoms, lag-rumination, and lag-negative emotion to prospectively predict the probability of a dysregulated behavior occurring in the next 2 to 3 hr. Note: High and low refer to 2 standard deviations above or below mean for lag-rumination (Rum) and lag-negative emotion (NE), and P (behavior) refers to the percentile probability of a dysregulated behavior occurring.

might distract. Identifying strong, distracting behaviors (perhaps word puzzles or exercise) to replace dysregulated behaviors may enhance current BPD treatments. In addition, it may be possible to identify potential emotional cascades with digital devices, potentially with a smartphone application, by monitoring levels of rumination and negative emotion. At times when both are high, the application could suggest other behaviors for distraction, which may then make it a useful adjunct to therapy.

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