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Self-Criticism and Dependency Predict Affective Variability in Borderline Personality Disorder: An Ecological Momentary Assessment Study

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Affective variability is a defining feature of borderline personality disorder (BPD). We hypothesize that patients with BPD who score higher on self-criticism and/or dependency—patients with a relative emphasis on self-definition and interpersonal relatedness, respectively—are characterized by more affective variability in positive and negative emotions. To examine this hypothesis, a sample of 32 patients with BPD reported their momentary feelings of anger, depression, anxiety, cheerfulness, and relaxation in an experience sampling study with 10 random signals scheduled per day for 8 days. Using heterogeneous linear mixed models, results indicate that patients with BPD who score higher on self-criticism show more within-person variance (WPV) in anger, depression, anxiety, cheerfulness, and feeling relaxed, whereas patients who score higher on dependency show more WPV in anger but less WPV in anxiety and feeling relaxed. Consequently, individual differences in affective variability in BPD are, after adjustment for the confounding between the mean and WPV of affect, related to personality vulnerabilities like self-criticism and dependency. These results add evidence to two-polarities models of personality and the existing view that there is substantial heterogeneity in BPD.

Keywords: self-criticism, dependency, affective variability, borderline personality disorder, ecological momentary assessment

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Borderline personality disorder (BPD) is a serious mental disorder that is present in 1% to 3% of the general population and is the most commonly diagnosed personality disorder in clinical settings, with 30–60% of patients receiving this diagnosis (Lenzenweger, Lane, Loranger, & Kessler, 2007; Trull, Jahng, Tomko, Wood, & Sher, 2010; Widiger & Trull, 1993). One of the defining features of BPD is affective instability, which refers to the tendency to experience emotions that fluctuate frequently and intensively over time (American Psychiatric Association, 2013; Gunderson, 2007; Nica & Links, 2009; Santangelo, Bohus, & Ebner-Priemer, 2014). Affective instability comprises two distinctive components: the variability and serial dependency (or autocorrelation) of affect over time (see Jahng, Wood, & Trull, 2008; Vansteelandt & Verbeke, 2016). In some studies, affective instability is examined, whereas in other studies only one of its subcomponents is examined. In the remainder of this article, we will use the terms—*instability*, *variability*, and *autocorrelation*—that adequately reflect what is actually meant or studied.

Affective Instability: BPD Versus Healthy Controls

Research on affective instability in BPD provides strong empirical evidence for heightened affective instability (Cowdry, Gardner, O'Leary, Leibenluft, & Rubinow, 1991; Ebner-Priemer, Kuo, et al., 2007; Ebner-Priemer & Sawitzki, 2007; Ebner-Priemer, Welch, et al., 2007) and heightened affective variability (Russell, Moskowitz, Zuroff, Sookman, & Paris, 2007) among patients with BPD in comparison with healthy controls. For a review, we refer to Santangelo et al. (2014), who concluded that there is evidence for heightened affective instability in BPD. In addition Reisch, Ebner-Priemer, Tschacher, Bohus, and Linehan (2008) found that patient with BPD switched more frequently from anxiety to sadness, from anxiety to anger, and from sadness to anxiety compared with healthy controls. Furthermore, a recent study also demonstrated that patients with PBD differ from healthy controls in terms of other affective processes. Using the DynAffect model, Ebner-Priemer et al. (2015) found that individuals with BPD are charac-

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terized by (a) a higher sensitivity to negative emotional stimuli (homebase), (b) more intense responses (variability) to emotional stimuli, and (c) a longer duration of emotional responses (attractor strength) compared with healthy controls, although the latter results were less consistent and of smaller magnitude. Finally, in general, a large meta-analysis (Houben, Van Den Noortgate, & Kuppens, 2015) revealed that more unstable, more variable, and more inert (autocorrelation) emotions are positively associated with lower psychological well-being in both normal control and clinical samples. In this meta-analysis, these relations were stronger for negative compared with positive emotions.

Specificity of Affective Instability in BPD

In addition, although less studied, patients with BPD show heightened affective instability in comparison with patients with other psychiatric disorders like depression (Cowdry et al., 1991; Jahng et al., 2008; Trull et al., 2008). For example, patients with BPD show both greater between-day and within-day instability of negative affect in general and more instability in hostility, fear, and sadness in particular compared with patients with a current depressive disorder (without BPD; Jahng et al., 2008; Trull et al., 2008). However, Houben and colleagues (Houben et al., 2016) found no differences in terms of emotional switching and the magnitude of these switches between positive and negative emotional states on consecutive moments over time between patients with BPD and patients with bulimia nervosa, patients with posttraumatic stress syndrome, and patients with a depressive disorder, respectively (although all these groups differed significantly from healthy controls in terms of these measures). Using the same data as Houben et al. (2016), Santangelo et al. (2016) also did not find evidence for the specificity of three interdependent components of the DynAffect model in BPD patients: (a) high sensitivity to negative stimuli (homebase), (b) intense responses to emotional stimuli (variability), and (c) longer duration of emotional responses (attractor strength). As a result, the findings with respect to the specificity of affective instability in patients with BPD are more mixed.

Heterogeneity in BPD

Within the group of patients with BPD, there may also be substantial individual differences in affective variability. Indeed, several authors have argued that the group of patients with BPD is heterogeneous in nature. However, lack of insight in the underlying etiology makes it difficult to clarify the nature of this heterogeneity in patients with BPD. In any case, the group of patients with BPD is heterogeneous with respect to diagnostic features because patients only have to meet five out of the nine criteria for BPD in the *Diagnostic and Statistical Manual of Mental Disorders*, *Fifth Edition* (*DSM–V*). Consequently, two patients diagnosed with BPD may only have one criterion in common. Further, subtypes of BPD have been identified based on their reactive and regulative temperament (see Sleuwaegen et al., 2017, 2018). Finally, evidence for heterogeneity in BPD was also found in two-polarities models of personality (Blatt, D'Afflitti, & Quinlan, 1976; Blatt & Luyten, 2009; Kopala-Sibley, Rappaport, Sutton, Moskowitz, & Zuroff, 2013; Kopala-Sibley & Santor, 2009; Kopala-Sibley, Zuroff, Russell, Moskowitz, & Paris, 2012; Luyten & Blatt, 2013). According to these models, personality develops across the life span through a dialectical synergistic interaction between two fundamental developmental psychological processes[1]: the development of self-definition and the development of interpersonal relatedness (Blatt & Luyten, 2009). Self-definition and relatedness refer respectively to the capacity to establish and maintain (a) a coherent, realistic, differentiated, and essentially positive sense of self, or an identity, and (b) meaningful, reciprocal, and personally satisfying relationships. Progress in each of these two dimensions facilitates the development of the other.

Within this framework, pathology is conceived as the consequence of severe disruptions of these developmental processes and compensatory exaggeration of one development process at the cost of the other, which may be due to major life events and all kind of biological and social factors (Blatt & Luyten, 2009; Lowyck, Luyten, Vermote, Verhaest, & Vansteelandt, 2017; Luyten & Blatt, 2011; Meyer & Pilkonis, 2005; Mikulincer & Shaver, 2007). Patients with an introjective or self-critical configuration struggle to achieve and maintain a sense of self-definition, and their exaggerated emphasis on self-definition results in the underdevelopment of interpersonal relatedness resulting in defensive avoidance of interpersonal relationships with fear for critic and disapproval. People with an anaclitic or dependent configuration have an exaggerated emphasis on interrelatedness and define themselves primarily in terms of the quality of their interpersonal relations, resulting in an overdependence on others and fear for abandonment and rejection by others (Blatt & Luyten, 2009). Different levels of impairments in (a) self-definition or (b) interpersonal functioning are central to defining (personality) disorders, which range from mild to extreme dysfunction, as expressed in (a) a profound inability to reflect on the self, or stronger, impairments in the self–other boundaries and (b) significant interpersonal impairments in the awareness and understanding of thoughts, feelings, and motivations of others. In the remainder of this article, we will refer to both configurations as respectively self-criticism and dependency.

In this context, research generally found that patients with BPD show higher levels of self-criticism and/or dependency relative to nonpsychiatric samples, depressed patients, and patients with personality disorders other than BPD (Köhling, Ehrenthal, Levy, Schauenburg, & Dinger, 2015; Southwick, Yehuda, & Giller, 1995; Westen et al., 1992; Wixom, Ludolph, & Westen, 1993). This may be explained by the fact that disruptions in the developmental processes of self-definition and relatedness in BPD are situated at an earlier developmental level. For example, patients with a self-critical configuration may have an inner representation of being "bad" or "evil." Moreover, Blatt and Auerbach (1988) and Levy, Edell, and McGlashan (2007) have found that borderline pathology relates to both dimensions. For example, Levy et al. (2007) related self-criticism and dependency to *DSM* criteria and found that patients with BPD who scored higher on self-criticism showed more identity disturbance and self-destructive behavior, whereas patients with BPD scoring higher on dependency showed more interpersonal distress.

[1] These two developmental dimensions are not unique for two-polarities models of personality but have been central across a wide variety of disciplines and study domains including personality models, interpersonal models, self-determination theory, attachment theory, and so forth (for an overview, see Luyten & Blatt, 2013).

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Current Study: Heterogeneity in Affective Variability in BPD

The goal of this article is to explore whether individual differences in self-criticism and/or dependency may be related to individual differences in affective variability. Notwithstanding the fact that affective variability is a well-established feature of BPD, little research (for exceptions, see Jahng et al., 2011; Vansteelandt et al., 2017) is devoted to personality features and/or other factors that play a role in affective variability in BPD. Jahng et al. (2011) have found that BPD drinkers (subjects who reported one or more instances of drinking during an 28-days ecological momentary assessment study) showed higher within-person variability in most negative affects compared with BPD nondrinkers. Further, Vansteelandt et al. (2017) showed that BPD patients who engage in nonsuicidal self-injury show heightened variability in valence and activation of affect compared with BPD patients who do not engage in nonsuicidal self-injury. These studies demonstrate that there may be heterogeneity with respect to affective variability among patients with BPD.

Recently, some studies have shown that individual differences in self-criticism and dependency may also be related to affective variability and reactivity (Kopala-Sibley et al., 2012). For example, Kopala-Sibley et al. (2013) examined flux (variability around the mean of individuals' interpersonal behaviors) and spin (individuals' dispersion in the display of interpersonal behaviors) in 113 adult community members in a 20-day event-contingent diary study. In this study, participants reported their interpersonal behaviors in the domains of dominance, submissiveness, agreeableness, and quarrelsomeness after interactions over 5 min. Self-criticism predicted greater spin and more flux in agreeableness, dominance, and submissiveness, whereas connectedness predicted lower levels of spin. In another event-contingent study (during 20 days) with BPD patients, Kopala-Sibley et al. (2012) found that perceived inferiority after a significant interaction was more strongly associated with negative affect in patients who reported higher levels of self-criticism, whereas perceived emotional insecurity after a significant interaction was more strongly associated with negative affect in patients who reported higher levels of dependency (controlling for base levels of depression and neuroticism, and lagged negative affect).

In this study, to gain more insight in the core symptom of affective variability in BPD, we want to further examine whether individual differences in self-criticism and dependency are related to heterogeneity in affective variability in BPD. As discussed above, patients who show a stronger emphasis on one developmental process at the cost of another are considered to have a higher probability of developing a clinical disorder. In addition, a recent meta-analysis showed that low psychological well-being is associated with more variable emotions (Houben et al., 2015). Moreover, the effect sizes were stronger for negative compared with positive emotions (Houben et al., 2015). As a result, we hypothesize that patients with BPD who score higher on self-criticism and/or dependency will be characterized by more affective variability in negative emotions typical for BPD like anger, depression, and anxiety in comparison with patients who score lower on these dimensions. In addition, we also included two positive emotions—cheerfulness and feeling relaxed—to explore the relation between self-criticism and dependency and the variability of these emotions. We also expect a positive association between self-criticism and/or dependency and variability in positive emotions, but this relation may be less pronounced in line with the meta-analysis of Houben et al. (2015). As a final note, we expect similar relations between respectively self-criticism, dependency, and affective variability as both developmental dimensions may be considered to be different pathways that may result in similar symptoms like affective variability (see notion of equifinality; Blatt & Luyten, 2009).

To examine these hypotheses, an ecological momentary assessment (EMA) study was conducted with patients with BPD reporting their affect at random times during the day for a number of successive days. EMA has many names (e.g., diary studies, experience sampling, ambulant monitoring) and exists in many shapes (e.g., time contingent, event contingent) but essentially consists of intensive repeated measurements of individuals in their natural circumstances at specific moments in time, using an electronic device like a smart phone. For an overview of diary methods, designs, and intensive longitudinal methods, see Bolger and Laurenceau (2013) and Mehl and Conner (2012). For the current study, using an EMA protocol has the following benefits (Ebner-Priemer & Trull, 2009): (a) Real-time assessment increases accuracy and minimize retrospective bias, (b) affective variability can be assessed without asking the participants directly to report on their affective variability, and (c) assessments in real-life situations enhance generalizability. To test our hypotheses that higher self-criticism and dependency are related to more affective variability in positive and negative emotions, heterogeneous mixed models will be used (Hedeker, Mermelstein, & Demirtas, 2012; see Method Section). Note that these models examine merely associations and do not warrant causal conclusions.

Method

Participants

In this study, 32 patients, five (16%) men and 27 (84%) women, with mean age of 28 years ($SD = 9$) were included: Nine patients were recruited at the Psychiatric Hospital in Duffel (Belgium) and 23 patients at the University Psychiatric Center, KU Leuven, Belgium. All patients were diagnosed with BPD according to the *DSM–V*. Ethical approval for this study was given by the ethical review board of the Faculty of Psychology and Educational Sciences of KU Leuven, the medical Ethics Committees of KU Leuven (ML8517 and ML5967), and the Local Ethical Committees of the involved hospitals. All patients gave written informed consent.

Materials

Assessment of *DSM–IV* Personality Disorders. The BPD scale of the Assessment of *DSM–IV* Personality Disorders (ADP-IV; Schotte, de Doncker, Vankerckhoven, Vertommen, & Cosyns, 1998) was used to assess the presence of BPD. This is a self-report instrument of the *DSM–IV*, Section II personality disorders (which are identical to *DSM–V* Axis II personality disorders) with each of the 10 items of this scale being scored on a 7-point Trait scale and on a 3-point Distress scale. Patients who score higher than 4 on the Trait scale *and* higher than 1 on the Distress scale on at least five

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items are diagnosed as having BPD. The ADP-IV shows good convergent validity (Schotte et al., 2004) with the Structured Clinical Interview of *DSM–IV* Axis II Personality Disorders (SCID-II; First et al., 1995).

Ecological momentary assessment of affect. Three negative emotions were assessed that are especially relevant for BPD: anger, depression, and anxiety. We opted for anger, depression, and anxiety as Nica and Links (2009) reported in a review on affective instability in BPD based on experience sampling studies that BPD patients show more variability in negative mood than patients with major depression and especially in hostility, depression, and fear. In addition, two emotions with positive valence were assessed: that is, cheerful and relaxed. Although no specific positive emotions were mentioned in their review, Nica and Links (2009) concluded that patients with BPD report more variability in positive affect than depressed patients, but mood changes are less frequent and less extreme in comparison with negative mood. As research on momentary affect (Russell, 1980, 2003; Russell & Barrett, 1999) has revealed that a large part of the information conveyed in people's daily momentary affect can be captured by two orthogonal dimensions of valence (pleasure–displeasure) and activation (activation–deactivation), we opted for "cheerful" and "relax" to have a positive emotion with respectively high and low activation. Each emotion word was preceded by the sentence: "At this moment, I am feeling (emotion word)" (e.g., At this moment, I am feeling angry.). Beside these questions, the EMA questionnaires consisted of a number of other questions that are not relevant for the present study. At each signal, items were presented in random order, and participants had to indicate the extent to which the questions were applicable to them at the moment of the signal using a slider (varying from 0 to 100).

Self-criticism and dependency. Self-criticism (SC) and dependency (DEP) were assessed using the Depressive Experiences Questionnaire (Blatt et al., 1976). The DEQ consists of 66 items, scored on a 7-point Likert-type scale, ranging from 1 (*I don't agree*) to 7 (*I totally agree*), assessing self-criticism and dependency. The DEQ factors were scored using the original independent factor scores of Blatt et al. (1976). The Dutch version of the DEQ has good internal consistency and validity, which is similar to those of the original DEQ (Luyten et al., 2007). Reliability of the DEQ is 0.75 as measured with the Cronbach's α.

Procedure

Participants were recruited after the intake process when they received a BPD diagnosis by an experienced senior psychiatrist, which was confirmed by the ADP-IV (ADP-IV–Borderline scale; Schotte et al., 2004; see also the Materials section). Next, patients were informed about the study and invited to participate. If they agreed to participate, they signed an informed consent and then completed a number of self-report questionnaires. In addition, they received a handheld computer and instructions about how to complete questionnaires on it. Participants carried the handheld computer and were prompted by signals scheduled 10 times a day for 8 days during waking hours (yielding 8 days × 10 signals = 80 possible signals per participant). This sampling scheme was chosen to have sufficient data to estimate the within-subject variability of the emotions and to obtain a balance between duration of sampling (i.e., multiple days), the frequency of sampling within each day, and feasibility for the patient. At each signal, participants were asked to complete the EMA questionnaire. The signals were programmed according to a stratified random interval time series; this means that a day (e.g., 8:30 a.m.–9:30 p.m.) was subdivided into 10 successive intervals of equal length, with one signal being randomly generated in each interval. It was emphasized that we hoped they would respond to as many signals as possible, but that it was reasonable they would miss some signals because they would not be able to report (e.g., when in the shower) or simply because they did not hear the signal. The mean time interval between consecutive signals was 80 min (SD = 35 min). Participants filled out an average of 50 of 80 repeated assessments per person (SD = 17, min = 15, max = 75); this corresponds with a compliance rate of 63%. This result is lower than some studies (Ebner-Priemer & Sawitzki, 2007 [94.74%]; Trull et al., 2008 [87%]) but in line with other studies (Chapman, Rosenthal, Dixon-Gordon, Turner, & Kuppens, 2017 [62.5%]; Links et al., 2007 [58%]; Snir, Rafaeli, Gadassi, Berenson, & Downey, 2015 [70%]) that used similar EMA protocols in patients with BPD. Of the original 34 patients, two participants were removed from the analysis because they responded to less than 15% of the scheduled signals.

Analysis

Heterogeneous mixed models (Hedeker et al., 2012) were used to examine simultaneously the effect of predictor variables like SC and DEP on the mean as well as on the between- (BS) and within-subject (WS) variance of a dependent variable (e.g., anger, sadness). BS variance pertains to individual differences in subjects' mean affect (compared with the population mean) reflecting trait differences. The WS variance pertains to differences in affect within subjects, that is, how a subject's affect varies from time to time reflecting state differences. Consider the following linear mixed model for emotion measurement Y_{ij} (e.g., anger) of Subject i ($i = 1, \ldots, N$) on occasion j ($j = 1, \ldots, O_i$):

$$Y_{ij} = (\beta_{00} + u_{0i}) + \beta_{01}SC_i + \beta_{02}DEP_i + \varepsilon_{ij} \quad (1)$$

where β_{00} is an overall intercept and u_{0i} is a random intercept for Subject i. This random effect is assumed to be normally distributed with a mean of zero and a variance of σ^2_u. Further, β_{01} is a fixed regression coefficient for the SC score of Subject i, β_{02} is a fixed regression coefficient for the DEP score of Subject i. In addition, the residuals ε_{ij} are assumed to be normally distributed with mean zero and variance σ^2_ε and independent of the random effects. As a result, this is a linear mixed model with random intercepts, which has the following characteristics: (a) the coefficients β_{01} and β_{02} indicate the effect of SC and DEP, respectively, on the mean affect, (b) σ^2_u represents the BS variation in mean affect, and (c) σ^2_ε reflects the WS variation in affect. To allow covariates (i.e., SC and DEP) to influence the BS and WS variance, Hedeker and Mermelstein (2007) extended this model using a log-linear representation for the variances:

$$\sigma^2_{u_i} = \exp(\alpha_0 + \alpha_1 SC_i + \alpha_2 DEP_i) \quad (2)$$

$$\sigma^2_{\varepsilon_i} = \exp(\tau_0 + \tau_1 SC_i + \tau_2 DEP_i + \tau_3 \overline{Y}_i) \quad (3)$$

Note that the linear mixed model described in (1) is a special case where $\sigma^2_{u_i} = exp(\alpha_0)$ and $\sigma^2_{\varepsilon_i} = exp(\tau_0)$. Further, it may be

noted that these variances have subscript i to indicate that their values change depending on the covariates SC_i and DEP_i of Subject i. As a result, both the BS and WS variance may vary as a function of the covariates SC_i and DEP_i of Subject i with their effects indicated by respectively the regression coefficients α_1 and α_2 for the BS variance and by the regression coefficients τ_1 and τ_2 for the WS variance. Because a subject's variance is often confounded with the subject's mean $\overline{Y_i}$ when measurements are bounded (Mestdagh et al., 2018), we adjusted the effect of SC_i and DEP_i of Subject i on the WS variance by Subject i's mean score $\overline{Y_i}$ of the involved emotions Y_{ij} (e.g., anger) with its effect being denoted by the regression coefficient τ_3. As a result, we are able to examine the effect of SC and DEP on the WS variance above and beyond their effect on the mean. In this study, we are especially interested in the effect of SC and DEP on the WS variance. All these models were estimated using the NLMIXED procedure of SAS 9.4 (see also Hedeker et al., 2012; SAS Institute Inc., 2015).

Results

In the next sections, we discuss the effects of SC and DEP on the mean, the BS variance, and the WS variance of the negative (first section) and positive emotions (second section). It is of interest to note that the correlation between SC and DEP is 0.01, r (32) = 0.01, p = .96.

Negative Emotions: Anger, Depression, and Anxiety

In Table 1, the effects of SC and DEP on the mean, the BS variance, and the WS variance of respectively anger, depression, and anxiety are depicted. In this table, it can be seen that BPD patients who score higher on SC and DEP are characterized by higher mean levels of anger, depression, and anxiety in daily life. For all three emotions, the effects of SC appear to be stronger than the effects of DEP. In addition, SC has a significant effect on the BS variance of anger, whereas DEP has a significant effect on the BS variance of anger and anxiety. These results indicate that more self-critical patients with BPD are more heterogeneous with respect to their disposition to experience anger, whereas more dependent patients with BPD are more heterogeneous with respect to their dispositions to experience anger and anxiety.

Finally, more relevant for our research hypotheses, SC has a significant positive effect on the WS variance of anger, depression, and anxiety, implying that BPD patients who are more self-critical are characterized by more affective variability in anger, depression, and anxiety in daily life. In addition, BPD patients who are more dependent show more WS variance or affective variability in anger but less WS variance in anxiety in daily life. No significant relation is found between DEP and the WS variance of depression.

Positive Emotions: Cheerful and Relaxed

In Table 2, the effects of SC and DEP on the mean, the BS variance, and the WS variance of cheerful and feeling relaxed are depicted. In this table, it can be seen that BPD patients who score higher on SC are characterized by lower mean levels of cheerfulness and feeling relaxed in daily life. However, for DEP, there are no effects on the mean levels of cheerfulness and feeling relaxed. In addition, SC has a significant effect on the BS variance of cheerfulness and feeling relaxed but, in contrast with the negative emotions, the results indicate that BPD patients with higher scores on these dimensions show less heterogeneity with respect to their disposition to experience cheerfulness and feeling relaxed. For DEP, no significant effects on the BS variance of cheerfulness and feeling relaxed are found.

Finally, in line with our hypotheses, SC has a significant effect on the WS variability of both cheerfulness and feeling relaxed, with subjects scoring higher on SC showing more variability in these positive emotions. However, contrary to our hypotheses, DEP has a significant negative effect on the WS variance of feeling relaxed, with BPD patients scoring higher on DEP showing less affective variability with respect to feeling relaxed. There is no significant association between DEP and cheerfulness.

Discussion

In this study, we found that patients with BPD who score higher on SC are, on average, more angry, depressed, and anxious and

Table 1
Negative Emotions: Effects of Self-Criticism and Dependence on the Mean, Between-Subject Variance, and Within-Subject Variance

Parameters	Anger			Depression			Anxiety		
	Est. (*SE*)	*t* (*df*)	$P < \|t\|$	Est. (*SE*)	*t* (*df*)	$P < \|t\|$	Est. (*SE*)	*t* (*df*)	$P < \|t\|$
Effect on the mean									
Intercept	11.61 (2.01)	5.79 (31)	<.0001	25.20 (4.63)	5.45 (31)	<.0001	16.92 (3.48)	4.86 (31)	<.0001
Self-criticism	8.55 (1.99)	4.30 (31)	.0002	13.66 (3.80)	3.59 (31)	.0011	10.31 (2.66)	3.87 (31)	.0005
Dependence	5.26 (1.60)	3.29 (31)	.003	6.41 (2.38)	2.69 (31)	.01	4.75 (1.88)	2.52 (31)	.02
Effect on the between-subject variance									
Intercept	4.02 (0.52)	7.69 (31)	<.0001	5.49 (0.52)	10.58 (31)	<.0001	5.06 (0.45)	11.26 (31)	<.0001
Self-criticism	1.02 (0.36)	2.80 (0.01)	.01	0.21 (0.37)	0.56 (31)	.58	0.30 (0.31)	0.96 (31)	.34
Dependence	0.92 (0.37)	2.47 (31)	.02	0.74 (0.45)	1.64 (31)	.11	0.90 (0.36)	2.45 (31)	.02
Effect on the within-subject variance									
Intercept	5.17 (0.07)	73.33 (31)	<.0001	5.71 (0.08)	70.34 (31)	<.0001	5.01 (0.07)	67.02 (31)	<.0001
Self-criticism	0.23 (0.05)	5.17 (31)	<.0001	0.42 (0.05)	3.11 (31)	<.0001	0.22 (0.04)	5.27 (31)	<.0001
Dependence	0.14 (0.04)	3.84 (31)	<.0006	−0.02 (0.03)	−0.60 (31)	.55	−0.22 (0.04)	−5.98 (31)	<.0001

Note. Est. = estimate; *df* = degrees of freedom; *SE* = standard error. The effects of dependence and self-criticism on the within-subject variance are adjusted for the subjects' mean on the involved emotion.

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Table 2
Positive Emotions: Effects of Self-Criticism and Dependence on the Mean, Between-Subject Variance, and Within-Subject Variance

Parameters	Cheerful			Relaxed		
	Est. (*SE*)	*t* (*df*)	$P < \|t\|$	Est. (*SE*)	*t* (*df*)	$P < \|t\|$
Effect on the mean						
Intercept	34.68 (4.78)	7.25 (31)	<.0001	37.32 (4.76)	7.85 (31)	<.0001
Self-criticism	−6.26 (2.66)	−2.35 (31)	.03	−7.07 (2.58)	−2.74 (31)	.01
Dependence	0.67 (1.63)	0.41 (31)	.69	−2.57 (1.71)	−1.50 (31)	.14
Effect on the between-subject variance						
Intercept	5.50 (0.44)	12.50 (31)	<.0001	5.67 (0.48)	11.88 (31)	<.0001
Self-criticism	−0.73 (0.34)	−2.16 (31)	.04	−.86 (0.37)	−2.31 (31)	.03
Dependence	0.67 (0.47)	1.49 (31)	.15	.40 (0.43)	0.93 (31)	.36
Effect on the within-subject variance						
Intercept	5.70 (0.12)	49.32 (31)	<.0001	6.05 (0.11)	52.72 (31)	<.0001
Self-criticism	0.16 (0.04)	4.08 (31)	.0003	.08 (0.04)	2.07 (31)	.0467
Dependence	−0.06 (0.04)	−1.56 (31)	.13	−.13 (0.04)	−3.52 (31)	.0014

Note. Est. = estimate; *df* = degrees of freedom; *SE* = standard error. The effects of dependence and self-criticism on the within-subject variance are adjusted for the subjects' mean on the involved emotion.

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less cheerful and relaxed in daily life compared with patients with BPD who score lower on SC. In addition, patients with BPD who score higher on DEP are, on average, more angry, depressed, and anxious in daily life compared with less dependent patients with BPD, whereas DEP had no effect on the mean level of positive emotions. These results add evidence to the existing literature (Kopala-Sibley et al., 2012; Levy et al., 2007; Luyten & Blatt, 2011) that there is heterogeneity within the group of BPD, with some patients exhibiting greater concerns pertaining to self-definition (SC) and/or insecurity in interpersonal relations (DEP) relative to other patients with BPD. Moreover, these results are in line with literature indicating that higher scores on these developmental dimensions are associated with a wide variety of psychopathology like negative affect, negative interpersonal behaviors, and negative outcomes (Blatt & Luyten, 2009; Kopala-Sibley et al., 2012; Lowyck et al., 2017; Luyten & Blatt, 2013). In general, these results contribute to existing literature on two-polarities models of personality in which psychopathology is viewed as the result of an excessive emphasis on the development lines of self-definition and/or interpersonal relatedness (Blatt & Luyten, 2009; Lowyck et al., 2017; Luyten & Blatt, 2011, 2013).

A novel finding of this study is that individual differences in SC and DEP are also associated with affective variability in BPD. Indeed, in line with our hypotheses, subjects who score higher on SC are characterized by an increased WS variance of anger, depression, anxiety, cheerfulness, and feeling relaxed (adjusting for the subjects' mean on these emotions). These are patients with an exaggerated concern about their self-definition who easily experience criticism and disapproval from others, which may result in more (extreme) angry, sad, and fearful reaction (Luyten & Blatt, 2011). At the same time, this vulnerability may also result in more extreme shifts in positive emotions, which is in line with findings that patients with BPD show evidence for dichotomous thinking (Oshio, 2012) in reaction to both negative and positive stimuli (Napolitano & McKay, 2007). For dependency, results are less clear-cut, with patients with BPD scoring higher on DEP showing more WS variance in anger but less WS variance in anxiety and feeling relaxed. Given the fact that these patients have an exaggerated concern about interpersonal relations and fear abandonment and rejection, we would rather expect an increased WS variance in anxiety and relaxation. However, maybe the fact that these patients show less WS variance in anxiety and relaxation is some kind of "freeze" reaction. The fact that both SC and DEP predict more variability in anger is in line with the concept of equifinality (Blatt & Luyten, 2009) that disruptions in different underlying developmental processes may result in the same clinical feature of variability in anger. This finding draws our attention to the fact that understanding heterogeneity in underlying developmental pathways in BPD, rather than a one-sided focus on symptoms like affective variability, is important in the understanding and treatment of this personality disorder (Blatt & Luyten, 2009).

In general, our findings are in line with our hypotheses and the hypotheses raised by Kopala-Sibley et al. (2012). In their study with BPD patients, Kopala-Sibley et al. (2012) found that SC moderated the relation between feelings of inferiority during interpersonal interactions and negative affect. More in particular, patients with BPD scoring higher on SC showed a stronger increase in negative affect when feeling inferior during interpersonal interactions compared with patients with BPD who score lower on SC. Moreover, this relationship was not found in a group of healthy controls. Our result with respect to the association of DEP and the WS variance of anger is also in line with the hypotheses raised by Kopala-Sibley et al. (2012) who found that the relation between perceived emotional insecurity in interpersonal interactions and negative affect was moderated by DEP. More in particular, patients with BPD scoring higher on DEP showed a stronger increase in negative affect when they felt emotionally insecure compared with patients with BPD who score lower on DEP. On the basis of their results, Kopala-Sibley et al. (2012) hypothesized that affective variability in some patients with BPD may be due to the fact that affect in many interpersonal interactions is influenced by underlying personality vulnerabilities like SC and DEP. The fact that these moderation effects did not show up in healthy controls shows that patients with a relative emphasis on self-definition (SC) and relatedness (DEP) are indeed more vulnerable for respectively feeling inferior and insecure and show stronger negative reactions in such interpersonal situations, which ultimately may result is

heightened affective variability. The results of our study confirm in a more direct way that SC is indeed related to increased affective variability in negative and positive emotions in BPD patients. However, it is less clear why subjects higher on DEP in our study show, beside more WS variability in anger, a reduced WS variability in anxiety and feeling relaxed. The latter results seem to be more in line with Kopala-Sibley et al. (2012) who found in an event-contingent diary study that connectedness predicted lower levels of spin in a sample of adult community members. Consequently, results concerning dependence are rather mixed. Maybe, the emotional insecurity of patients with BPD who score higher on DEP may trigger anger and variability in anger in interpersonal relations but rather a freezing reaction in terms of anxiety and relaxation.

The results of our study are also in line with a meta-analysis on the relation between short-term emotion dynamics and psychological well-being (Houben et al., 2015). In this meta-analysis, evidence has been found that variability in both negative and positive affect was associated with lower psychological well-being, although the effect sizes were weaker for positive emotions. Consequently, the part of the results that indicate that higher scores on SC and DEP are associated with more WS variability in negative and positive emotions are in line with the findings of this meta-analysis, as increased WS variability in affect is considered to be pathological in BPD. Indeed, more SC is associated with more WS variability in negative and positive emotions, and more DEP is associated with more WS variability in anger. However, once again, the result that patients with BPD who score higher on DEP show less variability in anxiety and feeling relaxed seem to contradict the results of this meta-analysis.

It is also important to mention that a deeper understanding of the heterogeneity in BPD may be beneficial for the effectiveness of specific treatment approaches with BPD patients. Therapists may identify BPD patients who score higher on SC and/or DEP and tailor interventions that focus on feelings of inferiority or insecurity in relationships to reduce affective variability. Research has demonstrated that patients primarily preoccupied with issues of self-definition (SC) are more responsive to interpretive–exploratory therapeutic interventions, whereas patients primarily preoccupied with issues of DEP are responsive mainly to supportive dimensions of interventions (Blatt, Zuroff, Hawley, & Auerbach, 2010).

Finally, note that the relations between SC and DEP and the WS variability of affect hold *above and beyond their effect on the mean*, as heterogeneous mixed models allow for the joint modeling of the effects of covariates on the mean, the BS, and the WS variance structure (Demirtas, Hedeker, & Mermelstein, 2009; Hedeker & Berbaum, 2006; Hedeker et al., 2012; Mestdagh et al., 2018). As a result, the effects of SC and DEP on the WS variance hold after adjusting for subjects' mean scores on the involved emotions. Indeed, a crucial and often encountered problem is that variability is severely confounded with the mean, especially when measurements are bounded like in our EMA protocol (for more information, see Mestdagh et al., 2018).

Further, we want to acknowledge that other statistical approaches than the one used in this study may yield other valuable insights. For example, differential equations models, which model variability in affect around a static or dynamic (changing) equilibrium state, focus more on within-person affective dynamics rather than affective variability (Deboeck, 2011; Deboeck et al., 2009; Oravecz & Tuerlinckx, 2011; Oravecz, Tuerlinckx, & Vandekerckhove, 2011; Oud & Jansen, 2000; Voelkle & Oud, 2013). In this context, an interesting approach is the one of Oravecz and Tuerlinckx (2011) who proposed a continuous-time state-space stochastic model with the following parameters: (a) an ideal latent position, called home base, in the two-dimensional (valence vs. arousal) core affect space subjects are assumed to be attracted to, (b) variances and covariances that represent fluctuations of individuals around their home base, and (c) a regulatory process that regulates the strength and direction with which individuals return to their home base. In addition, other models may be considered that focus on cycles or circadian rhythms in affect including frequency-domain time series methods, spectral density, Fourier analysis, parametric sinusoidal curve fitting, or autoregressive moving average time series models (Baehr, Revelle, & Eastman, 2000; Browne & Nesselroade, 2004; Ram et al., 2005).

Finally, we acknowledge that this study is not without limitations. First, we used an EMA protocol with patients being signaled 10 times/day during 8 days. This particular sampling schedule may limit the conclusions of this study. On the one hand, 8 days is only a very small amount of time relative to the bulk of a participant's life. Major life events like relationship fights, interpersonal loss, personal failures, and so forth may have a strong effect on affective variability, but none of these events may have occurred during these 8 days. As a result, 8 days of sampling is only a very short snapshot of a person's life. On the other hand, 10 signals/day may be too little to adequately capture particular affective processes. For example, Ebner-Priemer and Sawitzki (2007) studied discrepancies in findings with respect to affective instability in patients with BPD related to the sampling frequency. In this study, using a 24-hr EMA protocol, these authors tapped a specific affective process when the time intervals between self-reports were 15 and 30 min but not when these were longer. More in particular, significant autocorrelations were found between successive self-reports of distress for time intervals of 15 and 30 min but not when the time interval was longer. As a result, the time design of our study probably allows us only to study the variability component but not the serial autocorrelation component of affective instability. Consequently, a limitation of this study is that we only studied affective variability and not affective instability, which involves both a variability and serial autocorrelation component (see Jahng et al., 2008; Vansteelandt & Verbeke, 2016).

Second, the BPD diagnosis was made by an experienced psychiatrist and confirmed by a validated self-report questionnaire (ADP-IV; Schotte et al., 2004), which shows good convergent validity with the SCID-II (First et al., 1995). However, we recognize that it would have been better if the diagnoses of BPD were made by a validated structured interview like the SCID-II (First et al., 1995).

Third, another limitation is that our sample was relatively small and consisted predominantly of women who were treated in an inpatient setting. Although the patients in our sample certainly experienced intense emotional episodes, it is unclear to what extent affective experiences outside the hospital may lead to other results. For example, the frequency and intensity of emotional episodes may be higher in patients not receiving treatment, or lower in outpatients, as they may be characterized by less severe psychopathology. In addition, the ecological validity of our EMA proto-

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col may have been limited by the fact that we assessed their daily life within an inpatient hospitalization and not outside the hospital. This likely minimized the interpersonal stress that they might normally experience in living and dating within a problematic relationship or other forms of stress related to self-achievement. Therefore, the results of this study should be replicated in more gender balanced and outpatient samples before being generalized to the population of patients with BPD.

Fourth, given the fact that our sample size is rather small, replication of these findings in larger data sets is also necessary. It is worth noting, however, that although the sample of participants was rather small, the EMA protocol yields many repeated observations per subject, which results in rather reliable estimates of the WS variance. In addition, despite the rather small sample, we did find significant effects indicating that there was enough power to detect these effects. In general, modern data collection methods like EMA provide both WS and BS data, and so allow the opportunity for modeling both WS and BS variances as a function of covariates (Hedeker et al., 2012; Hedeker, Mermelstein, & Demirtas, 2008). However, the heterogeneous mixed models used in this study are fairly new, and it remains an open question how much WS and BS data are necessary for variance modeling purposes (Hedeker et al., 2008, 2012).

Fifth, the literature on the specificity of affective variability, affective instability, and other emotion dysregulation processes in BPD disorders is rather mixed, with some studies finding evidence for specificity compared with other clinical groups (Cowdry et al., 1991; Jahng et al., 2008; Trull et al., 2008) and other studies not (Houben et al., 2016; Santangelo et al., 2016). Therefore, it is necessary to further investigate whether the results we obtained are specific for BPD patients or whether the dimensions of SC and DEP are related to affective variability constituting a transdiagnostic mechanism that is present in several different mental disorders.

In conclusion, we have studied the relation between SC and DEP and affective variability in BPD. Self-critical patients with excessive concerns about self-definition and dependent patients with excessive concerns about interrelatedness show different patterns of affective variability in BPD. As a result, understanding and treatment of BPD may benefit from a focus on different underlying developmental processes rather than an exclusive focus on symptoms like affective variability at the manifest level. We hope that the results of this study will provide deeper insight in affective variability in BPD and may help to improve treatment in this heterogeneous group of patients with a severe personality disorder.

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