



AN ECOLOGICAL MOMENTARY ASSESSMENT (EMA) STUDY OF AFFECTIVE  
REACTIVITY WITHIN AN INTERPERSONAL CONTEXT IN YOUNG ADULTS WITH  
BORDERLINE (BPD) TRAITS

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A Dissertation

Presented to

The Faculty of the Department of Psychology

University of Houston

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In Partial Fulfillment

Of the Requirements for the Degree of

Doctor of Philosophy

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By

Allison Kalpakci

Summer, 2017

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**Abstract**

Borderline Personality Disorder (BPD) is a serious disorder associated with impairment across multiple domains of functioning and treatment refractory behavior. Affective reactivity is a particularly detrimental feature of BPD; however, there are limitations of using single time-point assessments to measure this symptom. Studies have therefore employed ecological momentary assessment (EMA) to measure real time affective reactivity in BPD, with findings pointing to greater affective reactivity in adults with BPD versus healthy controls. However, little is known regarding antecedents of within-person affect change in BPD. Moreover, while it has been suggested that affective reactivity in BPD occurs in reaction to interpersonal cues of rejection and abandonment, few studies have demonstrated this in the context of daily life. Interpersonal Theory, and the associated Interpersonal Circumplex, provides an empirically validated framework for this purpose. Using the Circumplex, it is possible to determine biases in person perception that may relate to affective reactivity. While Circumplex studies have examined the relation between biases in person perception and negative affect in BPD patients, Circumplex methodology has yet to be combined with electronic EMA methodology to elucidate antecedents or triggers of affective reactivity in healthy adults with BPD traits.

Against this background, the overall goal of the proposed study was to examine the relation between perceptions of non-communal behavior and affective reactivity in a non-clinical sample of college students. To this end,  $N = 123$  college students participated in twenty days of EMA during which they recorded their affective state, interpersonal perceptions, and their own

interpersonal behavior six times a day. The aims for the current study were two-fold: Aim 1 was to examine whether perceptions of partner non-communal behavior and negative affect were related, and whether BPD symptoms moderated this relation. Aim 2 was to examine whether perceptions of partner non-communal behavior and participants' self-reported non-communal behavior were related, and whether BPD symptoms moderated this relation. An ancillary aim was added to determine whether any of the PAI BOR subscales moderated the relation between perceptions of non-communality and negative affect or self-reported non-communal behavior.

In partial support of our hypotheses for Aim 1, results showed that perceptions of partner non-communal behavior predicted higher ratings of negative affect at the within-person levels. However, at the between-person level these relations were not significant, and BPD symptoms had no moderating effect. In partial support of our hypotheses for Aim 2, at the within-person level, perceptions of partner non-communal behavior were associated with participants own non-communal (ie. cold) behavior. However, at the between-person level these relations were not significant, and BPD symptoms had no moderating effect. Secondary analyses revealed a trend of the PAI-BOR subscale of identity problems moderating the relation between perceptions of non-communal behavior and participants' self-reported non-communal behavior; however, the moderating effect was not statistically significant ( $p = .09$ ).

Findings from this study provide support for the relation between interpersonal perceptions and affective and interpersonal behavioral reactivity. Moreover, a potential (though non-significant) moderating effect of the PAI-BOR subscale of Identity Problems suggests a greater understanding of the role of identity-related disturbance in interpersonal perceptions, affect, and behavior in BPD is warranted.

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AN ECOLOGICAL MOMENTARY ASSESSMENT (EMA) STUDY OF AFFECTIVE  
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**Borderline Personality Features in College Students**

Borderline Personality Disorder (BPD) is a debilitating psychiatric disorder, characterized by severe dysfunction across cognitive, affective, and behavioral domains. Symptoms include abandonment fears, identity disturbance, inappropriate anger, suicidality, impulsivity, chronic feelings of emptiness, affective instability, transient-stress related paranoid thoughts, and unstable interpersonal relationships (American Psychiatric Association, 2013). BPD affects 10% of outpatients (Lieb, Zanarini, Schmahl, Linehan & Bohus, 2004), up to 20% of inpatients (Lieb et al., 2004), and 2-6% of the general population (Grant et al, 2008; Lieb et al., 2004). Individuals diagnosed with BPD experience adverse outcomes including poor psychosocial functioning, treatment failure, and it has been estimated that nearly 10% of those with the disorder complete suicide (Black, Blum, Pfohl, & Hale, 2004; Lieb et al., 2004).

There has been a recent push within the field to study BPD (and other personality) traits (rather than diagnostic status) among non-clinical samples. Indeed, a debate about dimensional versus categorical representations of personality pathology is ongoing, representing an issue of particular relevance given the release of fifth addition of the Diagnostic and Statistical Manual (DSM-5; American Psychiatric Association, 2013). A categorical approach assumes that BPD is a discrete syndrome, clearly delineated from other psychiatric disorders as well as normal personality functioning (American Psychiatric Association, 2013; Paris, 2007; Westen & Shedler, 2000). A dimensional, trait-based perspective suggests instead that BPD traits may be distributed continuously within normal populations and may denote psychopathology only at the



severe end (Conway, Hammen, & Brennan, 2012; Widiger & Trull, 2007). Thus, a dimensional approach allows for the examination of BPD traits and their relation to other constructs across the full latent trait of borderline pathology and across varying levels of severity.

One non-clinical population that may allow for trait-based examination of BPD symptoms is college students. BPD is thought to emerge and peak in adolescence (Miller, Muehlenkamp, & Jacobson, 2008), with studies suggesting that symptoms remain high throughout early adulthood, including in college-aged years (Paris, 2003; Zimmerman & Coryell, 1989). Though data on BPD in college students are sparse, research has shown that low levels of BPD traits are informative and predictive of important outcomes (Trull, 1995). More specifically, compared with healthy college students, college students with BPD features have been found to exhibit higher rates of comorbid Axis I diagnoses (Trull, Useda, Conforti, & Doan, 1997), poorer academic performance, and greater interpersonal problems. Studies among college samples also report increased risk for symptoms directly related to BPD, including non-suicidal self-injury, eating disorders, substance abuse, and suicidality (Hersh, 2013; Pledge, Lapan, Heppner, & Roehlke, 1998). Even more, developmentally typical aspects of this period mirror features that are characteristic of BPD, suggesting that there is overlap between BPD symptomology and the developmental processes operating in young adulthood. Specifically, problems in identity development, instability in relationships, increased risk-taking behaviors, and (most relevant to the current study) affective reactivity, are common in college-age students, rendering this a useful age group in which to study BPD pathology.

### **Affective Reactivity**

BPD symptomology is characterized by extreme affective reactivity. BPD moods shifts are rapid, frequent, extreme, and occur most often in reaction to environmental stimuli

(American Psychiatric Association, 2013). Consistent with Linehan's (1993) biosocial theory that identifies affective reactivity as a core problem in BPD from which other symptoms develop, Yen et al. (2004) found that affective reactivity most strongly predicted suicidal behavior. Further, reactivity is the most life course persistent feature of BPD (Zanarini et al., 2004) and is linked to poor clinical outcomes (Bagge et al., 2004).

Given the centrality of affective reactivity to BPD and its deleterious effects, sound measurement of this construct is imperative. Traditionally, studies have utilized one-occasion, self-report- and interview-based measures; however, these methods may not be ideal for several reasons. First, they rely on retrospective recall, which may render responses vulnerable to recall bias (Hufford et al., 2001). Indeed, studies have demonstrated that experiences that are personally relevant, more temporally recent, that are unusual, or that are consistent with one's mood state are most readily recalled (Trull et al., 2008). Second, clinicians report that BPD mood shifts occur multiple times per day, every day. Thus, one-occasion assessments of mood may fail to capture within-day variability of affect. Third, traditional affect measures are unable to assess in real-time the situations that precede mood shifts, and thus, are unable to provide information regarding the context in which mood changes occur. Fourth, traditional one time-point designs utilize between-person designs, which can provide information about participants' behavior on average, but cannot provide information about event-level associations. In order to characterize affective reactivity in BPD, and understand the situations that surround affect shifts, a more ecologically valid method is required.

### **Ecological Momentary Assessment**

Ecological Momentary Assessment (EMA) is an ideal method for assessing affective reactivity in BPD. EMA (Stone & Shiffman, 1994), sometimes called intensive longitudinal

designs, involves the repeated assessment of individuals in their natural environment. EMA studies use pencil-and-paper methods and electronic diaries, though the latter is related to better respondent compliance (Morren et al., 2008). EMA addresses many of the aforementioned limitations of one-occasion assessments: (1) by assessing behavior temporally close to its actual occurrence, EMA lessens retrospective recall bias; (2) by sampling behavior multiple times per day, affect changes may be tracked across time, allowing for more accurate assessment of mood variability; (3) by collecting contextual information surrounding mood changes, we may understand the underlying relations between situation and mood changes; and (4) by collecting data repeatedly over time, EMA designs allow for the use of more sophisticated data analytic techniques, like multi-level modeling. These techniques capture both within- and between-level processes, thus allowing for a) conclusions regarding how participants behave on average (between) and b) how a participants behave in a specific event or occasion (within). To further illustrate the distinction between- and within-person levels, one could consider a hypothetical study examining stress and negative affect. Between-persons designs can conclude that individuals who have higher levels of stress also tend to have higher levels of negative affect. However, this does not mean that on *occasions* when an individual experiences higher than usual stress levels, that they will also experience high levels of negative affect. Within-person level of analyses is required to capture information at the level of the occasion or event.

To date, many studies have employed EMA-based methods to capture affective problems in BPD (See Santangelo et al., 2012, for a review). These studies have demonstrated that, compared with controls, BPD respondents report greater affective problems. Knowledge gained from this research is valuable and confirms what clinicians have long reported regarding BPD affect, but these results provide an incomplete picture. There is still little empirical evidence for

potential antecedents of within-person affect change in BPD as only a few studies have used EMA to investigate the relation between contextual factors and affective reactivity.

### **Interpersonal Theory and the Interpersonal Circumplex**

BPD is a highly interpersonal disorder (Sharp, 2014). When considering potential antecedents, it is reasonable to argue that interpersonal antecedents may be particularly salient. Disturbed interpersonal functioning represents a prominent feature of BPD. The DSM-5 (APA, 2013) conceptualizes this feature through two criteria: 1) frantic efforts to avoid real or imagined abandonment, and 2) a pattern of unstable and intense interpersonal relationships characterized by a tendency to vacillate between the idealization and devaluation of others. Findings that adolescent patients with BPD over-infer others' mental states, often with the thought that others' are rejecting or abandoning (Sharp et al., 2011), corroborates this conceptualization. This hypersensitivity to interpersonal cues of impending rejection and abandonment is thought to emerge early in development in the context of adverse family environments that chronically invalidated the child's emotional experiences (Linehan, 1993) and within insecure attachment relationships to caregivers (Fonagy & Luyten, 2009). A connection between interpersonal dysfunction and mood has also been theorized. BPD moods are thought to change in conjunction with contextual triggers of abandonment/rejection, rather than spontaneously or organically (Linehan, 1993) and are said to incite extreme negative affective states in those with the disorder (Gunderson & Lyons-Ruth, 2008; Sharp, 2014).

Despite strong clinical and theoretical consensus that affective reactivity associates with interpersonal events, it is challenging to capture this association in daily life. The Interpersonal Circumplex (Kiesler, 1983; Wiggins, 1991), developed from Interpersonal Theory, provides an empirically validated framework to study interpersonal perceptions and affective reactivity. The

Circumplex organizes interpersonal dispositions in a two-dimensional space including an agentic dimension, representing efforts that serve desires for autonomy and control, and a communal dimension, representing efforts that augment affiliation and interpersonal connectedness. Based on the Circumplex theory, a number of important predictions about interpersonal behavior can be made. One, most relevant to the current study, is the principle of complementarity, which suggests that along the agentic axis, there is a tendency for individuals to respond reciprocally (i.e. dominant behavior invites submissive behavior and vice versa) and sameness along the communal axis (i.e. warm behavior invites warm behavior and cold behavior invites cold behavior). Complementary interactions are experienced as more pleasant by interaction partners and have led to better outcomes with regard across relationship type. Correspondingly, interactions that do not follow this structure tend to be experienced as less satisfying and less self-validating (Estroff & Nowicki, 1992; Lock & Sadler, 2007; Russell et al., 2007; Markey & Markey, 2007; Tiedens & Fragale, 2007).

The Circumplex model has a rich tradition borne out of over 60 years of development and empirical research in the organization of interpersonal traits in the context of social psychology (Carson, 1969, Foa, 1961, Kiesler, 1983, Leary, 1957, Wiggins, 1979) as well as contemporary utility in psychopathology research, as it is largely endorsed by modern interpersonal researchers (Fournier et al., 2011; Hopwood et al., 2013). Its 2D structure has been validated in multiple studies (see Fournier et al., 2011 for a review), and its theoretical tenets have been tested widely across the social sciences including evolutionary (Buss, 1991), cross-cultural (Triandis, 1990), and clinical (Cain et al., 2012) sciences. This model is predictive of important psychosocial outcomes including socioeconomic status (Gallo et al., 2006), physical health (Lo Coco et al, 2012), and psychological disorders (Vittengl et al., 2003). Highly relevant to the proposed study,

the Circumplex draws heavily on social-cognitive theory and allows for the explanation of individual behavior within specific interpersonal perception contexts.

The Circumplex and EMA have been effectively combined to examine person perception and affective reactivity in adults with BPD, but not using electronic EMA technology.

Moskowitz and Zurroff (2005) created the Interpersonal Grid, a method for measuring interpersonal perceptions that directly corresponds to the Circumplex. The Interpersonal Grid was designed to allow for repeated assessment (i.e. EMA) of interpersonal perceptions. Given the hypersensitivity to rejection cues in BPD, Russell et al (2007) and Sadikaj et al (2010, 2013) used the Interpersonal Grid in an EMA context and found that interpersonal experiences that were perceived as low on communality (i.e. rejecting) triggered the greatest increase in negative affect in BPD patients compared to healthy controls. Sadikaj et al. (2013) also found that the relationship between perceptions of non-communal behavior and self-reported non-communal behavior were particularly strong in individuals with BPD. However, these studies were limited by methodological issues. First, the use of paper-and-pencil methods, rather than electronic diaries, was potentially problematic due to known low compliance rates in the former (Trull et al., 2008). Second, these studies employed event- rather than time-contingent methods, which allows the participant to decide when to report mood. As such, it is possible that participants may only report a subset of interactions, and thus valuable information may be lost. Instead, it is most ideal to employ a signal- or time-contingent design, in which participants are asked to report on the closest in time interaction. Third, these studies employed clinical samples, which precludes the ability to study constructs across the full latent trait of borderline pathology and across varying levels of severity.

### **The Current Study**

Given the poor prognosis of BPD (Lieb et al., 2004), the deleterious effects of affective reactivity (Bagge et al., 2004), and the salience of interpersonal factors in this pathology (Fonagy & Luyten, 2009), it is important to examine these constructs using ecologically valid assessment. Therefore, the overall goal of the proposed study is to examine the relation between perceptions of non-communal behavior and affective reactivity in a non-clinical sample of college students using EMA and Interpersonal Circumplex methodology. To this end, college students will participate in twenty days of EMA during which they will record their affective state, interpersonal perceptions, and their own interpersonal behavior, six times a day.

The specific aims of this study are twofold. **Aim 1** was to examine whether perceptions of partner non-communal behavior and negative affect were related, and whether BPD symptoms moderated this relation. We hypothesized that:

**(Hypothesis 1a)** Between-person differences in mean levels of perceptions of partner non-communal behavior would be positively associated with negative affect.

**(Hypothesis 1b)** Within-person momentary reports of perceptions of partner non-communal behavior would be positively associated with reports of negative affect.

**(Hypothesis 1c)** BPD symptoms would moderate the relation between between-person differences in mean levels of perceptions of partner non-communal behavior and negative affect, such that the positive association between between-person mean levels of perceptions of partner non-communal behavior and negative affect would be particularly strong among those with greater BPD symptoms.

**Aim 2** was to examine whether perceptions of partner non-communal behavior and participants' self-reported non-communal behavior were related, and whether BPD symptoms

moderated this relation. This second aim was included to determine whether: a) our data supported the complementary principle within the Circumplex model of interpersonal behavior and b) determine whether participants' degree of complementarity varied as a function of BPD features. Given previous theory which postulates an exaggerated sensitivity in response to perceptions of social rejection/disconnection (Gunderson, 1996) and research that has found that individuals with BPD respond with higher levels of cold/quarrelsome behavior (Sadikaj et al., 2013) in response to perceptions of non-communality, we hypothesized that:

**(Hypothesis 2a)** Between-person differences in mean levels of perceptions of partner non-communal behavior would be positively associated with participant's self-reported non-communal behavior.

**(Hypothesis 2b)** Within-person momentary reports of perceptions of partner non-communal behavior would be positively associated with participants' self-reported non-communal behavior.

**(Hypothesis 2c)** BPD symptoms would moderate the relation between between-person differences in mean levels of perceptions of partner non-communal behavior and participant's self-reported non-communal behavior, such that the positive association between between-person mean levels of perceptions of partner non-communal behavior and participants' self-reported non-communal behavior would be particularly strong among those with greater BPD symptom.

## **Implications**

The proposed research may lead to the greater understanding of the contexts that precede affective reactivity in this BPD. Given the poor prognosis of BPD (Lieb et al., 2004), the damaging effects of affective reactivity (Bagge et al., 2004), and the centrality of interpersonal



factors in this pathology (Fonagy & Luyten, 2009), it is important to examine these constructs using an ecologically valid methodology. Although the hypothesis that interpersonal triggers relate to affective reactivity in BPD is not new (Gunderson & Lyons-Ruth, 2008), this is the first study that will combine EMA and Circumplex methodology in an electronic format to study BPD features. As mentioned before, previous studies examining these relations have employed pencil-and-paper format, which has been associated with lower respondent compliance and decreased accuracy/certainty around time of data collection. Moreover, the use of a non-clinical sample (e.g., college students) allows for the examination of BPD traits and their relation to other constructs across the full latent trait of borderline pathology and across varying levels of severity. Additionally, this study includes several BPD-related emotions such as shame, guilt, and emptiness—which were neglected in previous EMA BPD Circumplex studies, but may allow us to capture specific BPD-related affect in response to interpersonal perceptions. Thus, this study may establish new methodology that could be expanded to other psychopathology, providing the foundation for development of real-time socially relevant EMA-based transdiagnostic assessment and interventions.

## **Methods**

### **Participants**

$N = 145$  college students between the ages of 18 and 35 were recruited for this study. Inclusion criteria for participation were ages between 18 and 35, English literacy, and daily use of an iPhone. The study recruited psychology students from the University of Houston via a study request posted on the Psychology Department's research recruitment website, email through the Department of Psychology Office of Academic Affairs, flyers posted at the University of Houston, and announcements in classes. Of 145 students recruited,  $N = 120$  (83%)

provided usable data (i.e. >50% of time-points completed). Participants' data were truncated if events were reported more than six time events per day or reported more than twenty days. The sample was 73% male, with an average age of  $M = 21.70$  ( $SD = 2.82$ ).

## **Procedures**

Interested participants were invited to come to the Developmental Psychopathology Lab located in the Houston Biomedical Science Building for a pre-EMA appointment. The purpose of this appointment was for participants to provide informed consent, complete pre-EMA assessments, and download the EMA application to their own iPhones. Participants received instructions for use of the app and completion of measures. Research staff demonstrated the audible prompt, explained how to initiate a response, and emphasized the importance of timely responding. Research staff observed use of the app and answered questions about the device and protocol. Research staff informed participants that compliance would be checked daily. Although timely responding was emphasized, staff explained that delayed responding might be unavoidable in certain situations (e.g., when driving a car). Participants were trained to respond as soon and as safely possible in such circumstances. During the EMA portion of the study, Participants carried their iPhones with the EMA app for 20 days. The EMA application recorded data six times a day.

## **Measures**

### **Pre-EMA Measures**

***Demographics.*** A demographics measure was used to collect information on participants' age, gender, education, marital status and income level.

***Borderline Personality Features:*** The Personality Assessment Inventory (Borderline Scale, PAI-BOR; Morey, 2007) is a dimensional measure of borderline personality

symptomology, with 24 items that are rated on a four-point scale. Items assess four empirically derived subfactors of BPD including affective instability, identity problems, negative relationships, and self-harm. Adequate psychometric properties have been reported for the measure (Morey, 2007).

## **EMA Measures**

***EMA iPhone Application (Figure 1):*** Participants downloaded a custom-written iPhone application which recorded affect (Diener & Emmons, 1984), interpersonal events, interpersonal behavior (SBI) and interpersonal perceptions (Interpersonal Grid).

### *Figure 1*

Respondents answered questions by tapping the iPhone on the box/circle which represented the best answer. During the week (Mon-Fri), the app delivered audible prompts at a random point within a 2-hour window at the following times of day: 1) 9:00 AM, 2) 11:00 AM, 3) 1:00 PM, 4) 3:00 PM 5) 5:00 PM, and 6) 7:00 PM. When a prompt is triggered, the app emitted a vibration and an audible beep that repeated every 5 minutes for up to 10 minutes. If participants failed to respond to prompt within the 10-minute period, beeping terminated. Data wirelessly uploaded to a secure network, with each time point time stamped.

***Affect.*** At each EMA time point, affect was assessed using a measure of positive and negative affect valence (Diener and Emmons, 1984). This measure has been used in EMA studies examining affective problems in adults with BPD (Sadikaj et al., 2010), but never in electronic diary format. Three BPD-specific emotions (ashamed [Rusch et al., 2007]) guilty [Rivzi & Linehan, 2005], and empty [Klonsky, 2008]) were added to this list. Participants rated affect on a 7-point likert scale ranging from 0 (not at all) to 6 (very much). For statistical analyses, a composite negative emotion scale was used.

***Characterization of Interpersonal Event.*** Participants completed questions regarding whether, since the last prompt, they had a social interaction with 1 person lasting at least 5 minutes (Sadikaj et al., 2010). If so, participants answered questions regarding setting, interaction partner's sex, age, and relationship to participant (Sadikaj et al., 2010).

***Perceptions of Interaction Partner Behavior.*** Participants completed the electronic version of the Interpersonal Grid (Moskowitz & Zuroff, 2005), an empirically validated single-item instrument that assesses perceptions of others' agentic and communal behavior within the Interpersonal Circumplex model. The grid consists of an 11 x 11 arrangement of squares depicting agentic and communal dimensions of interpersonal behavior. The vertical axis represents the agentic dimension and ranges from "assured-dominant" on the top to "unassured-submissive" on the bottom. The horizontal (or communal) axis ranges from "cold-quarrelsome" on the left to "warm-agreeable" on the right. Participants described their perception of others' behavior by tapping on the screen in a single square of the grid, indicating the extent to which the other person was perceived as dominant (vs. submissive) and as agreeable (vs. quarrelsome) in a specific interaction. Moskowitz and Zuroff (2005) provided evidence for the validity of the Interpersonal Grid.

***Interpersonal Behavior.*** Participants completed the Social Behavior Inventory (SBI; Moskowitz, 1994), which measures interpersonal behavior based on the circumplex model (Wiggins, 1991). The SBI consists of 12 behavior items that correspond to each of the four poles of the interpersonal circumplex. Participants indicated behaviors they engaged in during each interaction. To prevent the possibility that participants adopted a response set, four forms of the SBI were used in daily rotation, with each dimension of behavior represented by three items on each of the four forms. Four behavioral scores representing each pole of the circumplex were

constructed for each event following SBI scoring procedures (Moskowitz, 1994). Scores were then ipsatized by subtracting the average number of items endorsed in that interaction from each score.

### **Data Analytic Strategy**

Preliminary analyses included inspection of scatter plots for outliers, apparent data trends, and missing data. Following Barta et al.'s (2011) recommendations on addressing reactivity (Hufford et al., 2002) to EMA itself, we inspected data for time-based trends or response set changes that may suggest within- and/or across-participant EMA reactivity effects. Descriptive statistics and correlations for all study variables were examined. To test for multicollinearity, we examined variance inflation factors (VIFs). Evidence for multicollinearity was indicated if VIFs fall above 2.5 (O'Brien, 2007). Hypotheses were tested using multi-level structural equation modeling (MSEM) in Mplus version 8 (Muthén & Muthén, 2016) using full-information maximum likelihood estimation with robust standard errors (MLR estimator). MLR estimation can include missing data and produces unbiased parameter estimates and standard errors that are robust to moderate non-normality.

**Data Analyses for Aim 1:** As illustrated in Figure 2, the MSEM included the random intercept for negative affect, which captures individual differences in mean levels of negative affect across the week, and one random slope (“S”) reflecting momentary negative affect regressed on person-mean-centered repeated measures of perceptions of non-communal behavior (“perceptions non-communal behavior – within”).

#### *Figure 2*

The intercept of negative affect and the slope were then regressed on BPD symptom dimensional scores from the Pre-EMA assessment. The regression of BPD symptoms on slopes

allowed us to test the hypothesis that individuals with greater BPD symptoms would show a stronger within-person coupling of momentary perceptions of non-communal behavior with negative affect. In addition, the intercept of negative affect was regressed on each individual's mean levels of perceptions of non-communal behavior across the diary period (i.e., grand-mean-centered person means of perceptions of non-communal behavior, labeled as “perceptions of non-communal behavior-between”). An interaction term for BPD symptoms X perceptions of non-communal behavior was included as a predictor of the intercept of negative affect to test the hypothesis that those with higher BPD symptoms and higher mean levels of perceptions of non-communal behavior (i.e. greater dispositional tendency toward perceptions of non-communal behavior) across the 20-day period would also tend to report higher levels of negative affect. Both continuous between-person predictors (i.e., BPD symptoms, perceptions of non-communal behavior-between) were grand-mean centered. We probed for a significant interaction by testing the significance of simple slopes at selected values of the moderator (1 SD) and examining the regions of significance for such effects in accordance with Preacher, Curran, and Bauer (2006).

**Data Analyses for Aim 2:** As illustrated in Figure 3, the MSEM included the random intercept for participants' non-communal behavior, which captured individual differences in mean levels of participants' self-reported non-communal across the week, and one random slope (“S”) reflecting momentary self-reported non-communal behavior regressed on person-mean-centered repeated measures of perceptions of partner non-communal behavior (“perceptions non-communal behavior – within”).

*Figure 3*

The intercept of self-reported non-communal behavior and the slope was then regressed on BPD symptom dimensional scores from the Pre-EMA assessment. The regression of BPD

symptoms on slopes allowed us to test the hypothesis that individuals with greater BPD symptoms showed a stronger within-person coupling of momentary perceptions of non-communal behavior with self-reported non-communal behavior. In addition, the intercept of self-reported non-communal behavior was regressed on each individual's own mean levels of perceptions of non-communal behavior across the diary period (i.e., grand-mean-centered person means of perceptions of non-communal behavior, labeled as "perceptions of non-communal behavior-between"). An interaction terms for BPD symptoms X perceptions of non-communal behavior was included as a predictor of the intercept of negative affect to test the hypothesis that those with higher BPD symptoms and higher mean levels of perceptions of non-communal behavior (i.e. greater dispositional tendency toward perceptions of non-communal behavior) across the 20-day period also tended to report higher levels of behaving non-communally. Both continuous between-person predictors (i.e., BPD symptoms, perceptions of non-communal behavior-between) were grand-mean centered. We probed for a significant interaction by testing the significance of simple slopes at selected values of the moderator (1 SD) and examining the regions of significance for such effects in accordance with Preacher, Curran, and Bauer (2006).

## **Results**

### **Descriptive Analyses**

Descriptive data on all main study variables are depicted in Table 1. The analysis dataset consisted of 12,640 observations. All continuous variables had skewness and kurtosis values within acceptable limits ( $-/+ 2$ ) for normality (George & Mallery, 2001). Inspection of person-by-person scatterplots indicated that the within-person change in negative affect over time was approximately linear. The plots did not reveal any outliers. Total PAI-BOR score was estimated at  $M = 27.45$  ( $SD = 12.44$ ) for the full sample. On the Affect List, average negative affect was

estimated at  $M = .26$  ( $SD = .44$ ). On the SBI, self-reported non-communal (i.e. cold) behavior (ipsatized) was  $M = -.070$  ( $SD = .19$ ).

In regards to interaction partner, 46% were reported as male. The following interaction partner types were reported: friend (22.5 %), romantic partner (20%), parent (16%), sibling (9%), coworker (8.6%), other relationship (7.2%), best friend (6%), stranger (4%), classmate (2.8%), acquaintance (2.6 %), and teacher (2.2 %). Participants' perceptions of their interaction partners' communal behavior, as measured by the Interpersonal Grid, was estimated at  $M = 7.43$  ( $SD = 2.55$ ). Agentic behavior on the Interpersonal Grid was estimated at  $M = 2.93$  ( $SD = 2.34$ ).

Table 1

### **Bivariate Analyses**

Bivariate correlations were performed for all continuously-rated, main study measures using Pearson's correlation coefficient (denoted by  $r$ ) and are depicted in Table X. Of note, perception of partner communality as rated on the Interpersonal Grid was negatively correlated with participants' negative affect ( $r = -.25, p < 0.001$ ), BPD symptoms as measured by the PAI-BOR ( $r = -.043, p = .001$ ), and self-reported SBI non-communal (i.e. Cold) behavior ( $r = -.22, p < .001$ ). Self-reported SBI non-communal (i.e. cold) behavior was positively correlated with negative affect ( $r = .09, p < .001$ ). PAI-BOR was positively correlated with negative affect ( $r = .089, p < .001$ ). Age was not significantly correlated with any of the main study variables.

Independent sample t-tests were calculated in order to examine gender differences across continuously-rated, primary study variables (Negative Affect, Interpersonal Grid Communality, SBI Non-Communal (i.e. Cold) Behavior, PAI-BOR) prior to moderation analyses. Findings indicated gender differences in self-reported non-communal behavior ( $t = -2.23, p = .03$ ) such



that males ( $M = .87, SD = .93$ ) reported behaving in significantly more cold behaviors than did females ( $M = .33, SD = .67$ ).

Table 2

### **Multi-level structural equation modeling**

Data were analyzed using a multilevel model that specified both a between- and within-persons factor of affective and behavioral reactivity to perceptions of partner non-communal behavior. To test the main study hypotheses, a continuous dependent variable with a random intercept was included at both the within and between levels. In the between-level test, a moderating variable was included along with a cluster variable.

#### **Model 1: The moderating effect of BPD features on the relation between perceptions of communality and negative affect**

We hypothesized that Interpersonal Grid perceptions of partner non-communality and negative affect would be related, and this relation would be moderated by PAI-BOR BPD symptoms. At the between-level of analysis, perceptions of partner non-communality were not significantly related to negative affect ( $\beta = .036, t(6126) = 0.59, p = 0.551$ ). However, at the within-level, perceptions of partner communality were negatively related to negative affect ( $\beta = -0.041, t(6126) = -8.2, p < 0.001$ ), such that participants' negative affect increased as a function of perceiving lower levels of communality in their partner.

Next, we tested whether PAI-BOR BPD features moderated the relation between Interpersonal Grid perceptions of partner non-communality and negative affect. Given that BPD features were measured at only one time-point (and thus remained constant at the within-person level), the moderating effect of this variable was tested at the between-persons level only. Results revealed that BPD features did not moderate the relation between perceptions of non-

communal behavior and negative affect ( $\beta = 0.0$ ,  $t(6126) = 0.0$ ,  $p = 0.96$ ). That is, the relation between perceptions of non-communality and negative affect did not depend on the level of BPD features. The summary for Model 1 summary is presented in Table 3.

Table 3

**Model 2: The moderating effect of BPD features on the relation between perceptions of partner communality and self-reported non-communal (i.e. cold) behavior**

We hypothesized that the relation between Interpersonal Grid perceptions of partner non-communality and SBI self-reported non-communal (i.e. cold) behavior would be related, and this relation would be moderated by PAI-BOR BPD symptoms. At the between-level of analysis, perceptions of partner non-communality were not significantly related to negative affect ( $\beta = -.018$ ,  $t(6052) = -1.125$ ,  $p = 0.269$ ). However, at the within-level, perceptions of non-communality were associated with self-reported non-communal behavior ( $\beta = -0.017$ ,  $t = -17(6052)$ ,  $p < 0.001$ ), such that participants' own non-communal (i.e. cold) behavior increased as a function of perceiving lower levels of communality in their partner.

Next, we tested whether PAI-BOR BPD features moderated the relation between Interpersonal Grid perceptions of partner non-communality and SBI self-reported non-communal (i.e cold) behavior. Given that BPD features were measured at only one time-point (and thus remained constant at the within-person level), the moderating effect of this variable was tested at the between-persons level only. Results revealed that BPD features did not moderate the relation between perceptions of non-communal behavior and self-reported non-communal (i.e. cold) behavior ( $\beta = -0.001$ ,  $t(6052) = 1.0$ ,  $p = 0.154$ ). In other words, the relation between perceptions of non-communality and self-reported non-communal behavior did not depend on the level of BPD features. The summary for Model 2 summary is presented in Table 4.

Table 4

**Ancillary Analyses: The moderating effect of BPD sub-factors on the relation between perceptions of partner communality and self-reported non-communal (i.e. cold) behavior**

Given the non-significant findings of the moderating effect of total PAI-BOR BPD features on the above relations, additional analyses were conducted to determine whether specific PAI-BOR subscales (i.e. Negative Relationships, Identity Problems, Self-Harm, and Affective Instability) produced a moderating effect. Thus, eight separate models were performed to determine the moderating effect of each of the subscales on the relation between **a)** the relation between perceptions of communality and negative affect; and **b)** the relation between perceptions of communality and self-reported non-communal (i.e. cold) behavior. Results revealed that none of the four subscales had a significant moderating effect on these relations. However, PAI-BOR Identity Problems showed a trend toward moderating the relation between perceptions of partner communality and self-reported non-communal (i.e. cold) behavior, ( $\beta = .003$ ,  $t(6052) = 1.5$ ,  $p = 0.09$ ), with a very small effect size ( $\beta_{std} = .038$ ).

**Discussion**

The overall goal of the proposed study was to examine the relation between perceptions of non-communal behavior and affective reactivity in a non-clinical sample of college students using EMA and Interpersonal Circumplex methodology. The first aim (1) was to examine whether perceptions of partner non-communal behavior and negative affect were related, and whether BPD symptoms moderated this relation. In partial support of our hypotheses, results showed that perceptions of partner non-communal behavior predicted higher ratings of negative affect at the within-person level. However, at the between-person level these relations were not significant, and BPD symptoms had no moderating effect. The second aim (2) was to examine

whether perceptions of partner non-communal behavior and self-reported non-communal behavior were related, and whether BPD symptoms moderated this relation. In partial support of our hypotheses, at the within-person level of analysis, perceptions of partner non-communal behavior were associated with participants' self-reported non-communal behavior. However, at the between-person level these relations were not significant, and BPD symptoms had no moderating effect. Given non-significant findings of the moderating effect of BPD symptoms on these relations overall, ancillary analyses were performed to examine whether specific BPD symptom subscales (i.e. negative relationships, identity problems, self-harm, and affective instability) from the PAI BOR produced a moderating effect on the above relations. Results revealed a trend of the PAI-BOR subscale of Identity Problems moderating the relation between perceptions of non-communal behavior and participants' self-reported non-communal behavior; however, this effect was not statistically significant ( $p = .09$ ).

Findings that, at the within-person level, perceptions of non-communality in an interaction partner predicted higher levels of negative affect are consistent with previous research and theory. The communal axis of the Interpersonal Circumplex captures interpersonal behaviors that augment affiliation and interpersonal connectedness (Kiesler, 1983; Wiggins, 1991). Specifically, interpersonal behavior that is perceived as warm and communal is thought to signify social acceptance and connection, whereas behavior that is perceived as non-communal or cold signifies social non-acceptance or rejection. The relation between perceptions of rejection and negative affect has long been studied, particularly in single time-point, between-person research designs. For example, in a meta-analysis of 192 studies that examine the relation between social rejection and affect, Blackhart, Nelson, Knowles, and Baumeister (2009) found that natural and experimental laboratory contexts that elicit actual, imagined, threatened, future

or relived rejection produce an increase in immediate negative emotional states. On the other hand, within-person research designs, like EMA, have only been more recently employed to examine these relations. Few EMA or intensive longitudinal studies have linked perceptions of rejection or non-acceptance and negative affect—and even fewer yet have studied these relations within the Interpersonal Circumplex framework. Outside the Interpersonal Circumplex framework, studies have found increased rage, “aversive tension”, and other negative emotions in reaction to perceptions of rejection (Berenson et al., 2011; Stepp et al., 2009, Stiglmayr et al., 2005). Within the Interpersonal Circumplex framework, EMA-based studies have noted that perceptions of non-communal (i.e. cold) behavior are related to elevated negative and unpleasant affect (Russell et al., 2007, Sadikaj et al. 2010, 2013). Therefore, the current study findings, that perceptions of non-communality related to negative affect, add to a small, but growing, research base that has examined the dynamic interplay between perceptions of Interpersonal Circumplex-rated non-communality and negative affect.

Findings that, at the within-person level, perceptions of non-communal behavior predicted participants’ self-reported non-communal (i.e. cold) behavior supports the complementarity principle (Carson, 1969). This principle proposes that correspondence occurs along the communal axis such that warm behavior elicits warm behavior from the other. In contrast, cold behavior elicits cold behavior from the other. Complementary patterns of behavior appear to characterize successful interactions and have been shown to produce more positive outcomes for the interaction, such as greater liking of the other person, greater comfort, and higher efficacy beliefs with the other person (Estroff & Nowicki, 1992; Lock & Sadler, 2007; Russell et al., 2007; Tiedens & Fragale, 2003). Findings from our study are therefore not surprising, but do provide additional validation of the complementarity principle and the

Interpersonal Circumplex model of human interactions. And though the Interpersonal Circumplex's structure has been validated in multiple studies (see Fournier et al., 2011 for a review), and its theoretical tenets have been tested widely across the social sciences (Buss, 1991; Cain et al., 2012; Triandis, 1990), far fewer studies have combined EMA via electronic-based protocols with the Circumplex to examine interpersonal behavior (Moskowitz et al., 2007; Russell et al., 2007; Sadikaj et al., 2010, 2013).

Contrary to our hypotheses, total BPD symptoms did *not* moderate the relation between interpersonal perceptions of non-communality and negative affect or self-reported non-communal behavior. In other words, though participants responded with greater negative affect and more cold behaviors in response to perceptions of non-communality in others, this relation was not particularly enhanced in individuals with greater BPD features. Our findings stand in contrast to theory and clinical observation (Berenson et al., 2011; Gunderson, 1996; Stiglmayr et al., 2005), which has suggested that behavior that is perceived as cold and quarrelsome by individuals with BPD signifies hostility and rejection of the other, thereby activating attachment vulnerabilities (particularly salient for individuals with BPD), eliciting stronger emotional and behavioral reactivity. Empirically, our results also deviate from findings from both between-person research designs (Conklin, Bradley, & Westen, 2006; Selby, Anestis, Bender, & Joiner, 2009; Tragesser, Lippman, Trull, & Barrett, 2008; Zanarini et al., 1998) that link interpersonal perceptions and negative affect in BPD as well as those from EMA studies that have examined these relations in individuals with BPD (Russell et al., 2007; Sadikaj et al., 2010, 2013).

There are several possible explanations for the lack of replication of previous findings in this regard. First, previous studies have used clinical samples of BPD, whereas the current study made use of a non-clinical, college sample. Given the relatively low level of BPD symptomology

in this college sample, it is possible the sample was not sufficiently variable nor severe with regard to BPD symptoms in order to produce a moderating effect on these relations. Indeed, in this sample, about 90% of participants fell below clinical cut-off (T-score > 70; Trull, Useda, Conforti, & Doan, 1997) with the remaining top 10% having scores as high as only one standard deviation above clinical cut-off. Second, whereas the majority of the variables in the study were measured repeatedly over the 20-day assessment period, BPD symptoms were measured once, at the outset of the study. More recent studies have begun to consider BPD symptoms as a less stable construct and have even measured their fluctuation in EMA contexts (Lazarus, Beardslee, Pedersen, & Stepp, 2016). Future EMA studies examining BPD symptoms dimensionally would benefit from assessing BPD symptoms more frequently to examine how they may co-vary with interpersonal perceptions, behavior, and emotions. Overall, given that our findings differ from previous theory and EMA research, future studies that conceptualize BPD dimensionally within EMA and Interpersonal Circumplex contexts should be conducted to better understand these relations.

Given the non-significant findings of the moderating effect of total PAI-BOR on the above relations, ancillary analyses were conducted to determine whether any of the PAI-BOR subscales moderated the relation between perceptions of non-communal behavior and self-reported negative affect and/or self-reported non-communal behavior. Results showed that the PAI-BOR subscale of Identity Problems trended toward moderating the relation between perceptions of non-communal behavior and self-reported non-communal behavior; however, this relation was not statistically significant, and none of the other PAI-BOR subscales moderated these relations. The fact that the PAI-BOR Identity Problems emerged as a potential (albeit non-significant and with a very small effect size) moderator may speak to the salience of the specific

BPD factor of disturbed sense of identity in interpersonal interaction contexts. This finding, though tentative, may suggest that identity-related representations could be particularly vulnerable in interpersonal interactions, and therefore individuals who have more BPD-related identity problems may be more likely to behaviorally react in the form of increased non-communal behavior than those with fewer BPD-related identity problems. This merges well with conceptualizations of BPD as a disorder of self-other relatedness, originating in early insecure attachment to primary caregivers, leading to maladaptive mentalizing, thereby disrupting the development of a coherent self (Fonagy, 1989; Fonagy & Luyten, 2009; Fonagy, Steele, Steele, Moran, & Higgitt, 1991; Sharp & Fonagy, 2008b; Sharp et al., 2011). In order to clarify this finding and disentangle the specific effect of identity-related disturbances on daily interpersonal interactions in BPD, future studies should include, in their repeated EMA assessments, brief measures of identity coherence.

In light of the current study, several future research directions should be considered. First, though beyond the scope of the aims of the current study, a focus on the effect of interpersonal perceptions on emotions theorized to characterize the affective experience of individuals with BPD is needed. In the current study, we added BPD-related emotions of shame (Rusch et al., 2007), guilt (Rivzi & Linehan, 2005), and emptiness (Klonsky, 2008) to Diener & Emmons's (1984) Affect List. Examining these relations at a granular level would provide a more nuanced understanding of emotions and BPD in interpersonal contexts. Moreover, emotion research makes clear distinctions between the presence of negative emotions and the absence of positive ones (Burgdorf & Panskepp, 2006). In other words, the lack of negative emotions does not necessarily suggest that pleasant affect is present. Therefore, not only should studies focus on the presence of negative emotions, but also the absence/presence of positive ones.



Second, future research should examine how BPD features may moderate the degree to which the Interpersonal Circumplex axes (i.e. communal and agentic) co-vary with one another. An interesting line of research that has recently emerged examines the degree of covariation between agentic and communal domains as a function of psychiatric disorder or traits. Though Interpersonal Circumplex Theory postulates that the axes are orthogonal, research suggests that the degree of orthogonality varies and is more idiographic than originally theorized. For example, one study (Roche, Pincus, Hyde, Conroy, & Ram, 2013) found that personality pathology moderated the degree of covariation between the two axes. More specifically, individuals high on interpersonal dependency were more likely to perceive dominant (agentic) behavior as warm/agreeable (communal) and submissive (agentic) as cold/quarrelsome (communal). On the other hand, in individuals with narcissistic traits, there was a weaker relation on average between the correlation between perceptions of dominance and warmth, which the authors interpreted as reflective of a threat to “self-enhancement,” characteristic of narcissistic pathology (p. 449, Roche et al., 2013). Examining how BPD features moderate the covariation between these two axes would elucidate unique interpersonal perception anomalies inherent to the disorder and provide greater understanding of interpersonal problems in BPD.

Third, though beyond the scope of the current study, an examination of interpersonal behavior and affect as a function of relationship type would be of particular interest, given the aforementioned salience of attachment theory in BPD pathology. Previous Interpersonal Circumplex research suggests that interpersonal behavior varies as a function of relationship type. For example, studies have found that romantic relationships produce more quarrelsome behavior than friendships, a relation that is enhanced among women compared to men (Moskowitz et al., 2007). Finally, a clinically-relevant direction for future research would be to

examine how interpersonal perceptions may relate to many of the impulsive and highly dangerous behaviors that characterize BPD pathology (e.g., self-harm, suicide, substance use, risky sex, etc.). Understanding how maladaptive interpersonal perceptions and response patterns relate to these behaviors may ultimately produce more targeted clinical assessments and interventions for BPD.

There were a number of limitations in the current study. First, though EMA is considered more ecologically valid than single time-point measures of behavior, the signal-contingent design of the study has limitations. Upon receiving a prompt, participants in this study were instructed to report on the most recent interpersonal interaction they encountered in the past two hours. This invites the potential effect of retrospective reporting bias and the loss of valuable information about affect outside the context of interpersonal interactions. Event-contingent designs, like those employed in other EMA studies (i.e. Sadikaj et al., 2010, 2013), are useful for capturing discrete behaviors (like social interactions) but as mentioned previously, these designs are vulnerable to other forms of bias and issues with regard to participant compliance. One EMA sampling strategy that may be useful in future studies is *combined sampling* protocols, which integrate signal- with event-contingent collections (Shiffman, 2007). Combined sampling approaches are especially well-suited to studying the interplay between events (like social interactions) and continuous phenomenon (like affects). This would allow for a more nuanced investigation into how affect fluctuations are related to social interactions (Ebner-Priemer et al., 2009). It is important to note that combined sampling methods may increase participant burden, and thus the potential benefits must be weighed carefully against other methodological factors. Second, due to a data collection error, specific data on ethnic and racial makeup were not collected and therefore not included in analyses. This is regrettable, given the known diversity of

the sample (i.e. 29 % Hispanic, 35% Caucasian, 10% African American, and 17% Asian; “University of Houston Demographics”, 2016). Finally, the simultaneous collection of EMA variables (i.e. affect, interpersonal perceptions, behavior were all collected concurrently) precludes the ability to determine any true directionality or causality of effect. Whether perceptions of interpersonal behavior predict affect/behavior or vice versa is not determinable within this model, and all hypothesized directions cannot be confirmed. Future research should elaborate upon existing EMA methods to elucidate conclusions of causality and directionality.

Notwithstanding these limitations, there were several strengths in the current study. First, a notable strength was the examination of both between- and within-person effects—a strength of any multi-level design. When event-level scores are combined into a person-level score representing an aggregation of a person’s tendency to feel, behave, and perceive others, valuable information regarding antecedents of within-person variability is lost. By examining variation in affect, behavior, and interpersonal perception at the within-person level, information on the psychological functioning of the person in specific situations provide a rich context to a person’s interpersonal functioning (Moskowitz et al., 2007). Second, the combination of 120 participants, 20 days of assessment, and 6 time-points per day produced a large number of observations—larger than previous studies examining these constructs (to the best of our knowledge). Moreover, the extensive 20-day assessment period ensured that a more accurate survey of a person’s daily interactions would be collected, capturing the more natural fluctuations in affect, behavior, and relationships that occur across time in lives of young adults. Third, the use of the electronic format of the interpersonal grid was an innovative and theory-adherent way to assess interpersonal perceptions via the Circumplex. Previous Circumplex studies in BPD have used paper surveys (Russell, 2007; Sadikaj et al., 2010, 2013), which as previously discussed, have a

number of methodological issues associated with them. In our study, an exact replica of the grid was created and effectively used in an electronic format. This is substantial as it adheres most closely to the Circumplex as developed within the framework of Interpersonal Theory.

In conclusion, the current study was the first to effectively combine electronic Circumplex methodology within an intensive longitudinal design over an extensive data collection period. Findings not only validated previous findings on the relation between interpersonal perceptions and affective and interpersonal behavioral reactivity, but the use of a non-clinical sample (e.g., college students) allowed for the examination of BPD traits and their relation to other constructs across the full latent trait of borderline pathology. Though findings did not support a moderating effect of BPD features on the relation between perceptions of non-communality and negative affect and self-reported non-communal behavior, a potential (though non-significant) moderating effect of the PAI-BOR subscale of Identity Problems was detected. This suggests a greater understanding of the role of identity-related disturbance in interpersonal perceptions, affect, and behavior in BPD is warranted. Taking into consideration the highly preliminary nature of the findings, this study lays the groundwork for future work in this area and a more comprehensive understanding of interpersonal behavior in this disorder.

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Table 1

Descriptive data for study variables

	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Max</b>
Negative Affect	.26	.44	0	5.33
PAI-BOR Total	27.45	12.44	7	74
PAI-BOR IP	8.15	3.82	1	18
PAI-BOR SH	4.20	2.89	1	13
PAI-BOR NR	7.86	3.68	1	17
PAI-BOR AI	7.24	5.24	1	44
SBI Non-Communality (i.e. Cold)	-.070	.190	-.67	.75
SBI Agentic	.083	.341	-1	1
SBI Communal	.169	.342	-1	1
Interpersonal Grid Agentic	2.93	2.34	0	10
Interpersonal Grid Communal	7.43	2.55	0	10

*Note.* SBI Non-Communality score is an ipsatized value. PAI BOR values are raw scores. IP = Identity Problems; SH = Self-Harm; NR = Negative Relationships; AI = Affective Instability.

Table 2

Bivariate correlations among main study variables

	Negative Affect	PAI-BOR Total	SBI Non-Communality (i.e. Cold)	Interpersonal Grid - Agentic	Interpersonal Grid - Communal	SBI Agentic	SBI Communal
Negative Affect	-						
PAI-BOR Total	.089**						
SBI Non-Communality (i.e. Cold)	.091**	.01					
Interpersonal Grid - Agentic	.177**	.000	.085**				
Interpersonal Grid - Communal	.246**	-.050**	-.218**	-.253**			
SBI Agentic	-.033**	-.017	.122**	-.028*	.086**		
SBI Communal	-.132**	-.043**	-.815**	-.136**	.332**	-.098**	-

Note. \*\* < .001, \* < .01



Table 3

*Parameter Estimates for Multilevel Model of Negative Affect as a Function of Perceptions of Interpersonal Grid Non-Communality*

	$\beta$	(SE)	$t$	$\beta_{std}$	$p$
Fixed Effects (intercept, slopes)					
<i>Level 2 (between-person)</i>					
Intercept	0.206	0.438	0.47	0.02	0.639
Perception of Non-communality	0.036	0.061	0.59	-0.0145	0.551
PAI-BOR	0.004	0.017	0.23	0.0161	0.824
Moderating Effect with PAI-BOR	0.000	0.002	0.0	0.013	0.959
 <i>Level 1 (within-person)</i>					
Intercept	0.057	0.014	4.07	0.053	<0.001
Residual	0.048	0.017	2.82	0.219	<0.006
	$\beta$	(SE)	$t$		$p$
Random Effects					
<i>Level 2 (between-person)</i>					
Intercept	0.337	0.135	2.496	0.02	0.013
Residual	0.002	0.0	0	0.00	<0.001
 <i>Level 1 (within-person)</i>					
Intercept	0.521	0.044	11.84	0.048	<0.001
Perception of Non-communality	-0.041	0.005	-8.2	-0.219	<0.001
Residual	0.113	0.016	7.063	0.212	<0.001

Note.  $\beta_{std}$ = standardized beta estimates.

Table 4.

*Parameter Estimates for Multilevel Model of Non-communal behavior as a Function of Perceptions of Interpersonal Grid Non-Communality*

	$\beta$	(SE)	<i>t</i>	$\beta_{std}$	<i>p</i>
<b>Fixed Effects (intercept, slopes)</b>					
<i>Level 2 (between-person)</i>					
Intercept	0.191	0.124	1.54	0.006	0.124
Perception of Non-communality	-0.018	0.016	-1.125	0.008	0.269
PAI-BOR	-0.005	0.004	-1.25	0.003	0.175
Moderating Effect with PAI-BOR	0.001	0.001	1.0	0.00	0.154
<i>Level 1 (within-person)</i>					
Intercept	0.057	0.014	4.07	0.052	<0.001
Residual	0.034	0.002	17.0	0.036	<0.001
	$\beta$	(SE)	<i>t</i>	$\beta_{std}$	<i>p</i>
<b>Random Effects</b>					
<i>Level 2 (between-person)</i>					
Intercept	0.190	0.123	1.54	0.032	0.122
Residual	0.002	0.0	0	0.00	<0.001
<i>Level 1 (within-person)</i>					
Intercept	0.052	0.014	3.71	0.15	<0.001
Perception of Non-communality	-0.017	0.001	-17.0	-0.105	<0.001
Residual	0.33	0.002	16.5	0.09	<0.001

*Note.*  $\beta_{std}$ = standardized beta estimates.

Figure 1

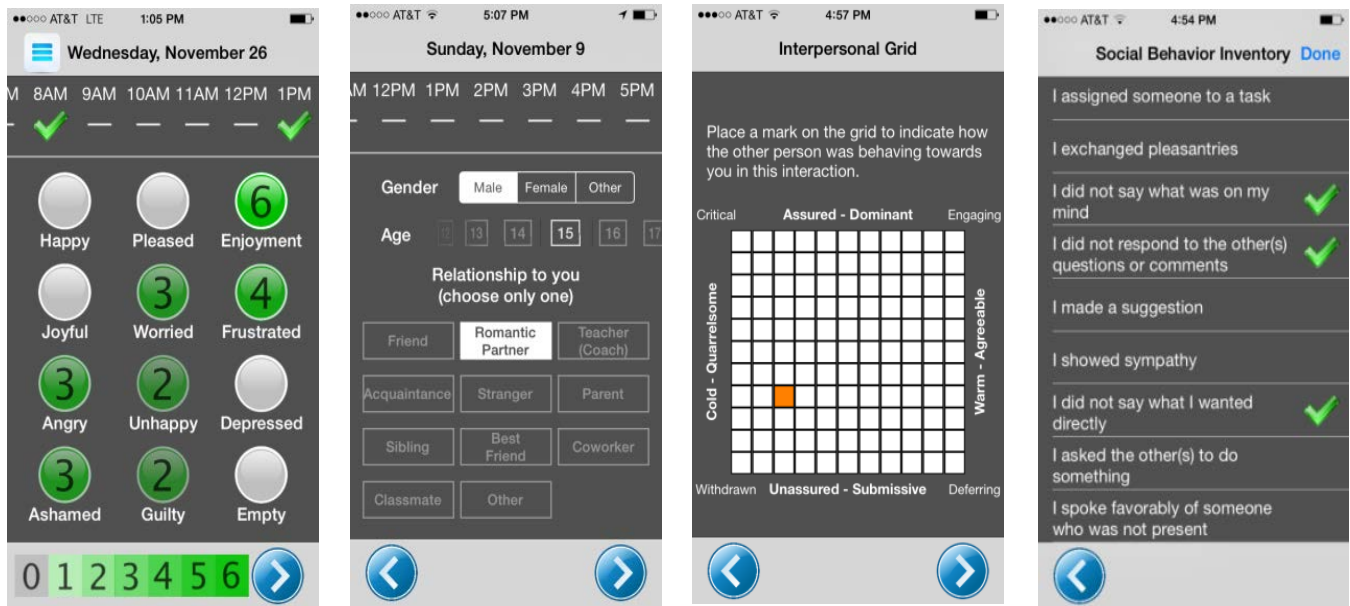


Figure 1. EMA application. Affect valence list (Diener & Emmons, 1984), characterization of interpersonal event (Sadikaj et al., 2010); Interpersonal Grid (Moskowitz & Zuroff, 2005); and Social Behavior Inventory (Moskowitz, 1994).

Figure 2

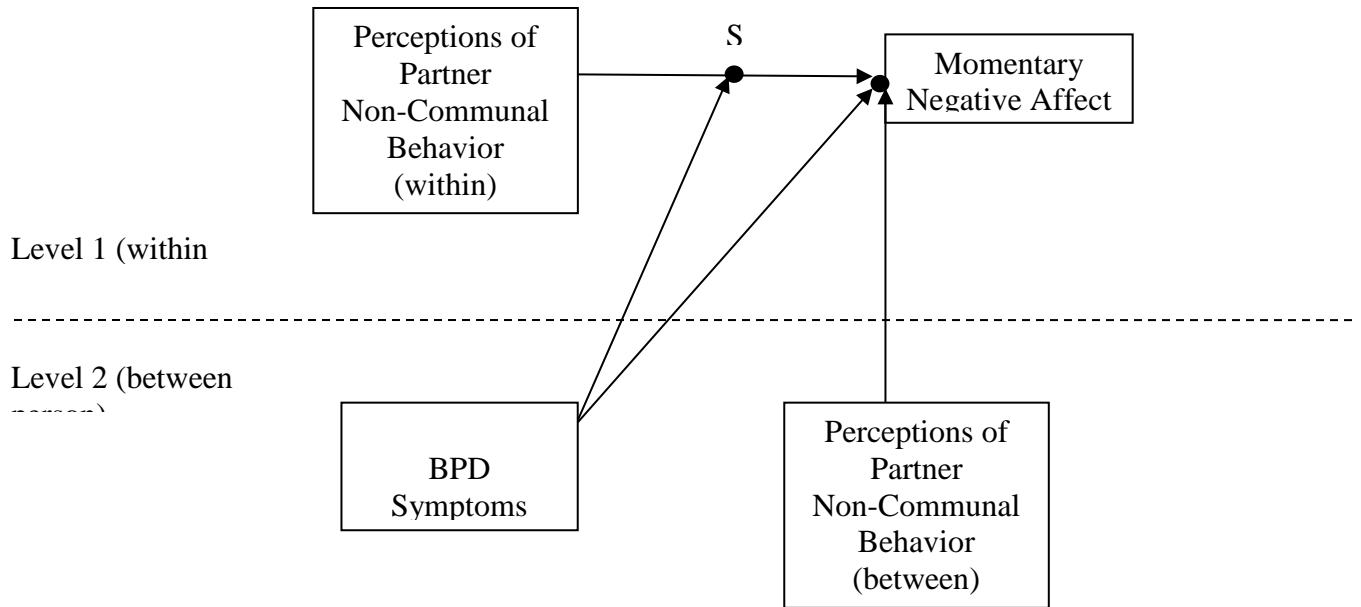


Figure 2. Multilevel structural equation model illustrating within-person effects at level 1 and between-person effects at level 2. Filled circles represent random effects. S = slope of momentary negative affect regressed on momentary perceptions of non-communal behavior. BPD = borderline personality disorder symptoms.

Figure 3

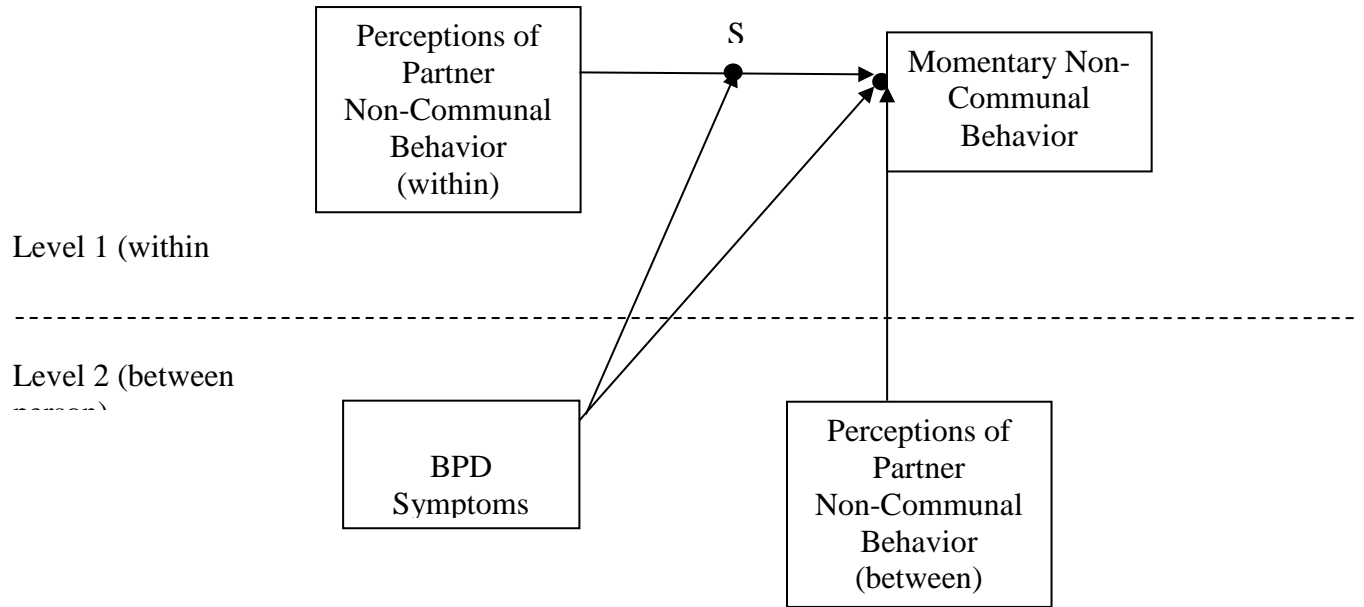


Figure 3. Multilevel structural equation model illustrating within-person effects at level 1 and between-person effects at level 2. Filled circles represent random effects. S = slope of momentary non-communal behavior regressed on momentary perceptions of partner non-communal behavior. BPD = borderline personality disorder symptoms.

## Appendix

### Social Behavior Inventory Items

#### Four Rotated Versions

1. I criticized the other(s)..... [Cold/Dominant]
2. I smiled and laughed with the other(s)..... [Warm]
3. I spoke softly.....[Submissive]
4. I made a sarcastic comment..... [Cold]
5. I expressed an opinion..... [Dominant]
6. I complimented or praised the other person..... [Warm]
7. I did not express disagreement when I thought it..... [Submissive]
8. I gave incorrect information..... [Cold]
9. I got immediately to the point.....[Dominant]
10. I made a concession to avoid unpleasantness..... [Warm]
11. I did not state my own views.....[Submissive]

1. I listened attentively to the other..... [ Warm]
2. I tried to get the other(s) to do something else..... [Dominant]
3. I let other(s) make plans or decisions ..... [Submissive]
4. I did not say how I felt. .... [Submissive]
5. I confronted the other(s) about something I did not like ..... [Cold]
6. I expressed affection with words or gestures..... [Warm]
7. I spoke in a clear firm voice..... [Dominant]
8. I withheld useful information..... [Cold]
9. I compromised about a decision..... [Warm]
10. I took the lead in planning/organizing a project or activity..... [Dominant]
11. I avoided taking the lead or being responsible..... [Submissive]
12. I ignored the other(s) comments..... [Cold]

1. I waited for the other person to talk or act first ..... [Submissive]
2. I stated strongly that I did not like or that I would not do something .....[Dominant/Cold]
3. I assigned someone to a task ..... [Dominant]
4. I exchanged pleasantries ..... [Warm]
5. I did not say what was on my mind ..... [Submissive]
6. I did not respond to the other(s) questions or comments ..... [Cold]
7. I made a suggestion ..... [Dominant]
8. I showed sympathy..... [Warm]
9. I did not say what I wanted directly ..... [Submissive]
10. I discredited what someone said ..... [Cold]
11. I asked the other(s) to do something ..... [Dominant]
12. I spoke favorably of someone who was not present ..... [Warm]

1. I showed impatience..... [Cold]
2. I asked for a volunteer..... [Dominant]

3. I went along with the other(s).....[Submissive/Warm]
4. I raised my voice..... [Cold]
5. I gave information..... [Dominant]
6. I expressed reassurance..... [Warm]
7. I gave in..... [Submissive]
8. I demanded that the other(s) do what I wanted..... [Cold]
9. I set goals for the other(s) or for us..... [Dominant]
10. I pointed out to the other(s) where there was agreement..... [Warm]
11. I spoke only when I was spoken to..... [Submissive]

### Personality Assessment Inventory-Borderline Scales

1. \_\_\_\_\_ My mood shifts quite suddenly.  
 False                       Slightly True                       Mostly True                       Very True
2. \_\_\_\_\_ My moods get quite intense.  
 False                       Slightly True                       Mostly True                       Very True
3. \_\_\_\_\_ My mood is very steady.  
 False                       Slightly True                       Mostly True                       Very True
4. \_\_\_\_\_ I have little control over my anger.  
 False                       Slightly True                       Mostly True                       Very True
5. \_\_\_\_\_ I've always been a pretty happy person.  
 False                       Slightly True                       Mostly True                       Very True
6. \_\_\_\_\_ I've had times when I was so mad I couldn't do enough to express my anger.  
 False                       Slightly True                       Mostly True                       Very True
7. \_\_\_\_\_ My attitude about myself changes a lot.  
 False                       Slightly True                       Mostly True                       Very True
8. \_\_\_\_\_ Sometimes I feel terribly empty inside.  
 False                       Slightly True                       Mostly True                       Very True
9. \_\_\_\_\_ I worry a lot about people leaving me.  
 False                       Slightly True                       Mostly True                       Very True



10. \_\_\_\_\_ I often wonder what I should do with my life.  
 False                       Slightly True                       Mostly True                       Very True
11. \_\_\_\_\_ I can't handle separation from those close to me very well.  
 False                       Slightly True                       Mostly True                       Very True
12. \_\_\_\_\_ I don't get bored very easily.  
 False                       Slightly True                       Mostly True                       Very True
13. \_\_\_\_\_ My relationships have been stormy.  
 False                       Slightly True                       Mostly True                       Very True
14. \_\_\_\_\_ I want to let certain people know how much they've hurt me.  
 False                       Slightly True                       Mostly True                       Very True
15. \_\_\_\_\_ People once close to me have let me down.  
 False                       Slightly True                       Mostly True                       Very True
16. \_\_\_\_\_ I rarely feel lonely.  
 False                       Slightly True                       Mostly True                       Very True
17. \_\_\_\_\_ I've made some real mistakes in the people I've picked as friends.  
 False                       Slightly True                       Mostly True                       Very True
18. \_\_\_\_\_ Once someone is my friend, we stay friends.

False       Slightly True       Mostly True       Very True

19. I sometimes do things so impulsively that I get into trouble.

False       Slightly True       Mostly True       Very True

20. When I'm upset, I typically do something to hurt myself.

False       Slightly True       Mostly True       Very True

21. I'm too impulsive for my own good.

False       Slightly True       Mostly True       Very True

22. I spend money too easily.

False       Slightly True       Mostly True       Very True

23. I'm a reckless person.

False       Slightly True       Mostly True       Very True

24. I'm careful about how I spend my money.

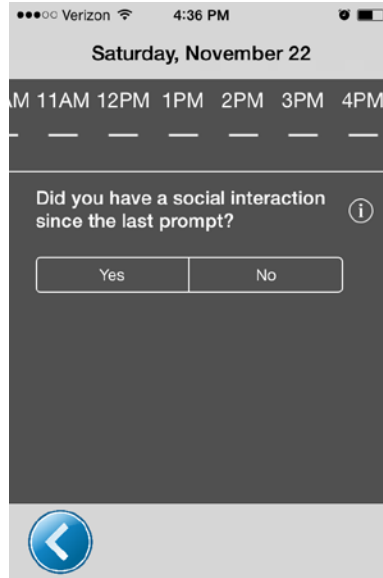
False       Slightly True       Mostly True       Very True

## APP INSTRUCTIONS

1. Once app is downloaded and installed on your iPhone, open it by clicking the icon.
2. For the first time only, you will need to create an account. Enter your information into the fields.
3. After entering your information, complete the first entry (emotion scale(s) and most recent social interaction information (if applicable)).
4. To complete the emotion scale, tap the emotion(s) you are currently experiencing (IMPORTANT: to record how intensely you are experiencing the emotion, tap the emotion 1-5 times. A number will appear (1-6) that indicates how intense the emotion is (6 is most intense). When no number appears, the number/intensity is 0, or least intense.)



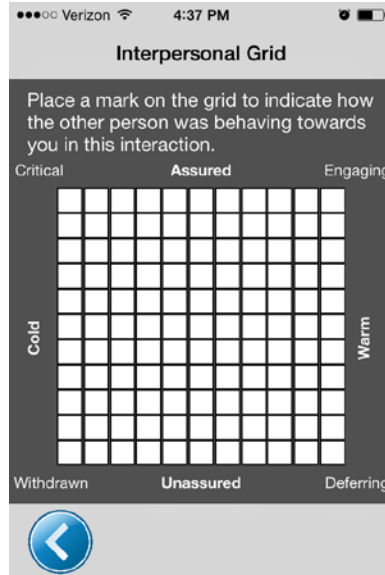
5. Next, answer whether or not you have had a social interaction (a conversation lasting more than 5 minutes) since the last prompting (or the last time you entered info into the app). If not, you are finished with this entry. If you have had a social interaction since your last update, please continue.



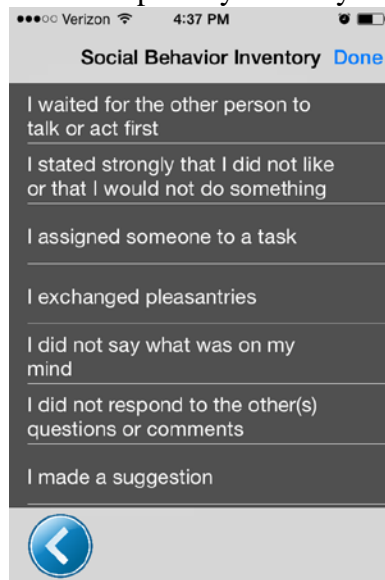
6. If you have had a social interaction since your last entry, please enter information about your MOST RECENT social interaction. Please identify the other person's gender, approximate age, and relationship to you (you may only choose ONE choice in any of these categories).



7. Next, please choose ONLY ONE indicator mark on the interpersonal grid relating to your most recent social interaction.



8. Next, please choose one OR MORE social behavior inventory choices relating to your most recent social interaction. This completes your entry.



9. For each subsequent time you complete an app entry, you will receive a notification to update the app with your current emotion/most recent social interaction. If you cannot complete an entry at the time of notification (if you were driving, etc.), please do so as soon as possible by opening the app.

## **Emotion Definitions**

Happy – Glad, Cheerful

Pleased – Satisfied, Content

Enjoyment/Fun – Pleasure, Amusement

Joyful – Lighthearted, Merry

Worried/Anxious – Nervous, concerned, uneasy

Frustrated – Annoyed, often due to inability to change situation

Angry/Irritable - Hostile, Mad, Irate, Short-tempered, Grouchy

Unhappy – Sad, Blue

Depressed – Miserable, really sad

Ashamed – Embarrassed, humiliated, feeling inferior/unworthy

Guilty – Remorseful, sorry, regret

Empty – Feeling like there is nothing inside, there is a black hole, a bottomless pit, a void that needs to be filled but can't, something is missin

## Interpersonal Grid Instructions

Please describe the behavior of your interaction partner by tapping on a **single** square on the grid. Try thinking first about how warm versus cold the person was, and then select the column that best describes the person's behavior. Then think about how dominant versus submissive the person was and move either up or down accordingly. Finally, take a look at the descriptive word nearest the square you have chosen, and see if the person's behavior was closer to that word than to any of the other descriptive words. *Remember, it is very important to use the whole grid when describing your interaction partner.*

Quarrelsome vs. Agreeable behaviors can be conceptualized as behaviors that promote interpersonal ties and Dominant vs. Submissive behaviors can be conceptualized as behaviors that assert status relative to other individuals

The diagram features a central 10x10 grid. The top row is labeled 'Cold-Quarrelsome' on the left and 'Warm-Agreeable' on the right. The bottom row is labeled 'Withdrawn' on the left, 'Unassured-Submissive' in the center, and 'Deferring' on the right. Four boxes provide examples of behaviors: 'Examples of quarrelsome behaviors' (top-left), 'Examples of dominant behaviors' (top-center), 'Examples of agreeable behaviors' (top-right), and 'Examples of submissive behaviors' (bottom-center).

**Examples of quarrelsome behaviors:**

- Not responding to others' questions or comments
- Raising your voice
- Making sarcastic comments
- Demanding for other people to as you wish
- Giving incorrect information

**Examples of dominant behaviors:**

- Setting goals for others
- Expressing own opinion
- Taking the lead in planning
- Speaking in a clear, firm voice

**Examples of agreeable behaviors:**

- Listening attentively to others
- Speaking highly about people who aren't present
- Compromising about decisions
- Complimenting or praising others
- Showing sympathy
- Reassuring others

**Examples of submissive behaviors:**

- Waiting for others to talk or act first
- Not expressing disagreement that is felt or thought
- Speaking softly
- Giving in

## **Interpersonal Grid Definitions**

Assured – Confident

Unassured –not confident

Critical – Finding fault, or judging

Engaging – Involved and attentive

Quarrelsome – argumentative, confrontational

Agreeable – enjoyable, pleasant

Withdrawn – reserved, detached

Deferring – not expressing opinion

Dominant – Assertive, powerful, authoritative

Submissive – Passive, compliant, unassertive