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Assessment of Emotion Dysregulation Using Ecological Momentary Assessment

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Abstract and Keywords

As emotion is a dynamic construct, ecological momentary assessment (EMA) methods, which gather data at multiple time points in individuals' real-world environments, in the moment, are particularly well suited to measure emotion dysregulation and related constructs. EMA methods can identify contextual events that prompt or follow an emotional response. This chapter provides an overview of traditional methods of studying emotion dysregulation and how EMA can be used to capture emotion dysregulation in daily life, both within and independent of psychiatric diagnoses. It reviews the literature on emotion dysregulation and related constructs within specific diagnoses (e.g., depression, bipolar disorder, borderline personality disorder, and eating disorders) and behaviors (e.g., suicide, nonsuicidal self-injury, and alcohol use). Finally, it discusses future directions in EMA research, as well as its implications for psychological treatment.

Keywords: ecological momentary assessment (EMA), emotion, emotion dysregulation, experience sampling, mobile devices

Introduction

In its simplest form, *emotion regulation* has been defined as the "processes by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions" (Gross, 1998, p. 275). Elaborating on this definition, Gratz and Roemer (2004) note that emotion regulation involves "(a) awareness and understanding of emotions, (b) acceptance of emotions, (c) ability to control impulsive behaviors and behave in accordance with desired goals when experiencing negative emotions, and (d) ability to use situationally appropriate emotion regulation strategies flexibly to modulate emotional responses as desired in order to meet individual goals and situational demands" (pp. 42–43). For our purposes, we adopt a definition of *emotion dysregulation* that encapsulates difficulties in any of these areas. We briefly review traditional approaches to assessment of emotion dysregulation, introduce the utility of ecological momentary assessment (EMA) of emotion dysregulation, and review findings from EMA studies across a variety of diagnoses and problem behaviors.

Traditional Measures of Emotion Dysregulation

Traditionally, emotion dysregulation has been measured as a static construct using self-report measures or observed behavior. For example, the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) is a widely-used self-report measure that asks respondents to rate emotion regulation difficulties when distressed; shorter versions have been recently introduced (Hallion, Steinman, Tolin, & Diefenbach, 2018). Behavioral paradigms have been developed to capture different aspects of emotion reactivity and regulation, such as emotional versions of the Attention Network Task (Tully, Lincoln, & Hooker, 2012) and Stroop tests, which examine interference control over emotional information (see Mathews & MacLeod, 2005, for a review); emotional go/no-go (Hare et al., 2008) and emotional stop-signal tasks (Allen & Hooley, 2015; Allen & Hooley, 2018), which assess emotional response inhibition; and the Trier Social Stress Test (Kirschbaum, Pirke, & Hellhammer, 1993), a stress induction used to evaluate physiological stress, including adrenocorticotropin (ACTH) and cortisol responses.

Psychophysiological assessments can also capture emotion dysregulation, if stimulus conditions are carefully controlled. For example, respiratory sinus arrhythmia (RSA; also known as heart rate variability, cardiac vagal control, or vagal tone) appears to mark emotion regulation capacity in healthy adults (see Balzarotti, Biassoni, Colombo, & Ciceri, 2017, for review), whereas low resting RSA and RSA withdrawal to stressors index emotion dysregulation (see Beauchaine, 2015, for review). Emotional responses are also evident in the noncontent features of speech, such as fundamental frequency (see Giddens, Barron, Byrd-Craven, Clark, & Winter, 2013, for review). Brain-based indices using electroencephalogram (see Coan & Allen, 2004, for review), event-related potentials (see Hajcak, MacNamara, & Olvet, 2010, for a review), and magnetic resonance imaging (e.g., Hare et al., 2008; Morawetz, Bode, Derntl, & Heekeren, 2017) have also been used to explore emotion regulation.

As with all measures, traditional methodologies have many strengths but are limited in several key ways. First, many rely on aggregate ratings of emotion (e.g., DERS items beginning with “When I’m upset…”) and are subject to autobiographical memory effects, such as random error and systematic bias due to heuristics and retrieval (Bradburn, Rips, & Shevell, 1987). Self-reports also tend to reflect self-conceptualizations, and it is not uncommon for respondents to organize or modify responses to reflect self-perception or worldviews, rather than actual events (Ross, 1989). Likewise, responses to behavioral tasks are often collected cross-sectionally; these narrow slices of behavior, under specific conditions, reduces the generalizability of findings.

When considering how to most accurately measure emotional experiences, we must recognize that emotions are dynamic. Thinking about emotion as a static construct, in which participants report overall levels of positive affect (PA) or negative affect (NA), neglects information that could be gained from a moment-to-moment assessment of emotional experience (Trull, Lane, Koval, & Ebner-Priemer, 2015). In contrast, EMA methods allow researchers to measure experiences *in the moment*. These methods can identify contextual events that prompt or follow an emotional response. In this chapter, we review ways in which EMA is well suited to capture emotion dysregulation in daily life, both within and independent of psychiatric problems.

Ecological Momentary Assessment

EMA encapsulates a set of methods employed to better understand the phenomenology of a particular emotion, behavior, or cognition within the context of participants' real-world experiences (Bolger, Davis, & Rafaeli, 2003). These methods are particularly useful when researchers are interested in understanding (1) group differences and (2) the natural history of individuals through repeated, within-subject assessments; real-world contexts and influences on affect, behavior, and cognition; and the temporal sequencing of events to explore causality. We briefly review the characteristics, benefits, and limitations of EMA next; however, a more thorough review can be found elsewhere (Shiffman, Stone, & Hufford, 2008).

In EMA, brief questionnaires and assessments are presented to participants through a handheld computing device on preselected schedules, optimized to capture relevant information about phenomena of interest. EMA descends from paper-and-pencil "daily diary" studies (Korotitsch & Nelson-Gray, 1999) and other "experience sampling" (Hektner, Schmidt, & Csikszentmihalyi, 2007), "self-report EMA" (Stone & Shiffman, 1994), or "real time data capture" methods (Stone & Broderick, 2007).

These methods have been in use, in some form, since the beginning of structured psychological assessment; however, technological innovations over the past two decades have revolutionized our understanding of daily experience of affect, behavior, and cognition. For assessments to be truly "ecological," they should occur in real-world environments (i.e., participants' homes), rather than through repeated measures in a research context (e.g., a lab). Likewise, the "momentary" component of these methods refers to the assessment of state, rather than trait, constructs. For example, an EMA measure of anger would ask participants to rate how angry they feel *right now*, rather than how they feel *in general*. Most modern EMA software programs allow for both random and event-cued assessments, where participants choose to complete an EMA when a certain event happens in their lives (e.g., a fight with a partner).

Ecological Momentary Assessment Strengths

EMA has a number of benefits when compared to cross-sectional methods. These methods significantly reduce self-report biases and effects of social desirability on responding (Ebner-Priemer & Trull, 2009; Shiffman et al., 2008). This emphasis on experiential states is often implemented by limiting the response window for assessments (e.g., within 10 minutes of a prompt). To further reduce biases, most EMAs are delivered randomly throughout the day, to limit the impact of participant expectancies on responding. The use of EMA in combination with cross-sectional, self-report measures assessing similar constructs permits the comparison of state and trait measures to better elucidate patterns of discrepancy or concordance, and can provide incremental construct validity above and beyond self-report, permitting improved prediction of low base rate behaviors such as nonsuicidal self-injury (NSSI; Armey, 2012). One particular strength of these methods is the identification of antecedents—which are often affective in nature—to problematic behaviors. EMA facilitates the examination of cyclical and nonlinear processes over time (Trull et al., 2008) or changes in affective state before, during, and after behavior (e.g., self-harm; Armey, Crowther, & Miller, 2011). Finally, using branching questions in EMA can significantly reduce participant burden by limiting the length of assessments.

Ecological Momentary Assessment Limitations

Despite these strengths, there are several practical and methodological limitations associated with EMA. Although handheld computing devices are nearly ubiquitous, access may be limited for some populations, and it can be expensive for researchers to provide devices to participants. Open-source and free EMA software packages have increasingly been replaced by paid or subscription services, which can increase costs of research. Further, storage and analysis of EMA data is a growing problem for the field. Even a relatively small EMA study can have hundreds of thousands of data points, which may necessitate a dedicated data manager or statistician. While these data sets can be analyzed with conventional within-subject regression models (Schwartz & Stone, 1998, 2007), the true potential of these data can only be unlocked through techniques such as intensive longitudinal modeling (Walls & Schafer, 2006), growth curve modeling (Armey et al., 2011), dynamic systems models (e.g., Butner, Amazeen, & Mulvey, 2005; Chow, Ram, Boker, Fujita, & Clore, 2005), and time-varying effects models (Shiyko, Burkhalter, Li, & Park, 2014), which are not commonly a part of the social scientist skill set.

Ecological Momentary Assessment of Emotion Dysregulation

Here, we provide an overview of EMA research on emotion dysregulation as it applies to individual differences, contextual factors, and physiological correlates. In addition, we discuss the use of EMA to examine emotion dysregulation within specific disorders (e.g., depressive disorders) or behaviors (e.g., NSSI).

Individual Differences in Emotional Trajectory and in Response to Stressors

Ecological methods can elucidate associations between emotion dysregulation and individual differences, including demographics, personality factors, and responses to stressful life events. For example, one study collected emotion-related data five times daily for 1 week from individuals ranging in age from 18 to 94 (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000). Results suggested that the frequency of NA decreased over the lifespan, declining until age 60, but the frequency of PA or the intensity of both NA and PA did not. Older people had more differentiated emotional experiences and were able to better regulate emotions. In addition, individuals with lower momentary PA ratings over 1 day had greater odds of death relative to those with higher momentary PA ratings (Steptoe & Wardle, 2011). Demographic factors are also associated with specific emotions, such as happiness over time collected via experience sampling methods. Csikszentmihalyi and Hunter (2003) reported that the highest levels of happiness over a week's time were experienced by teens in working-class communities, and happiness decreased over the teenage years.

Beyond demographics, EMA can shed light on how personality variables influence response to stressful life events. Using a daily diary approach, Bolger and Schilling (1991) examined same-day and later-day responses to stressors and found that those who were high in neuroticism experienced more distress in response to specific stressors (e.g., arguments with spouse). D. J. Miller, Vachon, and Lynam (2009) reported that NA instability and trait neuroticism were related but independent constructs, with neuroticism more strongly related to overall NA. In another study, adolescent romantic relationship dyads were assessed twice weekly for 12 weeks (Rogers, Ha, Updegraff, & Iida, 2018). Daily conflict predicted greater same-day NA, and NA was transmitted between partners. Among adult males, stressful events were associated with increases in NA, but perceived controllability attenuated these negative effects (van Eck, Nicolson, & Berkhof, 1998).

Gray's (1987) model of emotion describes two motivational systems—the behavioral activation system (BAS), which drives appetitive behavior, and the behavioral inhibition system (BIS), which drives avoidance behavior. In accordance with this model, Gable, Reis, and Elliot (2000) examined BIS/BAS associations with daily diary NA and PA. Here, BIS sensitivity predicted daily average NA, while BAS *and* BIS sensitivity predicted daily PA. Another study of male community residents signaled to respond to surveys eight times daily found that participants high in trait NA reported more distress to current-day problems, with slower recovery the following day (Marco & Suls, 1993). These results point to consistent relationships between personality traits and affective responses; however, one EMA study found that fluctuations in affect accounted for most, but not all, of the variance in personality states (Wilson, Thompson, & Vazire, 2017). Overall, these studies demonstrate that within- and between-person traits influence experiences of affect in response to stressful life events.

Analysis of Specific Emotions over Time

EMA methods allow for a more nuanced understanding of *specific* emotional experiences throughout the day and over time. Csikszentmihalyi and Hunter (2003) found that among teens, happiness is lowest on Sundays, that it increases slightly each day, and that the first part of the day—structured by work or school—is less happy. In a sample of working women, happiness was also lower in the first part of the day (Dockray et al., 2010).

EMA data can also be used to develop latent affect intensity profiles (Cushing, Marker, Bejarano, Crick, & Huffhines, 2017), suggesting that overall patterns of mood can be determined by more than one emotional state. Examining emotions over time can also provide information about the duration of emotional responses. In a sample of college students completing daily assessments, joy episodes were longer lasting than episodes of anger, which were longer lasting than fear episodes, suggesting that the duration of an emotional experience varies across emotions (Verduyn, Delvaux, Van Coillie, Tuerlinckx, & Van Mechelen, 2009). In a follow-up study, the authors found that the greater the importance of the emotion-eliciting situation and the higher the initial intensity of the emotion, the longer the episodes lasted.

Ecological Momentary Assessment and Psychophysiological Measures

EMA affect ratings can be combined with other sources of data (e.g., psychophysiology) for a more comprehensive picture of processes associated with emotion dysregulation. In one study of global life satisfaction, participants completed a salivary cortisol sample at each EMA assessment (Smyth, Zawadzki, Juth, & Sciamanna, 2017), with life satisfaction predicting lower momentary cortisol levels, greater arousal, and more positively valenced affect. Similarly, over two separate days, Steptoe, Gibson, Hamer, and Wardle (2007) examined PA measured by EMA and salivary cortisol collected throughout the day. Results suggested that rising cortisol output measured in the first hour after waking was negatively associated with EMA-reported PA. EMA methods can also be collected simultaneously with methods such as actigraphy, defined as the measurement of movement and rest cycles. M. A. Miller and colleagues (2015) collected both EMA and actigraphy data to elucidate the relationship between chronotype and PA and NA rhythms, measured hourly, and found that individuals with an evening chronotype had delayed and blunted PA rhythms. Using multiple sources of data yoked to EMA allows for a more complete understanding of objective and subjective experiences of emotion dysregulation.

Ecological Momentary Assessment of Emotion Dysregulation in Psychological Disorders and Behaviors

Emotion dysregulation is a transdiagnostic risk factor for psychopathology (Beauchaine, 2015; Cole, Hall, & Hajal, 2008). There is a burgeoning literature using EMA to examine emotion dysregulation in psychological disorders (e.g., Armey, Schatten, Haradhvala, & Miller, 2015; Ebner-Priemer & Trull, 2009; Myin-Germeys et al., 2009; Santangelo, Bohus, & Ebner-Priemer, 2014). To follow, we focus on key and recent findings regarding ecologically measured emotion dysregulation in mood disorders, self-injurious thoughts and behaviors, substance use, eating disorders, and borderline personality disorder (BPD).

Unipolar Depression

EMA measures of daily affect generally show poor concordance with retrospective self-report measures, which tend to exaggerate symptoms (Ebner-Priemer & Trull, 2009); evidence suggests that this may be especially true in depression. Specifically, depressed patients demonstrate less accurate recall of daily NA but not PA compared to nonclinical controls, who show an intensification bias in retrospective reports of PA (Ben-Zeev, Young, & Madsen, 2009). EMA studies also find that depressed participants have higher daily average NA and lower PA (Bowen, Peters, Marwaha, Baetz, & Balbuena, 2017; Myin-Germeys et al., 2003; Peeters, Berkhof, Delespaul, Rottenberg, & Nicolson, 2006), and more frequent days characterized by elevated NA, even though depressed and nondepressed participants report a similar number of negative events (Chepenik et al., 2006). Such studies also reveal nuance in these patterns that further reflect emotion dysregulation, such as greater NA variability from day to day (Bowen et al., 2017; Chepenik et al., 2006) and moment to moment (Peeters et al., 2006; R. J. Thompson et al., 2012). This instability has been prospectively linked to depressive symptoms in women with a history of major depression (Wichers et al., 2010). In contrast, PA gradually increases throughout the day, with a later peak in depressed patients compared to healthy controls (Peeters et al., 2006), but exhibits comparable momentary variability (R. J. Thompson et al., 2012).

EMA research also supports the idea that emotion dysregulation increases the risk for depression. For example, Wichers and colleagues (2007) suggested that negative emotional reactivity to daily stress may be a depression endophenotype (i.e., a behavioral response pattern with heritable biological underpinnings; Gottesman & Gould, 2003). Specifically, twins diagnosed with depression reported increased NA following stressful life events, with more pronounced elevations in monozygotic than dizygotic twins. This finding is consistent with enhanced NA reactivity to life stressors observed in depressed patients (Myin-Germeys et al., 2003), which persists even following remission (O'Hara, Armeli, Boynton, & Tennen, 2014).

PA may serve as a buffer between stressful life events and NA in depression; for example, experiencing PA during stressful moments attenuates the association between event-related stress and subsequent NA among depressed individuals (Wichers et al., 2007). Daily PA similarly reduces the association between perceived stress and NA in adults with a history of depression (O’Hara et al., 2014). In contrast, people with major depression report no PA change following daily stressors (Myin-Germeys et al., 2003; R. J. Thompson et al., 2012), distinct from patterns observed in bipolar disorder and nonaffective psychosis (Myin-Germeys et al., 2003).

In sum, EMA studies assessing the temporal dynamics of affect in depression reveal that daily emotion dysregulation primarily involves elevated NA variability and enhanced reactivity to stressful events. Furthermore, momentary NA instability and negative emotional reactivity are positively correlated in depressed individuals (R. J. Thompson et al., 2012). There is also evidence for persistently blunted PA, but this finding is not universal (e.g., Bowen et al., 2017).

Bipolar Disorder

The mood shifts inherent to bipolar disorder occur on the scale of days to weeks (American Psychiatric Association, 2013); however, EMA data provide valuable insight into the daily emotion dysregulation occurring during and between manic episodes. Relative to healthy controls, patients with remitted bipolar disorder report higher daily NA and lower PA (Havermans, Nicolson, Berkhof, & deVries, 2010), comparable to the pattern observed in depression. Further, this interepisode pattern of daily affect predicts future depressive, but not manic, symptoms 1 month later (Gershon & Eidelman, 2015). Bipolar spectrum pathology is associated with elevated daily NA, affective variability (Kwapil et al., 2012), and increasing levels of certain types of PA (i.e., “exuberance”) from noon to midnight (Kwapil et al., 2012; Walsh, Royal, Brown, Barrantes-Vidal, & Kwapil, 2012).

Some EMA evidence suggests a distinct pattern of emotion dysregulation between manic episodes. Compared to healthy individuals and those with remitted depression, patients with bipolar disorder report increased daily PA plus life satisfaction, as well as increased NA with functional impairment, relative to healthy controls (Gruber, Kogan, Mennin, & Murray, 2013). They also experience decreasing PA over the course of the day (Myin-Germeys et al., 2003). Longer term studies of daily affect in patients with bipolar disorder reveal that euphoric mood frequently occurs outside of hypomanic or manic episodes (Bauer et al., 2006). The temporal course of emotion dysregulation in bipolar illness may involve elevated NA that precedes momentary impulsivity, which in turn predicts reduced PA (Depp et al., 2016). Finally, EMA findings do not indicate a strong relation between bipolar disorder and emotion reactivity to daily stressors (Havermans et al., 2010; Havermans, Nicolson, Berkhof, & deVries, 2011). These data implicate both positive *and* negative emotion dysregulation in bipolar disorder.

Self-Injurious Thoughts and Behaviors

Suicide

Despite the emphasis on emotion dysregulation in theoretical models of suicide (Law et al., 2015; Linehan, 1993), EMA remains an underutilized approach in the study of self-injurious thoughts and behaviors (SITBs; Davidson, Anestis, & Gutierrez, 2017; Kleiman & Nock, 2018). This may be due to practical challenges of working with institutional review boards to approve potentially high-risk research and concerns about iatrogenic effects of repeated evaluation of emotions and self-harm, which are unfounded (Cha et al., 2016; Gould et al., 2005). Indeed, research supports the feasibility and acceptability of EMA in recent suicide attempters (Husky et al., 2014; Law et al., 2015). Empirical work in this area is essential; unlike affect and psychological symptoms, which tend to be exaggerated in retrospective reports (Ebner-Priemer & Trull, 2009; Shiffman et al., 2008), global recall may promote *underreporting* of suicidal ideation (SI; e.g., Torous et al., 2015). Furthermore, daily life emotion dysregulation is highly predictive of SITBs across diagnoses. Trajectories of daily NA and PA in a pilot study of patients with bipolar disorder predicted SI with 88% sensitivity and 95% specificity, strongly outperforming in-person clinical assessments (W. K. Thompson, Gershon, O'Hara, Bernert, & Depp, 2014). A recent study in patients with bipolar type II similarly found that daily ratings of depressed mood predicted increased SI 2 weeks later with excellent accuracy [area under the curve (AUC) = .78–.91; Depp, Thompson, Frank, & Swartz, 2017].

EMA studies also elucidate the types of emotion dysregulation most relevant to SITBs, which may be population specific. For example, a study in adult inpatients with depression indicated that sadness, tension, and boredom preceded SI within a time span of hours, whereas other forms of NA (e.g., hopelessness, anhedonia, worthlessness) did not (Ben-Zeev, Young, & Depp, 2012). Another recent study in adults discharged from the hospital following a serious suicide attempt (SA) confirmed daily sadness as a short-term predictor of SI (Husky et al., 2017). Other research by this group suggests that hopelessness and loneliness correlate with momentary SI but do not predict SI changes beyond several hours (Kleiman et al., 2017). In contrast, among adolescents with a history of NSSI, a range of NA states (particularly sadness, worthlessness, self-hatred, and anger) were observed prior to SI (Nock, Prinstein, & Sterba, 2009). Daily emotion dysregulation in the form of negative mood intensity is associated with SI, past suicidal behavior, and future SA likelihood among individuals with BPD (Links et al., 2007; Links, Eynan, Heisel, & Nisenbaum, 2008). In an inmate sample, momentary feelings of anger were associated with concurrent, but not subsequent, SI (Humber, Emsley, Pratt, & Tarrier, 2013). Similarly, recent EMA work from our research group using time-varying effect models (TVEMs) suggests that individual-level increases in NA over time are strongly associated with increases in SI (Armey, Brick, Schatten, Nugent, & Miller, 2019) in a sample of psychiatric patients recently discharged from the hospital. Despite substantial evidence linking elevated NA to suicidal thinking, a recent study suggests that SI may persist due to its reinforcing effects on mood: Kleiman and colleagues (2018) examined changes in affect surrounding SI in adults with a recent SA. They found that PA increased and sadness decreased from pre- to post-SI assessments, and SI predicted subsequent increased PA and decreased NA.

As in depression, EMA implicates daily mood instability in the prediction of suicidality. NA variability, but not average levels of affect, predicted the frequency and severity of SI in a sample of individuals at high risk for psychosis (Palmier-Claus, Taylor, Gooding, Dunn, & Lewis, 2012). Additionally, Links et al. (2007) found an association between emotion reactivity to environmental stressors and daily SI in BPD. These authors identified a subgroup of patients with BPD reporting the most suicidal behavior, based on high levels of daily NA intensity and mood amplitude. Overall, the EMA literature indicates that negative affective intensity and instability predict SI (Spangenberg, Forkmann, & Glaesmer, 2015), although research examining these phenomena in larger samples is needed to determine the long-term predictive utility of momentary emotion dysregulation.

Nonsuicidal Self-Injury

Recent research suggests that NSSI may be one of the strongest predictors of future SITBs (Ribeiro et al., 2016), and these behaviors are associated with mood and anxiety disorders transdiagnostically (e.g., Andover, Pepper, Ryabchenko, Orrico, & Gibb, 2005). Consistent with findings in depression, NSSI history is associated with daily life emotion dysregulation in the form of higher NA and lower PA (Bresin, 2014; Santanagelo, Koenig, et al., 2017; Victor & Klonsky, 2014), as well as instability in NA (Bresin, 2014) and overall affect (Santangelo, Koenig, et al., 2017). EMA and daily diary research tend to support an automatic negative reinforcement function of NSSI, suggesting that these behaviors serve to reduce NA (Armey, Crowther, & Miller, 2011; Nock et al., 2009; Shingleton et al., 2013). Specifically, undergraduates engaging in NSSI reported increased NA in the hours preceding an episode, followed by reduced NA post-NSSI (Armey et al., 2011). A recent study in a large sample of youth with BPD similarly observed increases in NA, as well as decreased PA, 15 and 10 hours (respectively) prior to NSSI, and this affective pattern was reversed after the episode (Andrewes, Hulbert, Cotton, Betts, & Channen, 2017a). Further, the number of co-occurring negative emotions similarly preceded NSSI episodes, peaked during episodes, and decreased afterward, a pattern mirrored by self-reported distress (Andrewes et al., 2017b). Although elevated NA prospectively predicted NSSI likelihood in another recent study of inpatients with BPD features, NSSI engagement was concurrently associated with elevated NA and reduced PA and predicted continued increases in NA hours later (Houben et al., 2017). A sample of women with bulimia nervosa also reported momentary increased NA and decreased PA prior to NSSI; however, NA remained unchanged following the episode, while PA increased (Muehlenkamp et al., 2009). Similarly, EMA studies of NSSI also provide evidence for automatic positive reinforcement (Nock et al., 2009; Selby, Nock, & Kranzler, 2014), suggesting that some individuals engage in these behaviors in order to generate affective states. Support for multiple reinforcement functions using EMA methods corroborate the assertion that emotion dysregulation is a core characteristic of NSSI (Andover & Morris, 2014; Hooley & Franklin, 2018; Nock, 2009).

In addition to affective valence, EMA research suggests that *variability* in affective responding may be associated with NSSI episodes. In a sample of women with eating disorders, Vansteelandt and colleagues (2013) found that variability in affective activation (regardless of valence) predicted NSSI acts. A follow-up study among individuals with BPD suggests that beyond simply reducing NA, NSSI may serve an affect stabilization function, as more frequent NSSI in this sample was associated with reduced variance in affective valence and activation (Vansteelandt et al., 2017). Even controlling for average levels of NA and momentary variability in affect, the interaction between past suicide attempts and trait affective lability was found to predict NSSI episodes in women diagnosed with bulimia nervosa (Anestis et al., 2012). Overall, this literature suggests that emotion dysregulation in NSSI may primarily involve affective variability at the state and trait level, in addition to high daily NA/low daily PA.

Daily life emotion dysregulation may promote NSSI urges in certain affective and cognitive contexts, specifically when feeling sad/worthless, overwhelmed, scared/anxious, rejected/hurt, or criticized/insulted (Nock et al., 2009; Shingleton et al., 2013). Despite the association between various NA states and NSSI thoughts, Nock and colleagues (2009) found that feelings of rejection, anger, and numbness were associated with increased odds of actually engaging in NSSI, whereas sadness and worthlessness were not. Elevated anger, guilt, and self-loathing were found to precede NSSI (Armey et al., 2011), peaking during the episode, and decreasing in intensity after. Results from a daily diary study suggest that trait negative urgency moderates the relation between emotion dysregulation and NSSI engagement, indicating that daily sadness predicts NSSI only among undergraduates who tend to react impulsively to negative emotions (Bresin, Carter, & Gordon, 2013). Moreover, variability in NA and rumination independently and interactively predict NSSI episodes (Selby, Franklin, Carson-Wong, & Rizvi, 2013). The effect of momentary rumination on NSSI urges and behaviors was replicated in a study of patients with BPD (Zaki, Coifman, Rafaeli, Berenson, & Downety, 2013). The relationship between rumination and NSSI was attenuated, however, among participants in this group, who demonstrated better emotion differentiation. In another EMA study in individuals with BPD and anxiety disorders, momentary NA was found to predict subsequent NSSI urges only when self-concept clarity was low (Scala et al., 2018). Taken together, these findings suggest that it may be useful to examine affective states as they interact with trait characteristics and cognitive factors.

Borderline Personality Disorder

Affective instability is considered a central feature of BPD. EMA research generally finds that BPD is characterized by affective instability in natural contexts (Santangelo, Reinhard, et al., 2017; see Santangelo, Bohus, et al., 2014, for a review), including variability in NA (Jahng, Wood, & Trull, 2008; Trull et al., 2008) and PA (Russell, Moskowitz, Zuroff, Sookman, & Paris, 2007), as well as rapid fluctuations from positive to negative mood (Ebner-Priemer, Kuo, et al., 2007; Houben, Vansteelandt, et al., 2016). In general, affective instability measured using retrospective self-report concords poorly with ecological assessments in patients with BPD (Solhan et al., 2009), especially compared to global recall of stable phenomena (e.g., elevated NA; Ebner-Primer, Bohus, & Kuo, 2007; Links, Heisel, & Garland, 2003). Findings have indicated the superiority of EMA methods for determining psychophysiological hyperarousal associated with emotion dysregulation in BPD compared to laboratory studies (Ebner-Priemer, Welch, et al., 2007; Ebner-Priemer et al., 2008; Lieb et al., 2004).

Again, EMA minimizes recall bias inherent to global self-report or interview measures, which tend to exaggerate the intensity of NA and underestimate PA in patients with BPD compared to healthy controls, who show the opposite effect (Ebner-Priemer et al., 2006; see also Ben-Zeev et al., 2009). Despite these biases, EMA findings suggest that patients with BPD experience a greater variety of negative emotions, more intense NA, and fewer positive emotions compared to clinical and healthy control groups (Ebner-Priemer, Welch, et al., 2007; Tomko et al., 2015; Wolff, Stiglmayr, Bretz, Lammers, & Auckenthaler, 2007). Examinations of the temporal sequence of momentary emotions in BPD indicate less activation (or initiation) of positive mood states (specifically joy and interest), greater persistence of negative mood, and more frequent switching between different types of NA, such as anxiety, sadness, and anger (Reisch, Ebner-Priemer, Tschacher, Bohus, & Linehan, 2008).

Ecological research on emotion dysregulation in BPD often focuses on risky or self-destructive behaviors thought to serve an emotion regulation function, including self-harm (Andrewes et al., 2017a, 2017b; Links et al., 2007, 2008; Nisenbaum, Links, Eynan, & Heisel, 2010), substance use (Jahng et al., 2011), and disordered eating (Selby et al., 2012). A three-way interaction between momentary rumination, NA, and BPD symptom severity predicts engagement in these types of impulsive behaviors 2 to 3 hours later (Selby & Joiner, 2013). As another example, a recent study examined the relationship between alcohol consumption rate, subjective stimulation (a measure of alcohol's rewarding pharmacological effects), and mood in patients with BPD and controls (Carpenter et al., 2017). Stimulation was associated with enhanced PA in both groups, but also with reduced NA in the BPD group, suggesting that patients consume alcohol more quickly to regulate emotion (Carpenter et al., 2017).

There is also evidence for heightened stress sensitivity in BPD (i.e., larger increases in NA and decreases in PA after a stressful event) compared to patients with psychosis and healthy controls (Glaser, Os, Mengelers, & Myin-Germeys, 2008). BPD traits predict perceived stressfulness of daily life events in women with bulimia nervosa (Pearson et al., 2017). This sensitivity may be particularly salient in the sensitivity of interpersonal stressors. Within patients with BPD, a variety of stressors (particularly being involved in a disagreement) predict elevated NA, feeling emotionally overwhelmed, and feeling out of control (Chaudhury et al., 2017). These patients report associations between rejection and sadness at the momentary, daily, and person level, whereas depressed patients report this association only at the momentary level (Hepp et al., 2017). Patients with BPD also reported a stronger link between momentary/daily interpersonal problems and feelings of hostility. BPD traits similarly predict daily aggression via increased NA (particularly anger) following perceived rejection (Scott et al., 2017).

In accordance with prevailing theoretical models, daily life emotion dysregulation in BPD is characterized by affective instability. Specifically, EMA data indicate variability in NA at the momentary and daily level, as well as rapid swings between negative and positive emotional states. BPD may also involve higher NA/lower PA on average, with a greater number of co-occurring negative emotions, and more switching between them. However, there is also evidence that affective instability (Santangelo, Reinhard, et al., 2014) and emotional switching (Houben, Bohus, et al., 2016) are not specific to BPD, and may represent transdiagnostic forms of emotion dysregulation. Finally, EMA also provides support for the conceptualization of impulsive or risky behavior as attempts to regulate emotions in patients with BPD.

Eating Disorders

Affect regulation has also been conceptualized as a primary motivation underlying eating disorder behavior (Bydlowski et al., 2005; Haynos & Fruzzetti, 2011; Lavender et al., 2015; Polivy & Herman, 2002). The majority of EMA studies support this notion, particularly highlighting the role of negative reinforcement in these behaviors. For example, in obese adults, NA predicts binge eating at the daily level (Berg et al., 2014), and discrete episodes are preceded by increased NA, particularly in the form of guilt, which are, in turn, followed by decreased NA at the momentary level (Berg et al., 2015). Guilt is also especially associated with episodes of behavior associated with bulimia nervosa, such as binge eating, purging, and binge-purge episodes (Berg et al., 2013). A large naturalistic study of affect in anorexia nervosa (AN) by Engel and colleagues (2013) found that NA also increases prior to AN-related behaviors (e.g., loss-of-control eating and purging) and decreases subsequently. EMA data also reveal that AN-related behaviors are most likely to occur during periods of heightened anxiety (Lavender et al., 2013). Mood instability seems particularly relevant to weight loss activities in AN. According to findings by Selby and colleagues (2015), such activities are associated with variability in both NA and PA, which also interact to predict attempted weight loss. In sum, studies of daily life emotion dysregulation in eating disorders largely support the role of associated behaviors in reducing NA and further implicate affective variability in the maintenance of AN.

Alcohol Use and Substance Use Craving

EMA is particularly suited for use in substance use research, as substance use is discrete and episodic (Shiffman, 2009). In this section, we focus on alcohol use, an area of substance use research where EMA methods have often been applied. In addition, we discuss craving across a variety of substances, another important focus of EMA research.

Models of substance use have emphasized emotional reinforcement processes, proposing that substances provide intrinsic reward or pleasure that initially facilitates enhanced PA, and use is maintained and progresses to addiction through negative reinforcement (i.e., to escape, alleviate, or avoid NA or withdrawal; Baker et al., 2004; Wise & Koob, 2014). EMA data are generally consistent with these models, corroborating findings from self-report (e.g., Cooper, Frone, Russell, & Mudar, 1995; Sher, Grekin, & Williams, 2005) and experimental studies (e.g., Allen & Gabbay, 2013; Greeley & Oei, 1999) of alcohol use. Some research indicates that anxiety experienced during the day increases drinking levels that night (Simons, Dvorak, Batien, & Wray, 2010; Swendsen et al., 2000; but see also Dvorak & Simons, 2014), as well as dependence symptoms (Dvorak, Pearson, & Day, 2014). This effect is particularly evident among individuals who report trait impulsivity in response to negative emotions (i.e., negative urgency; Simons et al., 2010). Even more consistently, ecological studies have found an association between daily PA and likelihood of drinking, consumption levels, and intoxication at night (Dvorak & Simons, 2014; Simons et al., 2010; Trull, Wycoff, Lane, Carpenter, & Brown, 2016). A large ecological investigation of the temporal dynamics of affect in relation to alcohol consumption suggests that PA increases and NA decreases in the hours preceding a drinking episode, and these trends continue after the first drink (Treloar, Piasecki, McCarthy, Sher, & Heath, 2015). Daily dysregulation in specific types of NA (e.g., irritability, loneliness) increases the risk for subsequent alcohol-related problems in the evening regardless of consumption level (Simons et al., 2005). An EMA study in underage social drinkers found that the ability to differentiate discrete types of momentary NA reduced the effect of elevated NA on later consumption, suggesting a protective role for emotion differentiation (Kashdan, Ferssizidis, Collins, & Muraven, 2010). Affective variability may have greater implications for alcohol use in clinical populations beyond momentary or daily NA/PA. For example, affective variability is associated with concurrent alcohol use among patients with BPD, in contrast to predicting next-day drinking among patients with depression (Jahng et al., 2011).

Another focus of EMA in substance use is craving. A review of this literature indicates that real-world emotion dysregulation increases subsequent craving across a variety of substances (Serre, Fatseas, Swendsen, & Auriacombe, 2015). Craving may also involve an interaction between daily-level affect and person-level mood. Among patients with opioid dependence, those with high *average* NA reported increased craving on days they experienced heightened NA, whereas patients with low *average* PA reported more craving on days they experienced particularly low PA (Huhn et al., 2016). Studies further suggest that aspects of real-world emotion dysregulation might interact with craving to predict use or relapse. Buckner and colleagues have found that momentary anxiety sensitivity (2011) and social anxiety (2012) interact with craving to predict subsequent cannabis use.

To summarize, real-world emotion dysregulation influences substance use in multiple ways. Among people who drink alcohol, heightened PA increases the amount consumed, whereas heightened NA predicts subsequent alcohol-related problems. EMA data also support both positive and negative reinforcement models of alcohol use, as individuals report elevated PA and reduced NA once they begin drinking. There is only equivocal evidence for the relationship between daily life emotion dysregulation and subsequent use of substances other than alcohol; however, both increased NA and PA predict craving across substances. Certain types of NA (particularly anxiety) may also lead to use in moments of increased craving, perhaps especially for individuals who are high in negative urgency. Finally, daily affective variability might have specific associations with substance use across different forms of psychopathology.

Conclusions

The literature reviewed in this chapter supports the use of EMA methods to measure emotion dysregulation both in the context of psychological disorders and as a distinct construct. Since emotions are dynamic, EMA permits research on emotion dysregulation by gathering data multiple times daily. These methods allow for the identification of contextual factors that influence emotional responding, as well as interactions between trait characteristics and momentary emotion states. Although a strength of EMA is the ability to reduce the impact of autobiographic memory effects and similar sources of error on responding, the momentary capture of emotion using EMA methods is still reliant on individuals' self-report of their current affect state, which may still be subject to some degree of bias.

To collect objective data without relying on self-report measures, researchers have begun to leverage information gathered by hardware and software sensors already on mobile phones, which Asselbergs and colleagues (2016) refer to as "unobtrusive EMA." This is related to the popularized concept of "digital phenotyping," in which sensor data are used to predict behavior and psychopathology (Insel, 2017). Although unobtrusive EMA or digital phenotyping cannot directly access an individual's affective experience, it can provide clues based on psychophysiological responding, contextual factors, and behavior (Asselbergs et al., 2016). LiKamWa, Liu, Lane, and Zhong (2013) predicted fluctuations of self-reported mood with 93% accuracy using variables including mobile phone use, physical activity, and social activity, while Asselbergs and colleagues (2016) accurately predicted 55% to 76% of EMA mood scores. Future research leveraging advanced statistical techniques for large datasets will provide researchers with the ability to take advantage of unobtrusive data collected automatically on smartphones.

At this stage, however, gathering EMA data in conjunction with data collected via digital phenotyping methods is fundamental for multiple reasons. EMA data can serve as a ground truth for sensor data; in fact, analyzing data on self-reported affective states in conjunction with objective measures allows for an examination of convergent validity. Collecting subjective and objective data simultaneously, in daily life, permits researchers to examine the incremental utility of these measurements in predicting outcomes of interest. Research identifying and comparatively evaluating predictors of behavioral and psychopathology outcomes at multiple levels of analysis is essential to elucidate the emotion dysregulation construct.

Clearly, EMA is an indispensable tool for capturing the phenomenology of emotion dysregulation, and it also has clinical utility. Data gleaned from EMA can provide information about response to psychological treatment. For example, in depression, lower levels of negative emotional reactivity to life stress were associated with positive early response to cognitive therapy (Cohen, Gunthert, Butler, O'Neill, & Tolpin, 2005); conversely, persistently elevated NA on the day following a stressor predicts a slower therapeutic response (Cohen et al., 2008). Similarly, daily variability in NA, but not PA, is related to slower treatment response, whereas a high daily PA-to-NA ratio predicts earlier symptom reduction (Husen, Rafaeli, Rubel, Bar-Kalifa, & Lutz, 2016). Longitudinal research indicates that baseline instability of momentary affect predicts depressive relapse (Timm et al., 2017). Thus, *changes* in affect, rather than presence of specific emotional states, may be more useful in determining treatment response.

Finally, if used to deliver interventions to people during their daily life, EMA technologies can be termed *ecological momentary interventions* (EMIs). EMIs are ecologically valid because they occur in individuals' natural environments and intervention components are provided at specific moments or in specific contexts (see Heron & Smyth, 2010, for review). Given the association between emotion dysregulation and psychopathology, EMIs developed to specifically target emotion-related "events" (e.g., emotional variability, experiencing particular emotions simultaneously) by providing intervention in response to these events are worthy of further study. In sum, EMA is a particularly well-suited research method for the assessment of dynamic processes such as emotion dysregulation, with the potential to use the information gained from these assessments to deliver timely and targeted interventions.

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References

Allen, K. J. D., & Gabbay, F. H. (2013). The amphetamine response moderates the relationship between negative emotionality and alcohol use. *Alcoholism: Clinical and Experimental Research*, *37*, 348–360.

Allen, K. J. D., & Hooley, J. M. (2015). Inhibitory control in people who self-injure: Evidence for impairment and enhancement. *Psychiatry Research*, *225*, 631–637.

Allen, K. J. D., & Hooley, J. M. (2018). Negative emotional response inhibition: Support for a cognitive mechanism underlying negative urgency in nonsuicidal self-injury. Manuscript submitted for publication.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Andover, M. S., & Morris, B. W. (2014). Expanding and clarifying the role of emotion regulation in nonsuicidal self-injury. *Canadian Journal of Psychiatry*, *59*, 569–575.

Andover, M. S., Pepper, C. M., Ryabchenko, K. A., Orrico, E. G., & Gibb, B. E. (2005). Self-mutilation and symptoms of depression, anxiety, and borderline personality disorder. *Suicide and Life-Threatening Behavior*, *35*, 581–591.

Andrewes, H. E., Hulbert, C., Cotton, S. M., Betts, J., & Chanen, A. M. (2017a). Ecological momentary assessment of nonsuicidal self-injury in youth with borderline personality disorder. *Personality Disorders: Theory, Research, and Treatment*, *8*, 357–365.

Andrewes, H. E., Hulbert, C., Cotton, S. M., Betts, J., & Chanen, A. M. (2017b). An ecological momentary assessment investigation of complex and conflicting emotions in youth with borderline personality disorder. *Psychiatry Research*, *252*, 102–110.

Anestis, M. D., Silva, C., Lavender, J. M., Crosby, R. D., Wonderlich, S. A., Engel, S. G., & Joiner, T. E. (2012). Predicting nonsuicidal self-injury episodes over a discrete period of time in a sample of women diagnosed with bulimia nervosa: An analysis of self-reported trait and ecological momentary assessment based affective lability and previous suicide attempts. *International Journal of Eating Disorders*, *45*, 808–811.

Armey, M. F. (2012). Ecological momentary assessment and intervention in nonsuicidal self-injury: A novel approach to treatment. *Journal of Cognitive Psychotherapy*, *26*, 299–317.

Armey, M. F., Brick, L. A., Schatten, H. T., Nugent, N. R., & Miller, I. W. (under review). Ecologically assessed affect and suicidal ideation follow psychiatric inpatient admission. Manuscript submitted for publication.

Armey, M. F., Crowther, J. H., & Miller, I. W. (2011). Changes in ecological momentary assessment reported affect associated with episodes of non-suicidal self-injury. *Behavior Therapy*, *42*, 579–588.

Armey, M. F., Schatten, H. T., Haradhvala, N., & Miller, I. W. (2015). Ecological momentary assessment (EMA) of depression-related phenomena. *Current Opinion in Psychology*, *4*, 21–25.

Asselbergs, J., Ruwaard, J., Ejdys, M., Schrader, N., Sijbrandij, M., & Riper, H. (2016). Mobile phone-based unobtrusive ecological momentary assessment of day-to-day mood: An explorative study. *Journal of Medical Internet Research*, *18*, e72.

Baker, T. B., Piper, M. E., McCarthy, D. E., Majeskie, M. R., & Fiore, M. C. (2004). Addiction motivation reformulated: An affective processing model of negative reinforcement. *Psychological Review*, *111*, 33–51.

Balzarotti, S., Biassoni, F., Colombo, B., & Ciceri, M. (2017). Cardiac vagal control as a marker of emotion regulation in healthy adults: A review. *Biological Psychology*, *130*, 54–66.

Bauer, M., Grof, P., Rasgon, N. L., Marsh, W., Munoz, R. A., Sagduyu, K., … Whybrow, P. C. (2006). Self-reported data from patients with bipolar disorder: Impact on minimum episode length for hypomania. *Journal of Affective Disorders*, *96*, 101–105.

Beauchaine, T. P. (2015). Respiratory sinus arrhythmia: A transdiagnostic biomarker of emotion dysregulation and psychopathology. *Current Opinion in Psychology*, *3*, 43–47.

Ben-Zeev, D., Young, M. A., & Depp, C. A. (2012). Real-time predictors of suicidal ideation: Mobile assessment of hospitalized depressed patients. *Psychiatry Research*, *197*, 55–59.

Ben-Zeev, D., Young, M. A., & Madsen, J. W. (2009). Retrospective recall of affect in clinically depressed individuals and controls. *Cognition and Emotion*, *23*, 1021–1040.

Berg, K. C., Crosby, R. D., Cao, L., Crow, S. J., Engel, S. G., Wonderlich, S. A., & Peterson, C. B. (2015). Negative affect prior to and following overeating-only, loss of control eating-only, and binge eating episodes in obese adults. *International Journal of Eating Disorders*, *48*, 641–653.

Berg, K. C., Crosby, R. D., Cao, L., Peterson, C. B., Engel, S. G., Mitchell, J. E., & Wonderlich, S. A. (2013). Facets of negative affect prior to and following binge-only, purge-only, and binge/purge events in women with bulimia nervosa. *Journal of Abnormal Psychology*, *122*, 111–118.

Berg, K. C., Peterson, C. B., Crosby, R. D., Cao, L., Crow, S. J., Engel, S. G., & Wonderlich, S. A. (2014). Relationship between daily affect and overeating-only, loss of control eating-only, and binge eating episodes in obese adults. *Psychiatry Research*, *215*, 185–191.

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

Bolger, N., & Schilling, E. A. (1991). Personality and the problems of everyday life: The role of neuroticism in exposure and reactivity to daily stressors. *Journal of Personality*, *59*, 355–386.

Bowen, R., Peters, E., Marwaha, S., Baetz, M., & Balbuena, L. (2017). Moods in clinical depression are more unstable than severe normal sadness. *Frontiers in Psychiatry*, *8*, 1–6.

Bradburn, N. M., Rips, L. J., & Shevell, S. K. (1987). Answering autobiographical questions: The impact of memory and inference on surveys. *Science*, *236*, 157–161.

Bresin, K. (2014). Five indices of emotion regulation in participants with a history of nonsuicidal self-injury: A daily diary study. *Behavior Therapy*, *45*, 56–66.

Bresin, K., Carter, D. L., & Gordon, K. H. (2013). The relationship between trait impulsivity, negative affective states, and urge for nonsuicidal self-injury: A daily diary study. *Psychiatry Research*, *205*, 227–231.

Buckner, J. D., Crosby, R. D., Silgado, J., Wonderlich, S. A., & Schmidt, N. B. (2012). Immediate antecedents of marijuana use: An analysis from ecological momentary assessment. *Journal of Behavior Therapy and Experimental Psychiatry*, *43*, 647–655.

Buckner, J. D., Zvolensky, M. J., Smits, J. A. J., Norton, P. J., Crosby, R. D., Wonderlich, S. A., & Schmidt, N. B. (2011). Anxiety sensitivity and marijuana use: An analysis from ecological momentary assessment. *Depression and Anxiety*, *28*, 420–426.

Butner, J., Amazeen, P. G., & Mulvey, G. M. (2005). Multilevel modeling of two cyclical processes: Extending differential structural equation modeling to nonlinear coupled systems. *Psychological Methods*, *10*, 159–177.

Bydlowski, S., Corcos, M., Jeammet, P., Paterniti, S., Berthoz, S., Laurier, C., … Consoli, S. M. (2005). Emotion-processing deficits in eating disorders. *International Journal of Eating Disorders*, *37*, 321–329.

Carpenter, R. W., Trela, C. J., Lane, S. P., Wood, P. K., Piasecki, T. M., & Trull, T. J. (2017). Elevated rate of alcohol consumption in borderline personality disorder patients in daily life. *Psychopharmacology*, *234*, 3395–3406.

Carstensen, L. L., Pasupathi, M., Mayr, U., & Nesselroade, J. R. (2000). Emotional experience in everyday life across the adult life span. *Journal of Personality and Social Psychology*, *79*, 644–655.

Cha, C. B., Glenn, J. J., Deming, C. A., D’Angelo, E. J., Hooley, J. M., Teachman, B. A., & Nock, M. K. (2016). Examining potential iatrogenic effects of viewing suicide and self-injury stimuli. *Psychological Assessment*, *28*, 1510–1515.

Chaudhury, S. R., Galfalvy, H., Biggs, E., Choo, T.-H., Mann, J. J., & Stanley, B. (2017). Affect in response to stressors and coping strategies: An ecological momentary assessment study of borderline personality disorder. *Borderline Personality Disorder and Emotion Dysregulation*, *4*, 8.

Chepenik, L. G., Thomas, T. H., Oslin, D., Datto, C., Zubritsky, C., & Katz, I. R. (2006). A daily diary study of late-life depression. *American Journal of Geriatric Psychiatry*, *14*, 270–279.

Chow, S. M., Ram, N., Boker, S. M., Fujita, F., & Clore, G. (2005). Emotion as a thermostat: Representing emotion regulation using a damped oscillator model. *Emotion*, *5*, 208–225.

Coan, J. A., & Allen, J. J. (2004). Frontal EEG asymmetry as a moderator and mediator of emotion. *Biological Psychology*, *67*, 7–50.

Cohen, L. H., Gunthert, K. C., Butler, A. C., O'Neill, S. C., & Tolpin, L. H. (2005). Daily affective reactivity as a prospective predictor of depressive symptoms. *Journal of Personality*, *73*, 1687–1714.

Cohen, L. H., Gunthert, K. C., Butler, A. C., Parrish, B. P., Wenze, S. J., & Beck, J. S. (2008). Negative affective spillover from daily events predicts early response to cognitive therapy for depression. *Journal of Consulting and Clinical Psychology*, *76*, 955–965.

Cole, P. M., Hall, S. E., & Hajal, N. (2008). Emotion dysregulation as a risk factor for psychopathology. *Child and Adolescent Psychopathology*, *2*, 341–373.

Cooper, M. L., Frone, M. R., Russell, M., & Mudar, P. (1995). Drinking to regulate positive and negative emotions: A motivational model of alcohol use. *Journal of Personality and Social Psychology*, *69*, 990–1005.

Csikszentmihalyi, M., & Hunter, J. (2003). Happiness in everyday life: The uses of experience sampling. *Journal of Happiness Studies*, *4*, 185–199.

Cushing, C. C., Marker, A. M., Bejarano, C. M., Crick, C. J., & Huffhines, L. P. (2017). Latent variable mixture modeling of ecological momentary assessment data: Implications for screening and adolescent mood profiles. *Journal of Child and Family Studies*, *26*, 1565–1572.

Davidson, C. L., Anestis, M. D., & Gutierrez, P. M. (2017). Ecological momentary assessment is a neglected methodology in suicidology. *Archives of Suicide Research*, *21*, 1–11.

Depp, C. A., Moore, R. C., Dev, S. I., Mausbach, B. T., Eyler, L. T., & Granholm, E. L. (2016). The temporal course and clinical correlates of subjective impulsivity in bipolar disorder as revealed through ecological momentary assessment. *Journal of Affective Disorders*, *193*, 145–150.

Depp, C. A., Thompson, W. K., Frank, E., & Swartz, H. A. (2017). Prediction of near-term increases in suicidal ideation in recently depressed patients with bipolar II disorder using intensive longitudinal data. *Journal of Affective Disorders*, *208*, 363–368.

Dockray, S., Grant, N., Stone, A. A., Kahneman, D., Wardle, J., & Steptoe, A. (2010). A comparison of affect ratings obtained with ecological momentary assessment and the day reconstruction method. *Social Indicators Research*, *99*, 269–283.

Dvorak, R. D., Pearson, M. R., & Day, A. M. (2014). Ecological momentary assessment of acute alcohol use disorder symptoms: Associations with mood, motives, and use on planned drinking days. *Experimental and Clinical Psychopharmacology*, *22*, 285–297.

Dvorak, R. D., & Simons, J. S. (2014). Daily associations between anxiety and alcohol use: Variation by sustained attention, set shifting, and gender. *Psychology of Addictive Behaviors*, *28*, 969–979.

Ebner-Priemer, U. W., Bohus, M., & Kuo, J. (2007). Can retrospective interviews assess instability? A comparison of ambulatory assessment and expert interviews regarding DSM-IV criteria for borderline personality disorder. In M. Sorbi, H. Rüddel, & M. Bühring (Eds.), *Frontiers in stepped eCare* (pp. 25–37). Utrecht, Netherlands: University Utrecht.

Ebner-Priemer, U. W., Kuo, J., Kleindienst, N., Welch, S. S., Reisch, T., Reinhard, I., … Bohus, M. (2007). State affective instability in borderline personality disorder assessed by ambulatory monitoring. *Psychological Medicine*, *37*, 961–970.

Ebner-Priemer, U. W., Kuo, J., Schlotz, W., Kleindienst, N., Rosenthal, M. Z., Detterer, L., … Bohus, M. (2008). Distress and affective dysregulation in patients with borderline personality disorder: A psychophysiological ambulatory monitoring study. *Journal of Nervous and Mental Disease*, *196*, 314–320.

Ebner-Priemer, U. W., Kuo, J., Welch, S. S., Thielgen, T., Witte, S., Bohus, M., & Linehan, M. M. (2006). A valence-dependent group-specific recall bias of retrospective self-reports: A study of borderline personality disorder in everyday life. *Journal of Nervous and Mental Disease*, *194*, 774–779.

Ebner-Priemer, U. W., & Trull, T. J. (2009). Ambulatory assessment: An innovative and promising approach for clinical psychology. *European Psychologist*, *14*, 109–119.

Ebner-Priemer, U. W., Welch, S. S., Grossman, P., Reisch, T., Linehan, M. M., & Bohus, M. (2007). Psychophysiological ambulatory assessment of affective dysregulation in borderline personality disorder. *Psychiatry Research*, *150*, 265–275.

Engel, S. G., Wonderlich, S. A., Crosby, R. D., Mitchell, J. E., Crow, S., Peterson, C. B., … Gordon, K. H. (2013). The role of affect in the maintenance of anorexia nervosa: Evidence from a naturalistic assessment of momentary behaviors and emotion. *Journal of Abnormal Psychology*, *122*, 709–719.

Gable, S. L., Reis, H. T., & Elliot, A. J. (2000). Behavioral activation and inhibition in everyday life. *Journal of Personality and Social Psychology*, *78*, 1135–1149.

Gershon, A., & Eidelman, P. (2015). Inter-episode affective intensity and instability: Predictors of depression and functional impairment in bipolar disorder. *Journal of Behavior Therapy and Experimental Psychiatry*, *46*, 14–18.

Giddens, C. L., Barron, K. W., Byrd-Craven, J., Clark, K. F., & Winter, A. S. (2013). Vocal indices of stress: A review. *Journal of Voice*, *27*, 390.e21–390.e29.

Glaser, J.-P., Os, J. V., Mengelers, R., & Myin-Germeys, I. (2008). A momentary assessment study of the reputed emotional phenotype associated with borderline personality disorder. *Psychological Medicine*, *38*, 1231–1239.

Gottesman, I. I., & Gould, T. D. (2003). The endophenotype concept in psychiatry: Etymology and strategic intentions. *American Journal of Psychiatry*, *160*, 636–645.

Gould, M. S., Marrocco, F. A., Kleinman, M., Thomas, J. G., Mostkoff, K., Cote, J., & Davies, M. (2005). Evaluating iatrogenic risk of youth suicide screening programs: A randomized controlled trial. *Journal of the American Medical Association*, *293*, 1635–1643.

Gratz, K. L., & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the difficulties in emotion regulation scale. *Journal of Psychopathology and Behavioral Assessment*, *26*, 41–54.

Gray, J. A. (1987). *The psychology of fear and stress* (2nd ed.). Cambridge, UK: Cambridge University Press.

Greeley, J., & Oei, T. (1999). Alcohol and tension reduction. In H. T. Blane & K. E. Leonard (Eds.), *Psychological theories of drinking and alcoholism* (pp. 14–53). New York, NY: Guilford Press.

Gross, J. J. (1998). Sharpening the focus: Emotion regulation, arousal, and social competence. *Psychological Inquiry*, *9*, 287–290.

Gruber, J., Kogan, A., Mennin, D., & Murray, G. (2013). Real-world emotion? An experience-sampling approach to emotion experience and regulation in bipolar I disorder. *Journal of Abnormal Psychology*, *122*, 971–983.

Hajcak, G., MacNamara, A., & Olvet, D. M. (2010). Event-related potentials, emotion, and emotion regulation: An integrative review. *Developmental Neuropsychology*, *35*, 129–155.

Hallion, L. S., Steinman, S. A., Tolin, D. F., & Diefenbach, G. J. (2018). Psychometric properties of the Difficulties in Emotion Regulation Scale (DERS) and its short forms in adults with emotional disorders. *Frontiers in Psychology*, *9*, 539.

Hare, T. A., Tottenham, N., Galvan, A., Voss, H. U., Glover, G. H., & Casey, B. (2008). Biological substrates of emotional reactivity and regulation in adolescence during an emotional go-nogo task. *Biological Psychiatry*, *63*, 927–934.

Havermans, R., Nicolson, N. A., Berkhof, J., & deVries, M. W. (2010). Mood reactivity to daily events in patients with remitted bipolar disorder. *Psychiatry Research*, *179*, 47–52.

Havermans, R., Nicolson, N. A., Berkhof, J., & deVries, M. W. (2011). Patterns of salivary cortisol secretion and responses to daily events in patients with remitted bipolar disorder. *Psychoneuroendocrinology*, *36*, 258–265.

Haynos, A. F., & Fruzzetti, A. E. (2011). Anorexia nervosa as a disorder of emotion dysregulation: Evidence and treatment implications. *Clinical Psychology: Science and Practice*, *18*, 183–202.

Hektner, J. M., Schmidt, J. A., & Csikszentmihalyi, M. (2007). *Experience sampling method: Measuring the quality of everyday life*. Thousand Oaks, CA: Sage.

Hepp, J., Lane, S. P., Carpenter, R. W., Niedtfeld, I., Brown, W. C., & Trull, T. J. (2017). Interpersonal problems and negative affect in borderline personality and depressive disorders in daily life. *Clinical Psychological Science*, *5*, 470–484.

Heron, K. E., & Smyth, J. M. (2010). Ecological momentary interventions: Incorporating mobile technology into psychosocial and health behaviour treatments. *British Journal of Health Psychology*, *15*, 1–39.

Hooley, J. M., & Franklin, J. C. (2018). Why do people hurt themselves? A new conceptual model of nonsuicidal self-injury. *Clinical Psychological Science*, *6*, 428–451.

Houben, M., Bohus, M., Santangelo, P. S., Ebner-Priemer, U., Trull, T. J., & Kuppens, P. (2016). The specificity of emotional switching in borderline personality disorder in comparison to other clinical groups. *Personality Disorders: Theory, Research, and Treatment*, *7*, 198–204.

Houben, M., Claes, L., Vansteelandt, K., Berens, A., Sleuwaegen, E., & Kuppens, P. (2017). The emotion regulation function of nonsuicidal self-injury: A momentary assessment study in inpatients with borderline personality disorder features. *Journal of Abnormal Psychology*, *126*, 89–95.

Houben, M., Vansteelandt, K., Claes, L., Sienaert, P., Berens, A., Sleuwaegen, E., & Kuppens, P. (2016). Emotional switching in borderline personality disorder: A daily life study. *Personality Disorders: Theory, Research, and Treatment*, *7*, 50–60.

Huhn, A. S., Harris, J., Cleveland, H. H., Lydon, D. M., Stankoski, D., Cleveland, M. J., … Bunce, S. C. (2016). Ecological momentary assessment of affect and craving in patients in treatment for prescription opioid dependence. *Brain Research Bulletin*, *123*, 94–101.

Humber, N., Emsley, R., Pratt, D., & Tarrier, N. (2013). Anger as a predictor of psychological distress and self-harm ideation in inmates: A structured self-assessment diary study. *Psychiatry Research*, *210*, 166–173.

Husen, K., Rafaeli, E., Rubel, J. A., Bar-Kalifa, E., & Lutz, W. (2016). Daily affect dynamics predict early response in CBT: Feasibility and predictive validity of EMA for outpatient psychotherapy. *Journal of Affective Disorders*, *206*, 305–314.

Husky, M., Olié, E., Guillaume, S., Genty, C., Swendsen, J., & Courtet, P. (2014). Feasibility and validity of ecological momentary assessment in the investigation of suicide risk. *Psychiatry Research*, *220*, 564–570.

Husky, M., Swendsen, J., Ionita, A., Jaussent, I., Genty, C., & Courtet, P. (2017). Predictors of daily life suicidal ideation in adults recently discharged after a serious suicide attempt: A pilot study. *Psychiatry Research*, *256*, 79–84.

Insel, T. R. (2017). Digital phenotyping: Technology for a new science of behavior. *JAMA*, *318*, 1215–1216.

Jahng, S., Solhan, M. B., Tomko, R. L., Wood, P. K., Piasecki, T. M., & Trull, T. J. (2011). Affect and alcohol use: An ecological momentary assessment study of outpatients with borderline personality disorder. *Journal of Abnormal Psychology*, *120*, 572–584.

Jahng, S., Wood, P. K., & Trull, T. J. (2008). Analysis of affective instability in ecological momentary assessment: Indices using successive difference and group comparison via multilevel modeling. *Psychological Methods*, *13*, 354–375.

Kashdan, T. B., Ferssizidis, P., Collins, R. L., & Muraven, M. (2010). Emotion differentiation as resilience against excessive alcohol use: An ecological momentary assessment in underage social drinkers. *Psychological Science*, *21*, 1341–1347.

Kirschbaum, C., Pirke, K.-M., & Hellhammer, D. H. (1993). The “Trier Social Stress Test”—a tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology*, *28*, 76–81.

Kleiman, E. M., Coppersmith, D. D., Millner, A. J., Franz, P. J., Fox, K. R., & Nock, M. K. (2018). Are suicidal thoughts reinforcing? A preliminary real-time monitoring study on the potential affect regulation function of suicidal thinking. *Journal of Affective Disorders*, *232*, 122–126.

Kleiman, E. M., & Nock, M. K. (2018). Real-time assessment of suicidal thoughts and behaviors. *Current Opinion in Psychology*, *22*, 33–37.

Kleiman, E. M., Turner, B. J., Fedor, S., Beale, E. E., Huffman, J. C., & Nock, M. K. (2017). Examination of real-time fluctuations in suicidal ideation and its risk factors: Results from two ecological momentary assessment studies. *Journal of Abnormal Psychology*, *126*, 726–738.

Korotitsch, W. J., & Nelson-Gray, R. O. (1999). An overview of self-monitoring research in assessment and treatment. *Psychological Assessment*, *11*, 415–425.

Kwapil, T. R., Barrantes-Vidal, N., Armistead, M. S., Hope, G. A., Brown, L. H., Silvia, P. J., & Myin-Germeys, I. (2012). The expression of bipolar spectrum psychopathology in daily life. *Journal of Affective Disorders*, *130*, 166–170.

Lavender, J. M., De Young, K. P., Anestis, M. D., Wonderlich, S. A., Crosby, R. D., Engel, S. G., … Le Grange, D. (2013). Associations between retrospective versus ecological momentary assessment measures of emotion and eating disorder symptoms in anorexia nervosa. *Journal of Psychiatric Research*, *47*, 1514–1520.

Lavender, J. M., Wonderlich, S. A., Engel, S. G., Gordon, K. H., Kaye, W. H., & Mitchell, J. E. (2015). Dimensions of emotion dysregulation in anorexia nervosa and bulimia nervosa: A conceptual review of the empirical literature. *Clinical Psychology Review*, *40*, 111–122.

Law, K. C., Khazem, L. R., & Anestis, M. D. (2015). The role of emotion dysregulation in suicide as considered through the ideation to action framework. *Current Opinion in Psychology*, *3*, 30–35.

Lieb, K., Rexhausen, J. E., Kahl, K. G., Schweiger, U., Philipsen, A., Hellhammer, D. H., & Bohus, M. (2004). Increased diurnal salivary cortisol in women with borderline personality disorder. *Journal of Psychiatric Research*, *38*, 559–565.

LiKamWa, R., Liu, Y., Lane, N. D., & Zhong, L. (2013). *Moodscope: Building a mood sensor from smartphone usage patterns*. Paper presented at the Proceedings of the 11th Annual International Conference on Mobile Systems, Applications, and Services. Taipei, Taiwan.

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

Links, P. S., Eynan, R., Heisel, M. J., Barr, A., Korzekwa, M., McMain, S., & Ball, J. S. (2007). Affective instability and suicidal ideation and behavior in patients with borderline personality disorder. *Journal of Personality Disorders*, *21*, 72–86.

Links, P. S., Eynan, R., Heisel, M. J., & Nisenbaum, R. (2008). Elements of affective instability associated with suicidal behaviour in patients with borderline personality disorder. *Canadian Journal of Psychiatry*, *53*, 112–116.

Links, P. S., Heisel, M., & Garland, A. (2003). Affective instability in personality disorders. *American Journal of Psychiatry*, *160*, 394–395.

Marco, C. A., & Suls, J. (1993). Daily stress and the trajectory of mood: Spillover, response assimilation, contrast, and chronic negative affectivity. *Journal of Personality and Social Psychology*, *64*, 1053–1063.

Mathews, A., & MacLeod, C. (2005). Cognitive vulnerability to emotional disorders. *Annual Review of Clinical Psychology*, *1*, 167–195.

Miller, D. J., Vachon, D. D., & Lynam, D. R. (2009). Neuroticism, negative affect, and negative affect instability: Establishing convergent and discriminant validity using ecological momentary assessment. *Personality and Individual Differences*, *47*, 873–877.

Miller, M. A., Rothenberger, S. D., Hasler, B. P., Donofry, S. D., Wong, P. M., Manuck, S. B., … Roecklein, K. A. (2015). Chronotype predicts positive affect rhythms measured by ecological momentary assessment. *Chronobiology International*, *32*, 376–384.

Morawetz, C., Bode, S., Derntl, B., & Heekeren, H. R. (2017). The effect of strategies, goals and stimulus material on the neural mechanisms of emotion regulation: A meta-analysis of fMRI studies. *Neuroscience and Biobehavioral Reviews*, *72*, 111–128.

Muehlenkamp, J. J., Engel, S. G., Wadeson, A., Crosby, R. D., Wonderlich, S. A., Simonich, H., & Mitchell, J. E. (2009). Emotional states preceding and following acts of non-suicidal self-injury in bulimia nervosa patients. *Behaviour Research and Therapy*, *47*, 83–87.

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

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

Nisenbaum, R., Links, P. S., Eynan, R., & Heisel, M. J. (2010). Variability and predictors of negative mood intensity in patients with borderline personality disorder and recurrent suicidal behavior: Multilevel analyses applied to experience sampling methodology. *Journal of Abnormal Psychology*, *119*, 433–439.

Nock, M. K. (2009). Why do people hurt themselves? New insights into the nature and functions of self-injury. *Current Directions in Psychological Science*, *18*, 78–83.

Nock, M. K., Prinstein, M. J., & Sterba, S. K. (2009). Revealing the form and function of self-injurious thoughts and behaviors: A real-time ecological assessment study among adolescents and young adults. *Journal of Abnormal Psychology*, *118*, 816–827.

O'Hara, R. E., Armeli, S., Boynton, M. H., & Tennen, H. (2014). Emotional stress-reactivity and positive affect among college students: The role of depression history. *Emotion*, *14*, 193–202.

Palmier-Claus, J. E., Taylor, P. J., Gooding, P., Dunn, G., & Lewis, S. W. (2012). Affective variability predicts suicidal ideation in individuals at ultra-high risk of developing psychosis: An experience sampling study. *British Journal of Clinical Psychology*, *51*, 72–83.

Pearson, C. M., Lavender, J. M., Cao, L., Wonderlich, S. A., Crosby, R. D., Engel, S. G., … Crow, S. J. (2017). Associations of borderline personality disorder traits with stressful events and emotional reactivity in women with bulimia nervosa. *Journal of Abnormal Psychology*, *126*, 531–539.

Peeters, F., Berkhof, J., Delespaul, P., Rottenberg, J., & Nicolson, N. A. (2006). Diurnal mood variation in major depressive disorder. *Emotion*, *6*, 383–391.

Polivy, J., & Herman, C. P. (2002). Causes of eating disorders. *Annual Review of Psychology*, *53*, 187–213.

Reisch, T., Ebner-Priemer, U. W., Tschacher, W., Bohus, M., & Linehan, M. M. (2008). Sequences of emotions in patients with borderline personality disorder. *Acta Psychiatrica Scandinavica*, *118*, 42–48.

Ribeiro, J. D., Franklin, J. C., Fox, K. R., Bentley, K. H., Kleiman, E. M., Chang, B. P., & Nock, M. K. (2016). Self-injurious thoughts and behaviors as risk factors for future suicide ideation, attempts, and death: A meta-analysis of longitudinal studies. *Psychological Medicine*, *46*, 225–236.

Rogers, A. A., Ha, T., Updegraff, K. A., & Iida, M. (2018). Adolescents' daily romantic experiences and negative mood: A dyadic, intensive longitudinal study. *Journal of Youth and Adolescence*, *47*, 1517–1530.

Ross, M. (1989). Relation of implicit theories to the construction of personal histories. *Psychological Review*, *96*, 341–357.

Russell, J. J., Moskowitz, D. S., Zuroff, D. C., Sookman, D., & Paris, J. (2007). Stability and variability of affective experience and interpersonal behavior in borderline personality disorder. *Journal of Abnormal Psychology*, *116*, 578–588.

Santangelo, P. S., Bohus, M., & Ebner-Priemer, U. W. (2014). Ecological momentary assessment in borderline personality disorder: A review of recent findings and methodological challenges. *Journal of Personality Disorders*, *28*, 555–576.

Santangelo, P. S., Koenig, J., Funke, V., Parzer, P., Resch, F., Ebner-Priemer, U. W., & Kaess, M. (2017). Ecological momentary assessment of affective and interpersonal instability in adolescent non-suicidal self-injury. *Journal of Abnormal Child Psychology*, *45*, 1429–1438.

Santangelo, P. S., Reinhard, I., Koudela-Hamila, S., Bohus, M., Holtmann, J., Eid, M., & Ebner-Priemer, U. W. (2017). The temporal interplay of self-esteem instability and affective instability in borderline personality disorder patients' everyday lives. *Journal of Abnormal Psychology*, *126*, 1057–1065.

Santangelo, P. S., Reinhard, I., Mussgay, L., Steil, R., Sawitzki, G., Klein, C., … Ebner-Priemer, U. W. (2014). Specificity of affective instability in patients with borderline personality disorder compared to posttraumatic stress disorder, bulimia nervosa, and healthy controls. *Journal of Abnormal Psychology*, *123*, 258–272.

Scala, J. W., Levy, K. N., Johnson, B. N., Kivity, Y., Ellison, W. D., Pincus, A. L., … Newman, M. G. (2018). The role of negative affect and self-concept clarity in predicting self-injurious urges in borderline personality disorder using ecological momentary assessment. *Journal of Personality Disorders*, *32*(Supplement), 36–57.

Schwartz, J. E., & Stone, A. A. (1998). Strategies for analyzing ecological momentary assessment data. *Health Psychology*, *17*, 6–16.

Schwartz, J. E., & Stone, A. A. (2007). The analysis of real-time momentary data: A practical guide. In A. Stone, S. Shiffman, A. Arienza, & L. Nebeling (Eds.), *The science of real-time data capture: Self-reports in health research* (pp. 76–113). New York, NY: Oxford University Press.

Scott, L. N., Wright, A. G. C., Beeney, J. E., Lazarus, S. A., Pilkonis, P. A., & Stepp, S. D. (2017). Borderline personality disorder symptoms and aggression: A within-person process model. *Journal of Abnormal Psychology*, *126*, 429–440.

Selby, E. A., Cornelius, T., Fehling, K. B., Kranzler, A., Panza, E. A., Lavender, J. M., … Grange, D. L. (2015). A perfect storm: Examining the synergistic effects of negative and positive emotional instability on promoting weight loss activities in anorexia nervosa. *Frontiers in Psychology*, *6*, 1260.

Selby, E. A., Doyle, P., Crosby, R. D., Wonderlich, S. A., Engel, S. G., Mitchell, J. D., & Le Grange, D. (2012). Momentary emotion surrounding bulimic behaviors in women with bulimia nervosa and borderline personality disorder. *Journal of Psychiatric Research*, *46*, 1492–1500.

Selby, E. A., Franklin, J. C., Carson-Wong, A., & Rizvi, S. L. (2013). Emotional cascades and self-injury: Investigating instability of rumination and negative emotion. *Journal of Clinical Psychology*, *69*, 1213–1227.

Selby, E. A., & Joiner, T. E. (2013). Emotional cascades as prospective predictors of dysregulated behaviors in borderline personality disorder. *Personality Disorders: Theory, Research, and Treatment*, *4*, 168–174.

Selby, E. A., Nock, M. K., & Kranzler, A. (2014). How does self-injury feel? Examining automatic positive reinforcement in adolescent self-injurers with experience sampling. *Psychiatry Research*, *215*, 417–423.

Serre, F., Fatseas, M., Swendsen, J., & Auriacombe, M. (2015). Ecological momentary assessment in the investigation of craving and substance use in daily life: A systematic review. *Drug and Alcohol Dependence*, *148*, 1–20.

Sher, K. J., Grekin, E. R., & Williams, N. A. (2005). The development of alcohol use disorders. *Annual Review of Clinical Psychology*, *1*, 493–523.

Shiffman, S. (2009). Ecological momentary assessment (EMA) in studies of substance use. *Psychological Assessment*, *21*, 486–497.

Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology*, *4*, 1–32.

Shingleton, R. M., Eddy, K. T., Keshaviah, A., Franko, D. L., Swanson, S. A., Yu, J. S., … Herzog, D. B. (2013). Binge/purge thoughts in nonsuicidal self-injurious adolescents: An ecological momentary analysis. *International Journal of Eating Disorders*, *46*, 684–689.

Shiyko, M. P., Burkhalter, J., Li, R., & Park, B. J. (2014). Modeling nonlinear time-dependent treatment effects: An application of the generalized time-varying effect model (TVEM). *Journal of Consulting and Clinical Psychology*, *82*, 760–772.

Simons, J. S., Dvorak, R. D., Batien, B. D., & Wray, T. B. (2010). Event-level associations between affect, alcohol intoxication, and acute dependence symptoms: Effects of urgency, self-control, and drinking experience. *Addictive Behaviors*, *35*, 1045–1053.

Simons, J. S., Gaher, R. M., Oliver, M. N., Bush, J. A., & Palmer, M. A. (2005). An experience sampling study of associations between affect and alcohol use and problems among college students. *Journal of Studies on Alcohol*, *66*, 459–469.

Smyth, J. M., Zawadzki, M. J., Juth, V., & Sciamanna, C. N. (2017). Global life satisfaction predicts ambulatory affect, stress, and cortisol in daily life in working adults. *Journal of Behavioral Medicine*, *40*, 320–331.

Solhan, M. B., Trull, T. J., Jahng, S., & Wood, P. K. (2009). Clinical assessment of affective instability: Comparing EMA indices, questionnaire reports, and retrospective recall. *Psychological Assessment*, *21*, 425–436.

Spangenberg, L., Forkmann, T., & Glaesmer, H. (2015). Investigating dynamics and predictors of suicidal behaviors using ambulatory assessment. *Neuropsychiatrie*, *29*, 139–143.

Steptoe, A., Gibson, E. L., Hamer, M., & Wardle, J. (2007). Neuroendocrine and cardiovascular correlates of positive affect measured by ecological momentary assessment and by questionnaire. *Psychoneuroendocrinology*, *32*, 56–64.

Steptoe, A., & Wardle, J. (2011). Positive affect measured using ecological momentary assessment and survival in older men and women. *Proceedings of the National Academy of Sciences*, *108*, 18244–18248.

Stone, A. A., & Broderick, J. E. (2007). Real-time data collection for pain: Appraisal and current status. *Pain Medicine*, *8*, S85–S93.

Stone, A. A., & Shiffman, S. (1994). Ecological momentary assessment (EMA) in behavioral medicine. *Annals of Behavioral Medicine*, *16*, 199–202.

Swendsen, J. D., Tennen, H., Carney, M. A., Affleck, G., Willard, A., & Hromi, A. (2000). Mood and alcohol consumption: An experience sampling test of the self-medication hypothesis. *Journal of Abnormal Psychology*, *109*, 198–204.

Thompson, R. J., Mata, J., Jaeggi, S. M., Buschkuehl, M., Jonides, J., & Gotlib, I. H. (2012). The everyday emotional experience of adults with major depressive disorder: Examining emotional instability, inertia, and reactivity. *Journal of Abnormal Psychology*, *121*, 819–829.

Thompson, W. K., Gershon, A., O'Hara, R., Bernert, R. A., & Depp, C. A. (2014). The prediction of study-emergent suicidal ideation in bipolar disorder: A pilot study using ecological momentary assessment data. *Bipolar Disorders*, *16*, 669–677.

Timm, C., Ubl, B., Zamoscik, V., Ebner-Priemer, U., Reinhard, I., Huffziger, S., … Kuehner, C. (2017). Cognitive and affective trait and state factors influencing the long-term symptom course in remitted depressed patients. *PloS One*, *12*, e0178759.

Tomko, R. L., Lane, S. P., Pronove, L. M., Treloar, H. R., Brown, W. C., Solhan, M. B., … Trull, T. J. (2015). Undifferentiated negative affect and impulsivity in borderline personality and depressive disorders: A momentary perspective. *Journal of Abnormal Psychology*, *124*, 740–753.

Torous, J., Staples, P., Shanahan, M., Lin, C., Peck, P., Keshavan, M., & Onnela, J.-P. (2015). Utilizing a personal smartphone custom app to assess the Patient Health Questionnaire-9 (PHQ-9) depressive symptoms in patients with major depressive disorder. *JMIR Mental Health*, *2*, e8.

Treloar, H., Piasecki, T. M., McCarthy, D. M., Sher, K. J., & Heath, A. C. (2015). Ecological evidence that affect and perceptions of drink effects depend on alcohol expectancies. *Addiction*, *110*, 1432–1442.

Trull, T. J., Lane, S. P., Koval, P., & Ebner-Priemer, U. W. (2015). Affective dynamics in psychopathology. *Emotion Review*, *7*, 355–361.

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

Trull, T. J., Wycoff, A. M., Lane, S. P., Carpenter, R. W., & Brown, W. C. (2016). Cannabis and alcohol use, affect and impulsivity in psychiatric out-patients' daily lives. *Addiction*, *111*, 2052–2059.

Tully, L. M., Lincoln, S. H., & Hooker, C. I. (2012). Impaired executive control of emotional information in social anhedonia. *Psychiatry Research*, *197*, 29–35.

van Eck, M., Nicolson, N. A., & Berkhof, J. (1998). Effects of stressful daily events on mood states: Relationship to global perceived stress. *Journal of Personality and Social Psychology*, *75*, 1572–1585.

Vansteelandt, K., Claes, L., Muehlenkamp, J., De Cuyper, K., Lemmens, J., Probst, M., … Pieters, G. (2013). Variability in affective activation predicts non-suicidal self-injury in eating disorders. *European Eating Disorders Review*, *21*, 143–147.

Vansteelandt, K., Houben, M., Claes, L., Berens, A., Sleuwaegen, E., Sienaert, P., & Kuppens, P. (2017). The affect stabilization function of nonsuicidal self injury in borderline personality disorder: An ecological momentary assessment study. *Behaviour Research and Therapy*, *92*, 41–50.

Verduyn, P., Delvaux, E., Van Coillie, H., Tuerlinckx, F., & Van Mechelen, I. (2009). Predicting the duration of emotional experience: Two experience sampling studies. *Emotion*, *9*, 83–91.

Victor, S. E., & Klonsky, E. D. (2014). Daily emotion in non-suicidal self-injury. *Journal of Clinical Psychology*, *70*, 364–375.

Walls, T. A., & Schafer, J. L. (2006). *Models for intensive longitudinal data*. London, UK: Oxford University Press.

Walsh, M. A., Royal, A., Brown, L. H., Barrantes-Vidal, N., & Kwapil, T. R. (2012). Looking for bipolar spectrum psychopathology: Identification and expression in daily life. *Comprehensive Psychiatry*, *53*, 409–421.

Wichers, M. C., Myin-Germeys, I., Jacobs, N., Peeters, F., Kenis, G., Derom, C., … van Os, J. (2007). Evidence that moment-to-moment variation in positive emotions buffer genetic risk for depression: A momentary assessment twin study. *Acta Psychiatrica Scandinavica*, *115*, 451–457.

Wichers, M., Peeters, F., Geschwind, N., Jacobs, N., Simons, C., Derom, C., … Van Os, J. (2010). Unveiling patterns of affective responses in daily life may improve outcome prediction in depression: A momentary assessment study. *Journal of Affective Disorders*, *124*, 191–195.

Wilson, R. E., Thompson, R. J., & Vazire, S. (2017). Are fluctuations in personality states more than fluctuations in affect? *Journal of Research in Personality*, *69*, 110–123.

Wise, R. A., & Koob, G. F. (2014). The development and maintenance of drug addiction. *Neuropsychopharmacology*, *39*, 254–262.

Wolff, S., Stiglmayr, C., Bretz, H. J., Lammers, C. H., & Auckenthaler, A. (2007). Emotion identification and tension in female patients with borderline personality disorder. *British Journal of Clinical Psychology*, *46*, 347–360.

Zaki, L. F., Coifman, K. G., Rafaeli, E., Berenson, K. R., & Downey, G. (2013). Emotion differentiation as a protective factor against nonsuicidal self-injury in borderline personality disorder. *Behavior Therapy*, *44*, 529–540.

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