ANTECEDENTS AND MOTIVES FOR SMOKING IN

BORDERLINE PERSONALITY DISORDER

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by

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The undersigned, appointed by the dean of the Graduate School, have examined the

thesis entitled

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and hereby certify that, in their opinion, it is worthy of acceptance.

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Abstract

Though borderline personality disorder (BPD) is associated with higher rates of substance use, including cigarette smoking (Carpenter, Wood, & Trull, 2016; Rohde, Lewinsohn, Brown, Gau, & Kahler, 2003; Trull, Jahng, Tomko, Wood, & Sher, 2010), relatively little is known about motives for smoking among those with BPD. The current study examined contextual and subjective triggers of smoking as well as self-monitored motives for smoking in borderlines ($n = 29$) and healthy controls ($n = 13$). Data were collected via ecological momentary assessment (EMA) over a three-week period. Analyses using a "case-crossover" analytic strategy identified a number of unique antecedents of smoking but did not indicate any group differences in smoking triggers. Notably, negative affect was not found to be an antecedent to smoking events. Analyses of self-monitored motives for smoking individual cigarettes indicate that craving, habit, and boredom were the most highly endorsed motives for smoking and that coping with negative affect and enhancing positive affect were more highly endorsed by those in the BPD group than controls. Supplementary analyses examined smoking motives assessed by self-report questionnaire and diary-reported consequences of smoking events. BPD patients tended to endorse most motives on the questionnaire more highly than controls, but these differences were not statistically significant in this small sample. Participants reported that smoking events were highly pleasurable, modestly relieving, and rarely punishing. Relative to controls, BPD individuals reported stronger acute relief from smoking. Overall, the findings tend to indicate that negative affect is an uncommon smoking trigger, but support the hypothesis that smoking among borderlines may be especially driven by attempts to manage affect.

Antecedents and Motives for Smoking in Borderline Personality Disorder

Borderline personality disorder (BPD) affects 1-3% of the general population and

an estimated 22.6% of the psychiatric outpatient population (Lenzenweger, Lane,

Loranger, & Kessler, 2007; Trull et al., 2010; Korzekwa, Dell, Links, Thabane, & Webb,

2008). BPD is characterized by affective instability, chronic impulsivity, self-harm,

identity disturbance, feelings of emptiness, and unstable relationships (American

Psychiatric Association, 2013). Diagnosable BPD and borderline traits are associated

with elevated rates of substance use, including cigarette smoking (Carpenter, Wood, &

Trull, 2016; Rohde, Lewinsohn, Brown, Gau, & Kahler, 2003; Trull et al., 2010).

A natural hypothesis for the overlap between BPD and smoking might be that

those with BPD use cigarettes to attempt to manage negative moods (Distel et al., 2012;

Kruedelbach, McCormick, Schulz, & Grueneich, 1993; Cheetham, Allen, Yucel, &

Lubman, 2010). Anhedonia is also a feature of BPD (Marissen, Arnold, & Franken,

2012), suggesting the hypothesis that BPD patients might use cigarettes to try to enhance

pleasure or positive affect. Tobacco cravings may be uniquely salient or difficult to resist

in those with BPD due to their impulsive traits such as negative and positive urgency

(Bornovalova, Lejeuz, Daughters, Rosenthal, & Lynch, 2005; Cyders & Smith, 2008;

Distel et al., 2012). In unselected smokers, higher trait anhedonia has been related to

enhanced cravings during periods of tobacco deprivation (Cook, Spring, McChargue, &

Hedeker, 2004; Leventhal, Waters, Kahler, Ray, & Sussman, 2009). This relation

suggests that the anhedonic features of BPD might also promote expression of tobacco

cravings. Although these hypotheses appear plausible, no studies have directly evaluated

which motives for smoking are most prominent in BPD or whether the profile of smoking triggers in BPD individuals differs from that seen in other smokers.

Ecological momentary assessment (EMA) represents a powerful method for investigating the determinants of addictive behaviors (Shiffman, 2009). EMA studies typically involve having participants use mobile computerized diaries to record their daily experiences in their natural environments. A common strategy for studying smoking involves collecting diary data from two kinds of diary records. Participants are trained to log user-initiated recordings whenever they smoke a cigarette. Diaries are also programmed to signal participants to complete entries at random times or on a fixed schedule throughout the day, independent of smoking behavior. Comparing of the situational features and subjective states across the two types of diary records allows identification of the unique antecedents of smoking behavior, similar to the logic of a case-crossover design (Shiffman, 2009). Studies using this approach have found that, although smokers frequently endorse coping with negative affect as a top reason for smoking on retrospective questionnaires, there is little systematic relation between negative mood intensity and cigarette use in real-time reports collected during ongoing smoking (e.g., Carter et al., 2008; Cronk & Piasecki, 2010; Shiffman et al., 2002; Shiffman, Paty, Gwaltney, & Dang, 2004; Thrul, Bühler, & Ferguson, 2014). In contrast, craving has emerged as a more consistent and robust antecedent of smoking events (Carter et al., 2008; Cronk & Piasecki, 2010; Shiffman et al., 2002, Shiffman et al., 2004; Shiffman & Paty, 2006; Thrul et al., 2014). Other situational correlates of smoking have been interpreted as indicators of "indulgent" or relaxed settings (Shiffman & Paty, 2006). These include consumption of food, alcohol, and coffee/caffeine; locations such bars,

restaurants, and the home; and activities such as relaxing, socializing, or doing nothing (Cronk & Piasecki, 2010; Piasecki, McCarthy, Fiore, & Baker, 2008; Shiffman & Paty, 2006; Thrul et al., 2014).

A second, less common strategy for identifying momentary reasons for smoking is to simply ask smokers to report why they smoked each cigarette as it is logged in the diary (Piasecki, Richardson, & Smith, 2007; Piasecki, Piper, Baker, & Hunt-Carter, 2011). Consistent with case-crossover EMA studies, investigations using self-monitored motives have found that cigarettes are most frequently attributed to factors such as acute craving, habit, opportunity to socialize, and boredom; they are rarely attributed to attempts to cope with negative mood states (Piasecki et al., 2007; Piasecki et al., 2011).

The self-monitoring and case-crossover strategies complement one another (Piasecki et al, 2007). One advantage of self-monitoring is that smokers themselves directly report their reasons for smoking. In contrast, the possible psychological functions of smoking have to be inferred from the nature of the situational correlates of smoking in the case-crossover design. Additionally, the self-monitoring approach may be uniquely capable of identifying uncommon but potentially important influences on smoking. A systematic association between a contextual or subjective state and smoking events must be present across all diary records to be detected in the case-crossover strategy. In contrast, participant reports may "flag" even single instances of smoking where rare motives are operative when self-monitoring reasons for smoking. For example, although coping with negative moods was the least common motive for smoking in a sample of college student smokers, a minority of smoking events (10.2%) was attributed to this motive (Piasecki et al., 2007). Additionally, when smokers endorsed smoking to cope

with negative affect, they reported contemporaneous elevations in negative moods, suggesting their reports had some degree of validity. This ability to identify and count rarer influences on smoking may be especially valuable in the context of studying clinical populations such as BPD patients, for whom these instigators may be more salient.

The current study uses data collected from an EMA investigation involving BPD patients and a comparison sample of community controls to investigate reasons for smoking in BPD. The diary assessment was designed to permit use of both the case-crossover and self-monitoring approaches, providing complementary perspectives on smoking triggers. Based on the existing smoking literature, we expect that urge/craving, habit, boredom, and social context would emerge as important determinants of smoking events and that there would be less evidence for a link between negative affect and smoking. Given the prominent symptomatic features of BPD, we tentatively predict that craving, elevated negative affect, and diminished positive affect would be more strongly tied to smoking in BPD patients compared to controls. The self-monitoring approach is expected to be more sensitive to detecting less common reasons for smoking, such as attempts to acutely manage affective states by smoking.

The current study uses two additional sources of data to supplement the primary analyses. First, we compare the BPD and comparison groups with respect to their profiles of subscale scores on the Brief Wisconsin Inventory of Smoking Dependence Motives (Brief WISDM; Smith et al., 2010). The Brief WISDM is a psychometric instrument that asks smokers to rate the extent to which various motives for smoking apply to their own smoking behaviors. As noted earlier, smokers' global self-reports of reasons for smoking often diverge from the evidence arising from EMA approaches (Shiffman, 1993; Piasecki

et al., 2007). To the extent this occurs, the global self-report data may indicate areas

where smokers hold mistaken perceptions or naïve theories about smoking. Second, we

compare BPD and control participants with respect to real-time ratings of the immediate

pleasurable, relieving, and punishing effects of smoking events captured in electronic

diary reports. The actual consequences of smoking provide another natural benchmark for

evaluating the psychological functions of smoking behavior inferred from EMA analyses

of smoking antecedents and self-reported smoking motives.

Methods

Participants

Data were drawn from a larger study (N = 116) of alcohol use in patients with

borderline personality disorder (BPD) and healthy community controls. As the focus of

the current investigation is on tobacco use, data were limited to participants who reported

at least one instance of cigarette use (*n* = 29 BPD patients and 13 controls). Those in the

BPD group were required to be in treatment at the time of the study, and they were

recruited from flyers in waiting rooms of psychiatric outpatient clinics and by referrals

from their doctors or therapists. Advertisements for the study were also placed in a

weekly print circular, at local businesses, on Craigslist, and distributed through a weekly

university-wide e-mail. These advertisements specifically targeted those experiencing

common features of BPD, such as intense mood swings, unstable relationships, impulsive

behavior, and mood swings. Community controls were also recruited through

advertisements, but these made no mention of symptoms of BPD. There were no

restrictions on psychiatric illness or treatment for the control group aside from BPD or

endorsement of the *DSM-IV* BPD affective instability criterion.

Potential participants first completed a form that was returned to the research staff or contacted the research staff directly. Potential participants were then briefly screened for eligibility over the phone; if initially eligible, they were brought in for an in-person diagnostic interview. Participants had to be between the ages of 18 and 45 and report consuming at least four alcoholic beverages in the past month. Exclusion criteria included current psychosis, pregnancy or trying to become pregnant, intellectual disability, severe neurological dysfunction, or traumatic brain injury that affected mood or concentration. Participants were also excluded for indication of severe alcohol use problems over the past year, such as seeking treatment or interest in seeking treatment for alcohol use problems, inability to successfully reduce drinking amount or abstain, or physiological withdrawal symptoms when not drinking. Those who were deemed eligible were scheduled for an orientation session, and everyone who completed the screening interview was compensated with $20.

Table 1 summarizes the demographic makeup and smoking behaviors of the BPD and control participants. The groups differed only on endorsement of current psychotropic medication use and past or current participation in therapy, both of which were more common in the BPD group.

Procedure

Participants underwent two diagnostic interviews, the Structured Clinical Interview for the *DSM-IV* Axis I Disorders (First, Spitzer, Gibbon, & Williams, 1995) and the Structured Interview for *DSM-IV* Personality Disorders (Pfohl, Blum, & Zimmerman, 1994), to assess for Axis I and II disorders, respectively. A second trained interview assessed the interrater reliability by rating videotapes of 20 interviews from the

larger sample; reliability was excellent for BPD diagnosis (k = 1.00) and for presence of affective instability (k = .89). During the initial orientation session, eligible participants completed a battery of self-report questionnaires. They then received their electronic diaries (ED; Palm Tungsten E2© handheld computer) that they carried for approximately 21 days. The mean number of days of participation in the study was 22.02 days, and the number of days ranged from 9 to 27.

Participants returned to the lab weekly for data download and to receive compensation. They received $50 at each visit with adequate recording compliance over the previous week (defined as 80% or greater completion of prompted assessments); payment was reduced by $10 for every 10% below 80% compliance. During the last visit, participants completed a self-report follow-up battery. The maximum payment per participant was $190 ($20 for the initial screening, $10 for orientation, three weeks of data collection with a possible $150 in earnings, and $10 for the follow-up battery).

Electronic Diary Protocol

The current protocol was modified from protocols of previous studies with different samples (see Piasecki, Wood, Shiffman, Sher, & Health, 2012; Trull et al., 2008). Participants completed seven different types of reports during the study. First, *morning reports* were made each day upon waking and had to be completed by noon. Second, *time-based random prompts* occurred on average six times per day, starting either after the morning report or after noon (whichever came first). Random prompts occurred at least 60 minutes apart and could not occur within 30 minutes of any scheduled assessment (such as a drinking episode sequence; see below). Third, *user-initiated initial drink reports* occurred when participants logged the completion of the

first drink of an episode. Fourth, an extensible set of *time-based drinking follow-ups* oversampled experiences during active drinking episodes. Fifth, participants completed *user-initiated cigarette reports* when they engaged in cigarette use. Sixth, participants completed *user-initiated self-harm reports* following a self-harm event. Seventh, *time-based self-harm follow-ups* occurred at 30, 60, and 90 minutes following an initial self-harm report. The current study will examine the data from all smoking moments across report types as well as random prompts with no smoking endorsed. The overall rate of compliance as described in a previous report was high, with participants completing 90.26% of the random prompts and 92.95% of all follow-up prompts (Lane, Carpenter, Sher, & Trull, 2016).

Measures

Baseline Questionnaires.

      Brief Wisconsin Inventory of Smoking Dependence Motives. The Brief WISDM is a self-report measure of tobacco dependence comprised of 37 statements related to motives for smoking. Participants rate each item on a Likert scale ranging from 1 (*not true of me at all*) to 7 (*extremely true of me*). The Brief WISDM consists of 11 subscales that can be grouped into two broad composites. The Primary Dependence Motives (PDM) combines scores from four subscales and taps core features of dependence including loss of control, craving, tolerance, and heavy automatic cigarette use (Piasecki, Piper, & Baker, 2010). The remaining scales form a Secondary Dependence Motives (SDM) composite tapping optional or instrumental reasons for smoking (e.g., affective enhancement, weight control). The mean of items in a subscale is the score for that

subscale; the total score is the sum of the means of the 11 subscales (excluding PDM and SDM scales).

Tobacco Use. Participants completed a questionnaire that assessed history of tobacco use, current tobacco use, relatives' history and current tobacco use, and perceived tobacco dependence. Perceived dependence was determined by a self-report question that asked if the participant has ever felt that (s)he needed tobacco or were dependent on it. Response options included "no, never," "yes, but <u>not</u> in the past year," and "yes, in the past year."

Diary Measures.

Cigarette Craving. Participants were asked at the onset of each assessment to rate the degree to which they were craving a cigarette in the "PAST 15 MINUTES" on scale of 1 (*not at all*) to 5 (*extremely*). Of all of the reports in the analyzed sample, 39.5% indicated no craving at all, 11.3% endorsed a slight amount of craving, 17.4% endorsed a little craving, 12.6% endorsed a large amount of craving, and 18.1% endorsed an extreme amount of craving.

Cigarette Consumption. For analysis, a record was counted as a smoking occasion if recent smoking was endorsed in any type of report. Participants were asked in morning reports if they had smoked a cigarette "SINCE WAKEUP," responding "yes" or "no." At each random prompt, participants were asked to indicate if they had smoked cigarettes in the "PAST 15 MINUTES," responding "yes" or "no." When a participant indicated that a cigarette had been smoked in any type of report, the participant rated a series of items on his or her motives for smoking the most recent cigarette and the effects

of that cigarette. The total number of diary records for the pooled sample totaled 6106 records, and 1899 (31.1%) of those records endorsed cigarette use.

 Smoking Motives. When participants endorsed smoking a cigarette, they were prompted to rate a series of motives for smoking that cigarette. These items were adapted from those used in prior EMA studies of smoking behavior (Piasecki, Richardson, & Smith, 2007; Piasecki, Piper, Baker, & Hunt-Carter, 2011). Ratings ranged from 1 (*strongly disagree*) to 4 (*strongly agree*). Participants could endorse more than one motive per cigarette. The motives were as follows: (1) *I SMOKED because it would reduce my craving,* (2) *I SMOKED because I would soon be going someplace where I can't smoke,* (3) *I SMOKED because it would help me cope with negative feelings I have,* (4) *I SMOKED because it would make my positive feelings even better/make me happier,* (5) *I SMOKED because it is a habit that is almost automatic,* (6) *I SMOKED because it would be an opportunity to socialize with others,* (7) *I SMOKED because it would be a break from working or from studying,* (8) *I SMOKED because I was bored and wanted to kill time.*

 Smoking Outcomes. In addition to motives for smoking each individual cigarette, participants also rated the effect of the most recent cigarette when smoking was endorsed. Ratings ranged from 1 (*not at all*) to 5 (*extremely*). The effects were as follows: (1) *Was the LAST cigarette PLEASURABLE?* (2) *Did the LAST cigarette RELIEVE UNPLEASANT FEELINGS OR SYMPTOMS?* (3) *Did the LAST cigarette MAKE YOU FEEL WORSE?* These items were intended to tap positive reinforcement, negative reinforcement, and punishment, respectively.

Positive and Negative Affect. At each momentary assessment, positive and negative affect were assessed using 21 items from the Positive and Negative Affect Schedule-Extended Version (PANAS-X; Watson & Clark, 1999). Items appeared on the screen, and participants rated the degree to which they felt each item, from 1 (*very slightly or not at all*) to 5 (*extremely)*, in the past 15 minutes. Items in the positive affect subscale were averaged to create an estimate of positive affect for that report, and the same was done for items in the negative affect subscale.

Time of Day. The ED automatically recorded a date and time stamp for each report. In the current analysis, reports are grouped according to the hour of day at which the report was completed.

Weekend. Reports are grouped dichotomously as either a weekday or weekend report, with the weekend report starting at 5pm on Friday and ending at 9pm on Sunday.

Location. During each report, participants indicated their current location. The options for location included school, work, a bar/restaurant, primary residence, outside, in a vehicle, and other. Participants could select more than one location at a time. The frequencies of each location endorsed were analyzed.

People. During each report, participants responded to the question, "In the PAST 15 MINUTES, who have you been with?" (checking all that applied). Responses included a romantic partner, friend, coworker, child(ren), parent, other family, or someone else. Responses are combined to indicate if participants reported being with anyone in the past 15 minutes (i.e., selecting at least one of the possible responses) in the past 15 minutes ("yes" = 1, "no" = 0). The frequency of being with someone was analyzed.

Statistical Analyses

The case-crossover approach was implemented using a series of binary logistic generalized linear mixed models to evaluate the contextual and subjective antecedents of smoking events. Each EMA record by participants in the sample was scored as a 1 if it was a smoking event and 0 if a nonsmoking event. Potential predictors of the events include group (borderline = 1, control = 0) and a particular diary-assessed context or state. An interaction term involving group and the antecedent on was evaluated in each model to examine if the effect of a specific trigger differs across groups.

The self-monitored motives for smoking were evaluated using linear mixed models. These models were limited to data from smoking records because self-monitored motives were only administered by the diary software when smoking was reported. Each model tested the main effect of group on the endorsement of a particular motive.

To explore the validity of self-monitored motives, an additional set of linear mixed models were estimated testing the associations between smoking motive endorsement and contemporaneous reports of congruent states and context. Reports of smoking to reduce craving, to cope with negative feelings, and to enhance positive mood were expected to be related to elevated diary-reported craving, negative affect, and positive affect, respectively. Similarly, reports of smoking to socialize were expected to be associated with the presence of others, and reports of smoking for a break from work or studying were expected to be associated with endorsement of the work and school location items.

Independent sample t-tests were used to compare groups with respect to their scores on Brief WISDM subscales and PDM and SDM composite scores.

Linear mixed models tested whether endorsement of the acute subjective consequences of smoking differed between groups. Because the diary software only assessed smoking consequences when recent smoking was reported, these models were limited to smoking records only.

Results

Contextual and Subjective Antecedents of Smoking Events

Table 2 summarizes the associations between different contextual and subjective antecedents and the likelihood of a smoking event. Smoking rate varied according to time of day (omnibus F (5, 6094) = 12.653, p < .001). Relative to the reference time block (4 – 7:59am), odds of smoking were significantly higher in the afternoon, evening, and late night hours (4pm to 7:59pm OR = 2.70, 95% CI = 1.06-6.92, p = .038; 8pm to 11:59pm OR = 3.08, 95% CI = 1.21-7.86, p = .019; midnight to 3:59am OR = 8.38, 3.01-23.36, p < .001). Records logged on weekends were not related to increased likelihood of a smoking event (OR = 0.83, 95% CI = 0.64-1.09, p = .179).

Several locations were related to increased odds of smoking events, including a bar or restaurant (OR = 2.10, 95% CI = 1.41-3.14, p < .001), outside (OR = 3.13, 95% CI = 2.09-4.68, p < .001), and a vehicle (OR = 1.90, 95% CI = 1.24-2.91, p = .003). Endorsement of the residence location was related to decreased likelihood of smoking (OR = 0.49, 95% CI = 0.38-0.62, p < .001). A participant was more likely to report a smoking event when he or she was with someone else (OR = 1.95, CI = 1.47-2.59, p < .001).

Momentary elevations in craving (OR = 1.48, 95% CI = 1.42-1.76, p < .001) and positive affect (OR = 1.87, 95% CI = 1.43-2.28, p < .001) were associated with smoking

events. However, momentary levels of negative affect were not related to smoking ($OR =$ 1.38, 95% $CI = 0.91\text{-}2.06$, $p = .334$).

Notably, there were no significant interactions between group and antecedent, indicating that these smoking triggers did not differ between BPD patients and controls.

Self-Monitored Motives of Smoking

Table 3 summarizes the means of the self-monitored smoking motives in the full sample and by group. In the pooled sample, the most highly endorsed motives were craving ($M = 2.74$), habit ($M = 2.53$), and boredom ($M = 2.25$). The only motives that varied significantly by group were the two affective motives: to enhance positive affect ($b = 0.54$, $SE = 0.25$, $p = .034$) and to cope with negative affect ($b = 0.64$, $SE = 0.20$, $p = .002$).

Validation of Self-Monitored Diary Motives

When participants reported smoking to cope with negative affect, they reported higher levels of negative affect ($b = 0.68$, $SE = .04$, $p < .001$). Similarly, when participants endorsed smoking to enhance positive affect, they reported higher levels of positive affect ($b = 0.14$, $SE = .02$, $p < .001$). Participants indicated that they were with someone when they cited smoking to socialize ($b = 0.56$, $SE = .05$, $p < .001$). Smoking to take a break from school/work was endorsed when participants were at work ($b = 0.93$, $SE = .07$, $p < .001$) or at school ($b = 0.19$, $SE = .09$, $p = .026$). When participants endorsed that they smoked to reduce craving, they reported experiencing craving in the past fifteen minutes ($b = 0.10$ $SE = .01$ $p < .001$).

Brief WISDM Subscale Differences

Figure 1 illustrates mean levels of endorsements for each Brief WISDM subscale and the Primary Dependence Motives (PDM) and Secondary Dependence Motives (SDM) composites as a function of group. As the figure illustrates, BPD patients tended to achieve higher means on most measures, but the group contrast was only significant for Weight Control subscale ($t(17) = 2.28$, $p = .036$). However, when examining Cohen's d between the subscales, a number of effect sizes pointed to differences. Table 4 summarizes the differences between groups on subscale endorsement. Weight Control showed a large effect size ($d = .999$). A number of subscales fell into the medium-to-large range for effect sizes, including Tolerance ($d = .746$), Affective Enhancement ($d = .735$), PDM ($d = .636$), Automaticity ($d = .594$), Craving ($d = .585$), Cognitive Enhancement ($d = .542$), and Taste ($d = -0.530$). The subscales that fell in the small-to-medium range included Loss of Control ($d = .419$), SDM ($d = .330$), Affiliative Attachment ($d = .315$), Social/Environmental Goads ($d = .247$), and Cue Exposure ($d = .193$).

Consequences of Smoking

Figure 2 depicts model estimated mean ratings of each smoking consequence by group. Overall, participants tended to most strongly endorse experiencing pleasure from smoking, more modest levels of smoking-contingent relief, and little smoking-related punishment. Those with BPD were more likely to report that the most recent cigarette relieved unpleasant feelings compared healthy controls ($b = 0.85$, SE $= 0.31$, $p = .007$). Groups did not differ with respect to their ratings of pleasurable ($b = 0.05$, SE $= 0.32$, $p = .869$) or punishing ($b = 0.035$, SE $= 0.125$, $p = .778$) effects.

Discussion

The current study examines reasons for smoking in those with BPD, as little is currently known about the topic. This study utilizes two strategies for characterizing reasons for smoking with EMA data: case-crossover design and self-monitored motives for smoking. The results of the case-crossover strategy generally conform to results from prior work suggesting that smoking is related to craving and relaxed, indulgent settings, such as being with other people, at a bar or restaurant and experiencing positive affect (Shiffman & Paty, 2006). None of these contexts differentiated borderlines and controls. This strategy also agreed with other research about the lack of a systematic association between negative mood and smoking, as ratings of level of negative affect did not predict smoking events.

When examining the self-monitored motives for smoking, the results are consistent with earlier work in that the most common reasons for smoking are to reduce craving and smoking out of habit, while smoking to reduce negative affect is among the less strongly endorsed reasons to smoke. However, positive and negative affect had a main effect of group, which aligns with the working hypothesis in the literature that those with BPD may turn to substances for emotion regulation purposes (Distel et al., 2012; Kruedelbach, McCormick, Schulz, & Grueneich, 1993; Cheetham, Allen, Yucel, & Lubman, 2010). In line with that possibility, one hypothesis of this study was that there would be a larger endorsement of craving for borderlines; however, craving was not differentially important for borderlines and healthy controls in this sample. Notably, supplementary analyses of contemporaneous reports supported the validity of the self-monitored motive ratings.

Analyses of the Brief WISDM provided a complementary perspective on participants' smoking motivation. The Brief WISDM captured retrospective smoking motives as opposed to real-time motives reported by EMA, and these retrospective motives only revealed one systematic difference between the groups for the Weight Control motive. Notably, the most commonly endorsed motives on this baseline measure (i.e., Social/Environmental Goads and Affective Enhancement) did not correspond with those reported by EMA Self-Monitored Motives (i.e., Craving and Habit). This discrepancy indicates that smokers' beliefs about the determinants of their smoking may be inaccurate or vestigial. Although borderlines and controls did not vastly differ on Brief WISDM measures, the pattern of endorsement suggests a tendency for borderlines to endorse higher levels of most of the instruments' constituent motives. Many of the effect sizes of the group differences on the subscales fell into the medium-to-large range, such as Tolerance, Affective Enhancement, PDM, Automaticity, Craving, Cognitive Enhancement, and Taste. Whereas intensive longitudinal assessment lends statistical power to the EMA group comparisons, power for t-tests examining the differences in responses between the groups on this baseline questionnaire is lower. Thus, future work using larger samples may detect identify several self-reported motives that are more reliably endorsed by borderlines than other smokers.

Analyses examining group differences in consequences of each individual cigarette indicated that the most strongly endorsed effect of smoking was that it was pleasurable. There was a lesser effect of smoking to alleviate negative affect, and smoking rarely made someone feel worse. The negative reinforcement of smoking to relieve negative affect did distinguish the two groups, and those with BPD reporting that

they experienced acute relief suggests that smoking to relieve negative affect may be important to those in the BPD group.

An important theme that emerges from the findings is that the analyses tend to capture the affect regulation pieces with strategies that involve declarative knowledge of the reporter. Participants directly report the effects that they are trying to obtain and that they experienced from smoking. Despite this theme, there is not a systematic relationship that cuts across all data records. One interpretation of this lack of relationship is that perhaps smokers are acting on mistaken beliefs about the ability of smoking to regulate moods, but they are reporting fulfilling these beliefs. However, if the reports are to be believed, then the participants are actually achieving the effects of smoking to regulate mood. There are a number of potential reasons as to why negative affect does not emerge as a predictor of smoking, such as the fact that the sample is comprised of relatively light smoking sample. Another possibility is that smoking is not a consistent response to negative mood states, but on some occasions, it does become the desired strategy for negative mood relief, but the case-crossover strategy cannot pick up these occasions specifically.

There are a number of limitations presented in the current study. Firstly, the study employs a small sample size of participants who were not selected for their smoking behaviors. Ergo, the sample may not be representative of smoking patterns in BPD and controls. Previous research has demonstrated that antecedents for smoking differ for heavy and light smokers (Shiffman & Paty, 2006), so a wider array of smoking dependence among participants would perhaps be more illustrative of smoking motives among borderlines and controls. We used brief, single-item measures of smoking

consequences intended to tap reward, negative reinforcement, and punishment. Because the wording of these items was general, caution must be exercised in interpreting the findings. For example, the negative reinforcement item asked whether smoking "relieved an unpleasant feeling or symptom." Although it is tempting to interpret the group difference for this outcome in terms of negative affect relief or management, it might reflect relief from a variety of unpleasant states (e.g., craving, pain, anhedonia, depersonalization). Similar issues could be raised about the brief assessments of self-monitored motives. Most notably, the wording of the positive affect smoking motive was double-barreled in nature. The statement read, "*I SMOKED because it would make my positive feelings even better/make me happier.*" Some participants may have interpreted this motive as also capturing negative affect relief as opposed to solely positive affect enhancement.

These limitations are balanced against several notable strengths of the project. This study rigorously ascertained and screened participants for BPD. It used two kinds of complementary EMA strategies for assessing antecedents of smoking to capture a robust picture of predictors of smoking. Lastly, it used intensive longitudinal data collection to track determinants and consequences of smoking behaviors in real time.

There are a number of future directions that could be used to further develop this study. Firstly, the affective dynamics could be modeled in a more sophisticated way than looking solely at the currently level of negative affect, such as examining acute changes or large swings in affect as potential antecedents for smoking (Trull et al., 2008). These analyses may be significant using the case-crossover effect in both BPD and non-BPD groups. Another set of analyses would include studying moments that people are rating

reasons for smoking as regulating negative affect, such as tracing back from a flagged endorsement of smoking to cope with negative affect and plotting trends in affect leading up to that endorsement (Shiffman, 2009). Additionally, another direction for future analyses are those probing other subjective states, such as impulsivity in the moment (Tomko et al., 2014), as momentary impulsivity is not represented in the literature as an antecedent of smoking in case-crossover designs. Momentary impulsivity could be related to smoking to alleviating craving, among other things.

The findings of this study present interesting implications for smoking cessation treatment. If smokers do indeed have mistaken beliefs about the effects of smoking and are biased to think that smoking helps negative affect relief, then it may be beneficial to educate clients on the lack of significant association between negative affect and smoking according to case-crossover designs and highlight that the association is only relevant with self-report. These beliefs of smoking to relieve negative affect may be modifiable, especially if individual clients use EMA to document their motives for smoking and are shown their own biases (Piasecki, Hufford, Solhan, & Trull, 2007). On the other hand, if subsequent research is successful in identifying the unique constellation of environmental and psychological triggers associated with infrequent self-nominated instances of smoking to cope with negative affect, then this information could be used to identify high-risk situations and enhance existing coping-based therapies.

The data of the current study suggests preliminary evidence that affective regulation is a potentially important motive, more so for borderlines than controls. However, this evidence needs to be probed in larger samples to explore how much the difference in approaches is related to an expectancies/self-reporting bias versus a genuine

experience of affect. The self-monitored motive approach offers unique perspective on instances of rare motives that the case-crossover approach does not offer, though both approaches are valuable in assessing antecedents and motives for smoking in borderlines and healthy controls.

References

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

Bornovalova, M.A., Lejuez, C.W., Daughters, S.B., Rosenthal, M.Z., & Lynch, T.R. (2005). Impulsivity as a common process across borderline personality and substance use disorders. *Clinical Psychology Review, 25,* 790-812. doi:10.1016/j.cpr.2005.05.005

Carpenter, R.W., Wood, P.K., & Trull, T.J. (2016). Comorbidity of borderline personality disorder and lifetime substance use disorder in a nationally representative sample. *Journal of Personality Disorders, 30,* 336-350. doi: 10.1521/pedi_2015_29_197

Carter, B.L., Lam, C.Y., Robinson, J.D., Paris, M.M., Waters, A.J., Wetter, D.W., & Cinciripini, P.M. (2008). Real-time craving and mood assessments before and after smoking. *Nicotine & Tobacco Research, 10,* 1165-1169. doi: 10.1080/14622200802163084

Cheetham, A., Allen, N. B., Yücel, M., & Lubman, D. I. (2010). The role of affective dysregulation in drug addiction. *Clinical Psychology Review, 30*, 621-634. doi:; 10.1016/j.cpr.2010.04.005

Cook, J.W., Spring, B., McChargue, D., & Hedeker, D. (2004). Hedonic capacity, cigarette craving, and diminished positive mood. *Nicotine & Tobacco Research, 6,* 39-47. doi: 10.1080/14622200310001656849

Cronk, N.J., & Piasecki, T.M. (2010). Contextual and subjective antecedents of smoking in a college sample. *Nicotine & Tobacco Research, 12,* 997-1004. doi: 10.1093/ntr/ntq136

Cyders, M.A. & Smith, G.T. (2008). Emotion-based dispositions to rash action: Positive and negative urgency. *Psychological Bulletin, 134, 807-828.* doi: 10.1037/a0013341

Distel, M.A., Trull, T.J., de Moor, M.M.H., Vink, J.M., Geels, L.M., van Beek, J.H.D.A…. Boomsma, D.I. (2012). Borderline personality traits and substance use: Genetic factors underlie the association with smoking and ever use of cannabis, but not with alcohol consumption. *Journal of Personality Disorders, 26,* 867-879. doi: 10.1521/pedi.2012.26.6.867

First, M. B., Spitzer, R. L., Gibbon, M. W. J. B., & Williams, J. B. (1995). Structured clinical interview for DSM-IV axis I disorders. *New York: New York State Psychiatric Institute.*

Korzekwa, M. I., Dell, P. F., Links, P. S., Thabane, L., & Webb, S. P. (2008). Estimating the prevalence of borderline personality disorder in psychiatric outpatients using a two-phase procedure. *Comprehensive Psychiatry*, 49(4), 380-386.

Kruedelbach, N., McCormick, R.A., Schulz, S.C. & Grueneich, R. (1993). Impulsivity, coping styles, and triggers for craving in substance abusers with borderline personality disorder. *Journal of Personality Disorders, 7, 214-222.* doi: 10.1521/pedi.1993.7.3.214

Lane, S. P., Carpenter, R. W., Sher, K. J., & Trull, T. J. (2016). Alcohol craving and consumption in Borderline Personality Disorder: When, where, and with whom. *Clinical Psychological Science*, 4(5), 775-792.

Lenzenweger, M.F., Lane, M.C., Loranger, A.W., & Kessler, R.C. (2007). DSM-IV

personality disorders in the National Comorbidity Survey Replication. *Biological*

Psychiatry, 62, 553-564. doi:10.1016/j.biopsych.2006.09.019

Leventhal, A.M., Waters, A.J., Kahler, C.W., Ray, L.A., & Sussman, S. (2009). Relations

between anhedonia and smoking motivation. *Nicotine & Tobacco Research, 11,*

1047-1054. doi: 10.1093/ntr/ntp098

Marissen, M.A.E., Arnold, N., & Franken, I.H.A. (2012). Anhedonia in borderline

personality disorder and its relations to symptoms of impulsivity.

Psychopathology, 45, 179-184. doi: 10.1159/000330893

Pfohl, B., Blum, N., & Zimmerman, M. (1994). *Structured interview for DSM-IV*

personality disorders. Iowa City: University of Iowa Hospitals and Clinics.

Piasecki, T. M., Hufford, M. R., Solhan, M., & Trull, T. J. (2007). Assessing clients in

their natural environments with electronic diaries: Rationale, benefits, limitations,

and barriers. *Psychological Assessment*, *19*(1), 25.

Piasecki, T.M., Piper, M.E., Baker, T.B., & Hunt-Carter, E.E. (2011). WISDM primary

and secondary dependence motives: Associations with self-monitored motives for

smoking in two college samples. *Drug and Alcohol Dependence, 114,* 207-216.

doi: 10.1016/j.drugalcdep.2010.10.005

Piasecki, T.M., McCarthy, D.E., Fiore, M.C., & Baker, T.B. (2008). Alcohol

consumption, smoking urge, and the reinforcing effects of cigarettes: An

ecological study. *Psychology of Addictive Behaviors, 22,* 230-239. doi:

10.1037/0893-164X.22.2.230

Piasecki, T.M., Piper, M.E., Baker, T.B., & Hunt-Carter, E.E. (2011). WISDM primary and secondary dependence motives: Associations with self-monitored motives for smoking in two college samples. *Drug and Alcohol Dependence, 114,* 207-216. doi: 10.1016/j.drugalcdep.2010.10.005

Piasecki, T.M., Richardson, A.E., & Smith, S.M. (2007). Self-monitored motives for smoking among college students. *Psychology of Addictive Behaviors, 21,* 328-337. doi: 10.1037/0893-164X.21.3.328

Piasecki, T. M., Wood, P. K., Shiffman, S., Sher, K. J., & Heath, A. C. (2012). Responses to alcohol and cigarette use during ecologically assessed drinking episodes. *Psychopharmacology, 223*(3), 331-344.

Rohde, P., Lewinsohn, P.M., Brown.R.A., Gau, J.M., & Kahler, C.W. (2003). Psychiatric disorders, familial factors, and cigarette smoking: I. Associations with smoking initiation. *Nicotine & Tobacco Research, 5,* 85.98. doi: 10.1080/1462220031000070507

Shiffman, S. (2009). Ecological momentary assessment in studies of substance use. *Psychological Assessment, 21,* 486-497. 2009. doi: 10.1037/a0017074

Shiffman, S., Gwaltney, C. J., Balabanis, M. H., Liu, K. S., Paty, J. A., Kassel, J. D., . . . Gnys, M. (2002). Immediate antecedents of cigarette smoking: An analysis from ecological momentary assessment. *Journal of Abnormal Psychology, 111*, 531-545. doi: 10.1037/0021-843X.111.4.531

Shiffman, S., & Paty, J. (2006). Smoking patterns and dependence: Contrasting chippers and heavy smokers. *Journal of Abnormal Psychology, 115,* 509–523. doi: 10.1037/0021-843X.115.3.509

Shiffman, S., Paty, J. A., Gwaltney, C. J., & Dang, Q. (2004). Immediate antecedents of

cigarette smoking: An analysis of unrestricted smoking patterns. *Journal of

Abnormal Psychology, 113*, 166–171. doi: 10.1037/0021-843X.113.1.166

Thrul, J., Bühler, A., & Ferguson, S.G. (2014). Situational and mood factors associated

with smoking in young adult light smokers. *Drug and Alcohol Review, 33,* 420-

427. DOI: 10.1111/dar.12164

Tomko, R. L., Solhan, M. B., Carpenter, R. W., Brown, W. C., Jahng, S., Wood, P. K., &

Trull T. J. (2014). Measuring impulsivity in daily life: The momentary

impulsivity scale. *Psychological Assessment*, *26*(2), 339.

Trull, T.J., Jahng, S., Tomko, R.L., Wood, P.K, & Sher, K.J. (2010). Revised NESARC

personality disorder diagnoses: Gender prevalence and comorbidity with

substance dependence disorders. *Journal of Personality Disorders, 24,* 412-426.

doi: 10.1521/pedi.2010.24.4.412

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*(3), 647-661.

Table 1: *Demographic and Smoking Characteristics by Group*

	BPD (*n* = 29)		COM (*n* = 13)		
Demographic	*n*	%	*n*	%	χ^2
Gender-female	23	79.3	11	84.6	.164
Ethnicity					4.367
African-American	3	10.3	1	7.7	
Hispanic	1	3.4	0	0	
Caucasian	24	82.8	11	84.6	
Asian/Asian- American	0	0	1	7.7	
Other	1	3.4	1	7.7	
Marital Status					3.544
Single, never married	23	79.3	9	69.2	
Married	2	6.9	2	15.4	
Cohabitating	0	0	1	7.7	
Divorced or separated	4	13.8	1	7.7	
Annual income					5.347
$0 to $25,000	24	82.8	8	61.5	
$25,001 to $50,000	4	13.8	2	15.4	
$50,001 to $75,000	0	0	2	15.4	
$75,001 to $100,000	0	0	0	0	
Above $100,000	1	3.4	1	7.7	
Currently Employed	21	72.4	11	84.6	.737
Current Psychotropic Meds	22	75.9	0	0	20.710***
Past or Current Therapy	26	89.7	2	15.4	14.245***
Smoking Frequency					4.064
Daily	19	65.5	6	46.2	
5-6 days/week	0	0	1	7.7	
3-4 days/week	4	13.8	2	15.4	
1-2 days/week	4	13.8	3	23.1	
1-2 days/month	1	3.4	1	7.7	
< 1/month	1	3.4	0	0	
Smoking Amount					1.771
1.5 packs/day	1	3.4	0	0	
Pack/day	5	17.2	1	7.7	
Half-pack/day	6	20.7	2	15.4	
1-5 cigs/day	13	44.8	7	53.8	
< 1 cig/day	4	13.8	3	23.1	
Perceived Tobacco Dependence					3.409
Not Dependent	10	34.5	5	38.5	
Not Currently Dep.	3	10.3	4	30.8	
Currently Dependent	16	55.2	4	30.8	

Note. Tobacco dependence was determined by a self-report question at baseline. ***$p < .00$

Table 2: *Results from Case-Crossover Analyses Predicting Smoking Events from Contextual and Subjective Antecedents*

Predictor	Antecedent Coefficient			Group Differences			Group x Antecedent Interaction		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Time of Day[a]				3.85	(1.00, 14.80)	.050			
12am-3:59am	8.38	(3.01, 23.36)	< .001				.42	(.13, 1.34)	
4am-7:59am	-	-	-				-	-	-
8am-11:59am	2.04	(.77, 5.41)	.151				.50	(.18, 1.44)	.201
12pm-3:59pm	2.33	(.91, 6.01)	.079				.46	(.17, 1.28)	.137
4pm-7:59pm	2.70	(1.06, 6.92)	.038				.46	(.17, 1.27)	.133
8pm-11:59pm	3.08	(1.21, 7.86)	.019				.40	(.15, 1.12)	.402
Weekend	.83	(.65, 1.10)	.206	1.63	(.64, 4.13)	.305	1.15	(.84, 1.57)	.388
Location									
Bar/Restaurant	2.10	(1.41, 3.14)	< .001	1.69	(.66, 4.33)	.274	1.52	(.87, 2.66)	.142
School	1.31	(.77, 2.22)	.315	1.70	(.67, 4.30)	.263	.85	(.45, 1.61)	.615
Work	1.03	(.74, 1.45)	.849	1.75	(.69, 4.39)	.237	.71	(.45, 1.11)	.131
Residence	.49	(.38, 0.62)	< .001	1.58	(.61, 4.11)	.350	1.14	(.84, 1.54)	.410
Outside	3.13	(2.09, 4.68)	< .001	1.67	(.65, 4.29)	.287	.86	(.54, 1.39)	.543
Vehicle	1.90	(1.24, 2.91)	.003	1.62	(.64, 4.09)	.313	1.47	(.88, 2.44)	.141
Other	1.53	(.99, 2.36)	.052	1.69	(.67, 4.29)	.267	.79	(.49, 1.28)	.334
With Someone	1.95	(1.47, 2.59)	< .001	1.75	(.66, 4.67)	.262	.99	(.71, 1.39)	.958
Negative Affect	1.37	(.91, 2.06)	.131	1.68	(.59, 4.81)	.334	.92	(.59, 1.44)	.729
Positive Affect	1.87	(1.53, 2.28)	< .001	2.77	(.93, 8.27)	.068	.81	(.64, 1.03)	.080
Craving	1.58	(1.42, 1.76)	< .001	1.54	(.71, 3.34)	.273	.96	(.84, 1.09)	.523

[a]Omnibus Group x Time interaction, $F(5, 6094) = .714$, $p = .613$

Table 3: *Overall and Group Means of Self-Monitored Motives for Smoking*

Motive	Overall Mean	BPD Mean	Control Mean	Group Difference b	SE	p
Craving	2.74	2.80	2.68	.12	.25	.615
Habit	2.53	2.72	2.33	.39	.30	.192
Boredom	2.25	2.32	2.18	.14	.26	.582
Enhance Positive Affect	2.18	2.45	1.91	.54	.25	.034
Socialize	2.16	2.04	2.27	-.23	.26	.375
Cope with Negative Affect	1.96	2.28	1.64	.64	.20	.002
Break from School/Work	1.96	1.94	1.97	-.03	.23	.894
Going Someplace Couldn't Smoke	1.83	1.94	1.72	.22	.22	.320

Table 4: *Group Means and Effect Sizes of the Brief WISDM Motive Differences*

Subscale	BPD Mean	Control Mean	t-value	*p*	Cohen's *d*
Social/Environmental Goads	4.19	3.61	.50	.624	.247
Affective Enhancement	3.97	2.78	1.66	.117	.735
Cue Exposure	3.77	3.44	.34	.738	.193
Craving	3.33	2.33	1.05	.308	.585
Secondary Dependence Motives	3.13	2.70	.59	.562	.330
Automaticity	3.06	2.13	1.26	.230	.594
Cognitive Enhancement	3.05	2.06	1.16	.267	.542
Primary Dependence Motives	2.94	2.03	1.43	.172	.636
Taste	2.82	3.67	-1.23	.235	-.530
Weight Control	2.69	1.44	2.28	.036	.999
Tolerance	2.69	1.54	1.35	.194	.746
Loss of Control	2.69	2.13	.76	.745	.419
Affiliative Attachment	2.33	1.89	.67	.502	.315

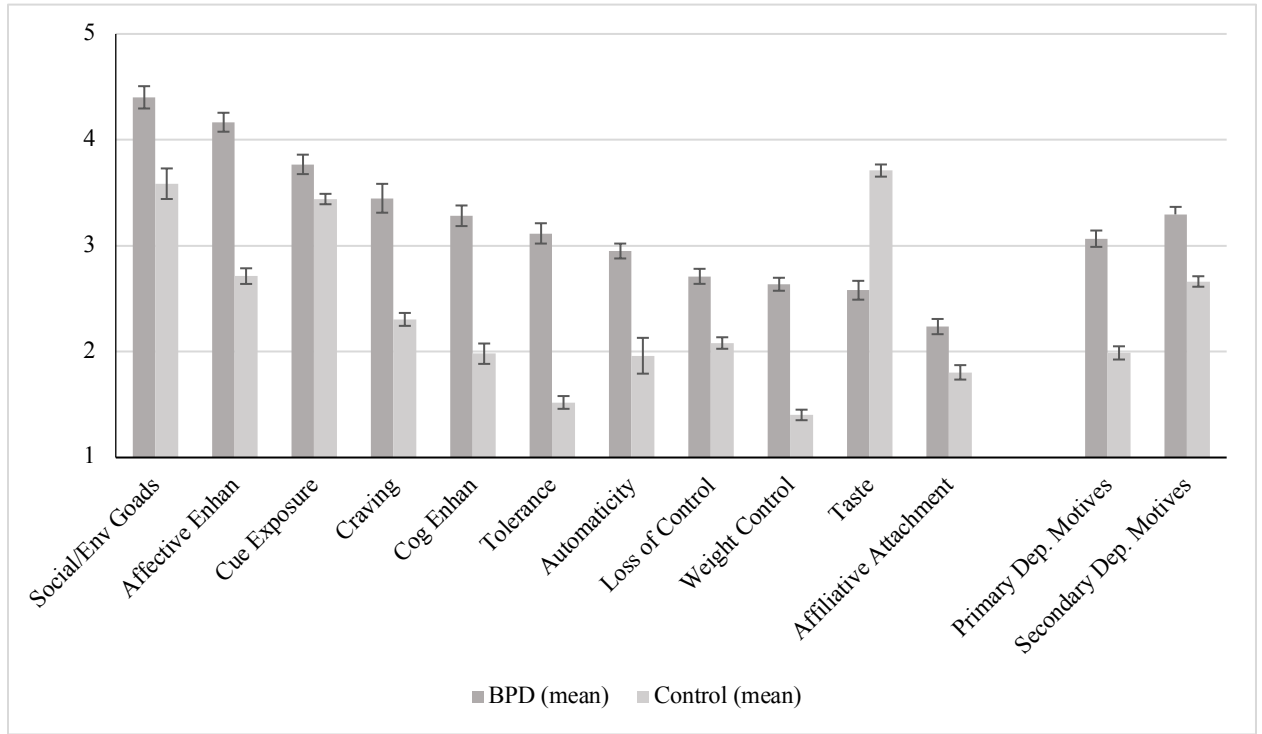Figure 1: *Group Differences of Mean Levels in Brief WISDM Motives*

Figure 2: *Group Differences in Mean Levels of Smoking Outcome Ratings*