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Drinking motives moderate daily-life associations between affect and alcohol use in individuals with borderline personality disorder

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Abstract

People often report drinking to cope with negative affect (NA) or to enhance positive affect (PA). However, findings from daily-life studies examining the interaction of motives and affect to predict alcohol use are mixed. Individuals with borderline personality disorder (BPD) may be particularly susceptible to drinking for the purpose of changing affective states, comprising a population in which these patterns may be more readily identifiable in daily life. We tested whether drinking motives moderate daily-life associations between affect and drinking in individuals with BPD. Regular drinkers with BPD (*N*=54; 81.5% female) completed ecological momentary assessments approximately 6–10 times daily for 21 days. We tested whether the interactions between (1) person-level coping motives and NA so far that day (i.e., cumulative-average NA), and (2) person-level enhancement and cumulative-average PA were associated with subsequent drinking. We also tested whether effects differed for the initiation versus continuation of a drinking episode. Using generalized estimating equations, the interaction between coping and cumulative-average NA was positively associated with momentary drinking, with some evidence for a stronger relation during the continuation of drinking. The interaction between enhancement motives and cumulative-average PA was positively associated with initiation but negatively associated with continuation of drinking. Our novel approach of using cumulative-average affect and distinguishing initiation and continuation of drinking allowed us to examine differential momentary patterns across the drinking episode, and results suggest that awareness of motives as well as affect leading up to and during drinking may be a useful intervention target.

Keywords

alcohol; drinking motives; affect; ecological momentary assessment; borderline personality disorder

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According to the motivational model (Cooper, Frone, Russell, & Mudar, 1995; Cooper, Kuntsche, Levitt, Barber, & Wolf, 2016; Cox & Klinger, 1988), individuals drink alcohol to experience rewards that fall along two dimensions, valence (positive or negative) and locus (internally or externally focused). This results in four motives: enhancement (positive-internal), coping (negative-internal), social (positive-external), and conformity (negative-external). Internally-focused motives are associated with drinking problems, whereas externally-focused motives are associated with less problematic, more moderate drinking (Kuntsche, Knibbe, Gmel, & Engals, 2005). Specifically, drinking to enhance positive affect (PA) is associated with elevated quantity and frequency of alcohol use and drinking to cope with negative affect (NA) is associated with risky behaviors while drinking, academic/occupational problems, and development of alcohol dependence (Cooper et al., 1995; Kuntsche et al., 2005; Merrill, Wardell, & Read, 2014). Thus, the current investigation focused on these internal drinking motives, coping and enhancement.

Enhancement and coping motives imply that individuals are driven to drink to change their affective states. This follows from reinforcement theories of substance use (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Brown, Goldman, Inn, & Anderson, 1980; Cooper et al., 1995) but posits that, beyond current affect, it is important to consider desire to change that affect. For example, an individual may only drink when depressed if they believe drinking will make them less depressed. Given associations with problematic drinking, it is essential to understand how enhancement and coping motives interact with daily-life affective states to lead to momentary drinking.

Ecological momentary assessment (EMA; Stone & Shiffman, 1994) is ideally suited to examine these associations. It involves repeated assessments of momentary affect, behaviors, and contexts in daily life (e.g. via smartphone apps). EMA provides ecological validity, minimizes retrospective bias, and allows for the tracking of dynamic patterns across time. Past research has used EMA or daily diary methods to examine affect prior to daily-life drinking (Simons, Dvorak, Batien, & Wray, 2010; Treloar, Piasecki, McCarthy, Sher, & Heath, 2015), and whether trait-level motives moderate affect-drinking associations (e.g., Armeli, Todd, Conner, & Tennen, 2008; Hussong, 2007). However, findings are mixed regarding whether motives and affect interact to predict drinking, such that some studies find support for these associations (e.g., Mohr et al., 2005; Todd, Armeli, & Tennen, 2009) but others do not (e.g., Hussong, Galloway, & Feagens, 2005; Littlefield, Talley, & Jackson, 2012). Further, no discernable patterns have emerged based on additional factors such as drinking contexts (Mohr et al., 2005), gender (Dvorak, Pearson, & Day, 2014; Hussong, 2007), NA subtypes of sadness, fear/anxiety, anger/hostility, shyness, loneliness, and boredom (Armeli et al., 2008; Hussong, 2007; Hussong et al., 2005; O'Hara, Armeli, & Tennen, 2014a; Todd, Armeli, Tennen, Carney, & Affleck, 2003; Todd et al., 2005), or timeframe of how quickly affect leads to drinking (Hussong, 2007; Littlefield et al., 2012; Todd et al., 2009). There is no consensus regarding whether trait-level motives interact with daily-life affect to predict drinking.

Prior work is also limited in two important methodological aspects. First, previous studies primarily focused on day-level associations, perhaps because alcohol use is often restricted

to certain days or times (e.g., weekends, evenings). For instance, many studies examined the associations between daytime affect and evening drinking (Dvorak et al., 2014; O'Hara et al., 2014a; Simons et al., 2010). This approach establishes temporal precedence of affect preceding drinking but imposes predetermined daytime/nighttime cutoffs and sacrifices information about momentary associations. An exception to the above approach involves modeling affect trajectories on each day to examine affect leading up to alcohol use (Treloar et al., 2015), which does not impose cutoffs but still does not assess momentary associations. To overcome this limitation, we conducted analyses in the current study at the momentary level. However, as alcohol use is often restricted to certain times of the day (potentially limiting the ability to detect associations for momentary affect and drinking), we created a "cumulative-average" affect predictor that averaged same-day affect ratings prior to the current moment. We focused on the effect of cumulative-average affect instead of momentary affect ("in the past 15 minutes") to acknowledge restrictions on timing of alcohol use, while conducting analyses at the momentary level still allowed us to predict drinking in the moment.

The second limitation is that previous EMA studies primarily sampled college students. While college students are an important population of interest due to the prevalence of alcohol use and related problems (e.g., O'Malley, 2002; Slutske, 2005), EMA work may also benefit from recruiting individuals not only on the basis of being regular drinkers but also on the basis of explicitly exhibiting variability on other constructs of interest, in this case intense and fluctuating affective states. In doing so, associations between motives, affect, and drinking may be more readily identifiable in daily-life studies. Given that the timeframe that EMA covers is typically short, it may not capture enough variability in constructs of interest, especially affect, if they are not experienced with sufficient frequency or intensity to adequately power the analyses (Lane & Hennes, 2019).

To address this, we utilized a sample of individuals with borderline personality disorder (BPD; APA, 2013), a disorder characterized by emotion dysregulation and high levels of NA (Linehan, 1993). Almost half of individuals with BPD meet for current alcohol use disorder (AUD; Trull, Sher, Minks-Brown, Durbin, & Burr, 2000; Trull et al., 2018), and EMA studies find that BPD individuals engage in problematic patterns of alcohol use (Carpenter et al., 2017; Jahng et al., 2011; Lane, Carpenter, Sher, & Trull, 2016). In addition, individuals who experience more emotional instability and negative affectivity report higher endorsement of coping motives (Simons, Gaher, Correia, Hansen, & Christopher, 2005; Stewart & Devine, 2000), and coping and enhancement motives are positively associated with symptoms of Cluster B personality disorders (including BPD; Tragesser, Sher, Trull, & Park, 2007; Tragesser, Trull, Sher, & Park, 2008). Finally, a large body of research indicates that personality disorders tend to represent extreme scores of normal personality dimensions, rather than categorically distinct entities. As such, personality disorders are seen as quantitatively, but not qualitatively, different from variants of normal personality, with empirical evidence supporting this notion (Samuel & Widiger, 2008; Trull, Distel, & Carpenter, 2011). Thus, findings based on individuals with BPD should be relevant to the broader population of drinkers. In sum, BPD individuals exhibit rich variability in constructs of interest and are therefore well-suited for the study of the daily-life associations between motives, affect, and drinking.

Our first aim was to test whether the interaction between baseline drinking motives and accumulated daily-life affect is associated with alcohol use in individuals with BPD. Our first research question was 1) Are BPD individuals who are high on coping motives more likely to drink in the moment when their NA has been high so far that day? We hypothesized that the interaction of high coping motives and high cumulative-average NA would be associated with momentary drinking. Our second research question was 2) Are BPD individuals who are high on enhancement motives more likely to drink in the moment when their PA has been low so far that day? We hypothesized that the interaction of high enhancement motives and low cumulative-average PA would be associated with momentary drinking, conceptualizing alcohol use as a possible attempt to increase PA when it has been undesirably low. In both cases, we hypothesized effects for the cumulative-average affect scores, because we expected that external constraints (e.g., being at work) would make alcohol use more likely toward the end of a day if that day had thus far been characterized by undesirable levels of the relevant affect.

Our second aim was to investigate potential differences between drinking *initiation* and drinking *continuation*. Past work has typically focused on initial drink or total number of drinks in an episode. However, motives may have an equal, if not greater, impact on the association of affect and drinking continuation versus initiation, as drinking initiation may be determined more by environmental factors. For example, two individuals, one high and one low in coping, may both experience NA and may both initiate drinking at a social event. However, if their NA remains high, the individual high in coping may be more likely to choose to continue to drink, in a continued effort to reduce NA, than the individual low in coping. Specifically, our research questions were 3) Does the interaction of high coping motives and high cumulative-average NA predicting momentary drinking differ for the initial drink versus subsequent drink continuation, and 4) Does the interaction of high enhancement motives and low cumulative-average PA predicting momentary drinking differ for the initial drink versus subsequent drink continuation? As no EMA research has differentiated initiation and continuation, we did not hypothesize how effects might differ.

Method

Participants

The initial sample included 56 current drinkers with BPD diagnoses according to the DSM-IV (APA, 2000). Two were excluded due to no reported drinking during the EMA period (final N=54). Participants were recruited through advertisements in local psychiatric clinics and in the community, targeting individuals with BPD symptoms (i.e., intense mood swings, impulsive behavior, unstable relationships, and intense anger) on recruitment ads.[1] After phone screening, participants completed in-person diagnostic interviews using the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I; First, Spitzer, Gibbon, & Williams, 1995) and Structured Interview for DSM-IV Personality Disorders (Pfohl, Blum, & Zimmerman, 1994). Inter-rater reliabilities were computed for a subset of 20 participants and were high for the diagnosis of BPD (κ=0.88), and current AUD (κ=1.00).

[1]The sample originally included a comparison group of community participants. Results for this group are not presented herein as the current study focused on alcohol-related processes within the BPD population.

Participants were required to be 18–45 years old, in mental health treatment, and report drinking at least once/week. Participants were excluded if they were seeking or in treatment for alcohol use, experienced significant withdrawal symptoms, or were unsuccessful in past-year efforts to cut back or stop drinking. Further exclusion criteria included history of psychosis, intellectual disability, significant head trauma, and being pregnant or planning to become pregnant.

Mean age was 26.22 years (*SD*=7.21), and the majority of participants were women (81.5%) and currently employed (77.8%). Seventeen (31.5%) participants met criteria for a current AUD diagnosis and forty-six (85.2%) participants were taking psychotropic medication at the time of participation. See Table 1 for additional characteristics and co-occurring conditions.

Procedure

Ethics approval was granted by the Institutional Review Board of the University of Missouri (Protocol 1133597). Before the EMA period, participants completed an orientation and information session, during which they provided consent, demographic and self-report data, and received the electronic diary (ED; Palm Tungsten E2©) and instructions for use.

The EMA period lasted 21 days (*M* days=21.31, *SD*=3.22). Upon wakeup, participants filled out a morning report. After completion of the morning report or 12pm, whichever came first, six random prompts were scheduled approximately 2.5 hours apart throughout the day. Participants could delay random prompts up to 15 minutes and could suspend the ED, preventing random prompts (e.g., while driving). Participants completed 89.9% (*SD*=9.3) of random prompts and were compensated according to random-prompt compliance. They received $50/week for at least 80% compliance.

Participants were instructed to initiate a report after consuming a standard drink of alcohol. Following this initial drink report, participants received four follow-up assessments that occurred 30, 60, 120, and 180 minutes after the initial report. If participants reported additional drinks during the last scheduled drinking follow-up, an additional follow-up was presented 60 minutes later. Participants also initiated reports following cigarette use and self-harm events, and the latter were followed by three follow-up assessments. Recent alcohol use was assessed at every type of prompt, in case participants failed to self-initiate an initial drink report. In total, 7,244 observations were included in the current analyses.

Measures

Drinking motives—At the orientation session, participants completed the Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994) which assesses motives for drinking with 5 items per motive and responses ranging from 1–5 (1=almost never/never, 5=almost always/always) for each item. Average scores on each motive were: 15.37 for enhancement (*SD*=3.35, range=8–24), 12.02 for coping (*SD*=4.84, range=5–22), 17.56 for social (*SD*=4.64, range=5–25), and 7.07 for conformity (*SD*=3.38, range=5–17). We used the enhancement and coping scores in the current study, which were not significantly correlated with each other (r=.20, p=.157).

Affect—At each prompt, participants rated their affect over the past 15 minutes (1=very slightly/not at all, 5=extremely) using items from the Positive and Negative Affect Schedule-Extended version (PANAS-X; Watson & Clark, 1999). PA (10 items) and NA (21 items) items were aggregated into mean scores at each prompt. Across all moments, average NA was 1.47 (*SD*=0.59, range=1–5) and average PA was 2.27 (*SD*=0.88, range=1–5).

Alcohol use

At each prompt, participants were asked, "Have you CONSUMED ALCOHOL SINCE LAST RECORDING?" with the exception of the initial drink, where drinking was implied by initiation the report. A dichotomous drinking variable indicated whether any drinking was reported at each prompt.

Analytic method

Variable construction

Cumulative-average affect: We created a cumulative-average affect variable that averaged all affect ratings throughout the day *prior to the current prompt*, continuously updating at each new prompt.

Phase: To test the possibility that affect and motives have differential effects on engaging in alcohol use at the initiation versus continuation of a drinking episode, we created a dummy-coded dichotomous "phase" variable. This variable separated the data into observations where the *initiation* of a drinking episode was possible (coded as 0) and observations where the *continuation* of a drinking episode was possible (coded as 1). Phase was therefore coded 0 (i.e., initiation phase) for all observations on non-drinking days, for pre-drinking observations on drinking days, and the first drink of any episode. Phase was coded 1 (i.e., continuation phase) for all observations after the first drink until the end of the day, regardless of whether additional drinking was reported. Thus, importantly, phase was orthogonal from drinking: both phases included observations where drinking did and did not occur. For example, a participant might report an initial drink, a second drink at the first follow-up prompt, no drinking at the second follow-up, a third drink at the third follow-up, and no drinking at the fourth follow-up. The initial drink would be included in the initiation phase while the four follow-ups would be coded as the continuation phase, with the drinking reported at the first and third follow-up prompts considered instances of drinking continuation.

Analyses—We employed four logistic regression models with generalized estimating equations (GEE; Liang & Zeger, 1986) to accommodate our dichotomous outcome variable using SAS PROC GENMOD, assuming an independent covariance structure. GEE models indirectly account for the uneven and random spacing of assessments over time, as well as the non-independence of observations within persons and days. The criterion for all four models was momentary dichotomous drinking and the four models tested research questions one through four, respectively. The analyses were not pre-registered, and results should be considered exploratory.

The effect of interest in Model 1 was the interaction between baseline coping and cumulative-average NA. Additional predictor variables in Model 1 were momentary and person-level NA. The effect of interest in Model 2 was the interaction between enhancement and cumulative-average PA. Additional predictor variables in Model 2 were momentary and person-level PA. Models 3 and 4 expanded Models 1 and 2, respectively, to include the dichotomous phase variable. Thus, the effect of interest in Model 3 was the three-way interaction between phase, coping, and cumulative-average NA, and the effect of interest in Model 4 was the three-way interaction between phase, enhancement, and cumulative-average NA. Models 3 and 4 also included the two-way interactions that made up the three-way interactions of interest: motive and phase, cumulative-average affect and phase, and cumulative-average affect and motive.[2]

In all four models, predictors were centered to create distinct and disaggregated momentary, cumulative-average, and person-level affect (Curran & Bauer, 2011), each centered on the cluster mean at the next level, with person-level estimates centered on the sample mean. The momentary variable (Level 1) represented an individual's momentary affect ratings compared to other affect ratings from the same individual, for the same day. The cumulative-average variable (Level 2) represented an individual's affect scores up to the current timepoint on a particular day, compared to average affect ratings for that person across all of their days in the study. Lastly, the person-level variable (Level 3) represented an individual's mean affect ratings across all study days compared to the sample-mean of affect across all participants. As our primary conceptual interest was on the cumulative-average predictors, the momentary and person-level affect variables are covariates and were only included in the models to disaggregate the three levels of affect (momentary, cumulative-average, and person), with person-level affect representing the between-person component and cumulative-average and momentary affect representing the within-person components (Curran & Bauer, 2011). Finally, all four models included covariates: sample-centered age, gender, day of the week (as participants were more likely to drink on weekend days), hour after wake-up (as participants were more likely to drink later in the day), and a dummy variable indicating whether it was the first day in the study (as participants in this sample were more likely to report drinking on the first day; Shrout et al., 2017).

Results

There were 924 instances of momentary drinking (12.8% of all observations): 362 reports of initial drinking during the initiation phase (6.0% of initiation phase observations) and 562 instances of additional drink reports during the continuation phase (47.6% of continuation phase observations). We also examined what time of day participants reported their first drinks, and found that first drink times ranged from 8:23 AM to 2:26 AM the next calendar day (mean = 7:50 PM, SD = 3 hours and 7 minutes).

[2]Given that 31.5% of the sample met criteria for an AUD, we repeated Models 3 and 4 with AUD diagnosis (present/absent) as the moderator instead of phase. All information related to these models and results are included in the Supplemental Materials for the interested reader.

Models 1 and 2: Motives and affect

Table 2 presents results from Model 1, showing the effects of baseline coping and daily-life NA on momentary drinking. Coping motives moderated the association between cumulative-average NA and drinking such that greater cumulative-average NA was associated with greater odds of momentary drinking for individuals high on coping (Figure 1).

Table 3 presents results from Model 2, showing the effects of baseline enhancement and daily-life PA on momentary drinking. Enhancement and cumulative-average PA did not significantly interact to predict momentary drinking.

Models 3 and 4: Motives, affect, and phase

Table 4 presents results from Model 3, showing the effects of baseline coping, cumulative-average NA, and phase on momentary drinking. Coping and cumulative-average NA were not differentially related to the initiation versus the continuation of the drinking episode, as the three-way interaction between coping, cumulative-average NA, and phase was not significantly associated with momentary drinking. However, the two-way interaction between coping motives and cumulative-average NA was statistically significant in the continuation phase, as indicated by the significant interaction for cumulative-average NA and coping when the continuation phase was the reference, qualifying the overall effect reported in Model 2. Table 5 presents results from Model 4, showing the effects of baseline enhancement, daily-life PA, and phase on momentary drinking. The three-way interaction of enhancement, cumulative-average PA, and phase was significant such that the interaction for cumulative-average PA and enhancement differed across initiation and continuation phases (Figure 2). Inspection of Figure 2 suggests that individuals high on enhancement motives are more likely to initiate a drinking episode when PA has been high so far that day and are more likely to continue drinking regardless of PA once they are already in a drinking episode. In contrast, cumulative-average PA appears to be relevant for individuals low on enhancement motives only in the continuation phase of drinking, such that these individuals are most likely to continue drinking if PA has been high so far that day. Of note, however, is that the two-way interactions between enhancement and cumulative-average PA within the drinking phases are not significant, which limits the current interpretation and warrants additional examination.

Discussion

The current study utilized EMA to examine the motivational model of alcohol use by testing whether coping and enhancement motives moderated associations between undesirable affective states and drinking in the daily lives of BPD individuals. Although the question of whether motives interact with affective states to predict drinking has been examined with EMA designs, past research has been mixed. While this study alone cannot resolve the inconsistent findings of past work, it presents possible ways forward for the field. First, it highlights the value of recruiting samples that experience variability in affect and alcohol-related problems. Second, it offers novel methodological strategies for predicting drinking using daily-life data, namely the distinction between different phases of the drinking episode

(i.e., initiation versus continuation) and the use of cumulative-average variables to predict drinking at the momentary level of analysis.

As hypothesized and consistent with theory (Cooper et al., 1995; Cooper et al., 2016; Cox & Klinger, 1988), BPD individuals high on coping were more likely to drink when their day had thus far been characterized by high NA. Although phase did not significantly moderate this interaction between coping and cumulative-average NA, the simple slopes reported in Table 4 show that the interaction of coping and cumulative-average NA only remained significant for the continuation phase of drinking. This suggests a potential influence of phase, such that individuals high on coping motives were more likely to continue drinking, but not initiate drinking, if NA had been high so far that day. However, as the 3-way interaction with phase was not significant, further examination is warranted to determine what qualifying effect phase might have.

Contrary to our hypothesis, enhancement motives did not, overall, increase the probability of drinking if participants had experienced little PA during the day. Rather, we found that enhancement and PA during the day were differentially related to drinking depending whether drinking occurred in the initiation versus the continuation phase of a drinking episode. Inspection of Figure 2 suggests that high PA during the day precedes drinking initiation for individuals high on enhancement motives, consistent with an anticipatory effect of feeling increased PA leading up to drinking initiation on drinking days (Treloar et al., 2015). Meanwhile, when considering what influences an individual's decision to *keep* drinking, it appears that as PA during the day increases, individuals at *lower* levels of enhancement motives are at increased risk of continuing to drink, whereas individuals high on enhancement motives are likely to continue drinking regardless of PA. To be clear, the two-way interactions between enhancement and cumulative-average PA did not reach significance at the $p<.050$ level in either phase. Rather, that the pattern differed across phases of the drinking episode highlights the utility in examining initiation and continuation as separate processes with distinct proximal risk factors.

Our study offers a unique perspective by examining these processes in BPD individuals. BPD individuals experience high levels of NA and are prone to utilizing maladaptive affect regulation strategies such as substance use. The question that may arise, however, is what applicability the findings have for drinkers who do not have BPD or who may endorse coping but infrequently experience high NA. Our findings likely are not unique to BPD individuals but, instead, are more readily detectable in this population in the timespan captured by EMA designs because of the frequency of relatively intense affect in this group. This is consistent with conceptualizations of BPD as representing extreme scores on continuous traits (e.g., NA and affective instability), as opposed to qualitatively distinct from the general population (Samuel & Widiger, 2008; Trull, Distel, & Carpenter, 2011; Trull & McCrae, 2002). Thus, our findings may be applicable to the association of motives, affect, and drinking generally, though this warrants attention from future research.

From an analytic perspective, the current study contributes to daily-life investigations of the influence of motives and affect on drinking in two important ways. First, using cumulative-average affect allowed us to examine affect as a cumulative process. Given societal and

cultural restrictions on drinking behavior (e.g. being at work), most individuals cannot drink in response to undesirable levels of affect at any moment. Many daily-life studies address this by aggregating to the day level or splitting days into daytime affect to predict nighttime drinking. However, cumulative-average aggregation made it possible to acknowledge that affect may be most likely to lead to drinking when it accumulates over time, while additionally allowing for the prediction of momentary drinking. Furthermore, the cumulative-average method does not assume a standard timeframe of accumulation across all people (i.e., until 5pm), but is unique to each day and person.[3] This point may have been especially relevant in our sample, as the time of day at which participants reported their first drinks ranged from 8:23 AM to 2:26 AM the next calendar day. This wide range of first drink times supported our use of cumulative-average affect to predict momentary drinking instead of an analytic approach that takes daytime affect (pre-5:00 PM) to predict evening (post-5:00 PM) drinking. To this point, 17.17% of first drinks occurred prior to 5:00 PM, and 25.48% of first drinks occurred after 10:00 PM. This suggests that, had we used daytime affect to predict evening drinking, we would have "missed" pre-5:00 PM drinking on 17.17% of days, and 25.48% of days would have over 5 hours of unaccounted for affect between 5:00 PM and 10:00 PM. Further, daytime affect would have been confounded with drinking on 17.17% of days.

Second, we examined the entire drinking episode, distinguishing initiation versus continuation. By examining phase, we were able to test whether the interaction of motives and affect differed for these two phases that previously have been aggregated together. Without considering phase, we would have concluded no interaction effect of enhancement and cumulative-average PA on drinking, which was not actually the case. Future EMA work should study the entire drinking episode, distinguishing between phases. It is important to understand the factors associated with the first drink, and arguably more important to understand the factors associated with consuming additional drinks, as negative consequences are more likely to occur at higher levels of consumption (Hingson, Zha, & White, 2017). Combined with using the cumulative-average, this has the added advantage above and beyond predicting total number of drinks per episode because it allows for the moment-by-moment examination of proximal factors that contribute to each decision to keep drinking.

Limitations

Several limitations are notable in addition to those associated with EMA methods in general. First, studying phase of drinking requires splitting the dataset into two parts with different base rates of alcohol use. In our study, drinking was reported in 6.0% of observations during the initiation phase, reflecting that alcohol use initiation reports are fairly infrequent in the context of all reports, limiting statistical power to identify these.[4] In contrast, alcohol use

[3]To determine whether our analytic strategy afforded us anything above and beyond what has typically been done in the existing literature, we re-analyzed our data using the interaction of baseline motives and daytime affect to predict evening drinking. Although it was not an aim of the current study to make comparisons between analytic strategies, it is important to examine whether our method has incremental utility. Additional analyses, presented in the Supplemental Materials, show that previous modeling approaches do not have the granularity or flexibility to identify how affective and motivational processes unfold uniquely day by day to inform drinking onset, and then shift into predicting whether individuals will continue to drink. We thank an anonymous reviewer for the suggestion to formally compare our approach with an alternative extant approach.

was reported in 47.6% of observations during the continuation phase, reflecting that most drinking episodes consisted of more than one drink.

Second, momentary affect ratings during the continuation phase were likely influenced by drinking. Our inclusion of the phase variable accounted for the fact that, in the continuation phase, individuals have already started drinking, which mitigated our concern about affect being confounded by alcohol use at that point. However, the phase variable does not account for how much alcohol individuals have consumed, which could further influence an individual's reported affect. Our study demonstrates the utility in considering factors that influence continuing to drink once an individual has already started, and future work on this topic could extend this line of research to determine whether how much alcohol a person has already consumed influences their decisions to keep drinking. Another concern regarding continuation-phase affect is that our cumulative-average affect variable aggregated affect prior to drinking with any affect reported so far in the drinking episode, up until the current moment. While it was our goal to examine how all affect so far on a given day influenced continued drinking, future work could focus solely on whether affect during drinking predicts continued drinking, to test the idea that affect prior to drinking may no longer be a salient predictor of alcohol use once the drinking episode has started.

Third, related to the second limitation, the dichotomous coding of our outcome variable (momentary drinking since the last prompt) may have failed to capture some of the more nuanced aspects of alcohol consumption. For example, future work could benefit from predicting alcohol quantity (number of drinks since the last prompt) or quality (alcohol content) for a more precise estimate of alcohol consumption or estimated blood alcohol content (BAC), which could provide insight into not only quantity of drinking but also rate of drinking (Carpenter et al., 2017). Breathalyzers or devices that passively measure BAC may be incorporated into EMA studies to aid in this inquiry as well (Piasecki, 2019; Wang, Fridberg, Leeman, Cook, & Porges, 2019).

Fourth, by measuring drinking motives at baseline, we treated motives as trait-like and stable. However, motives may fluctuate within person, and drinking episodes characterized by different motives show differential patterns of correlates (Arbeau, Kuiken, & Wild, 2011; Dvorak et al., 2014; O'Hara, Armeli, & Tennen, 2015; O'Hara et al., 2014b). These findings are consistent with the motivational model, which posits that motives are the final common pathway to alcohol use (Cooper et al., 2016), implying proximity of motives to daily-life drinking. Future EMA work seeking to characterize associations between motives, affect, and drinking would benefit from assessing motives at the momentary or episode level.

Fifth, recent work has demonstrated the benefit of examining coping in terms of coping with anxiety versus depression. The Modified DMQ-R (Grant, Stewart, O'Connor, Blackwell, & Conrod, 2007) separates coping into anxiety-coping and depression-coping, and initial EMA work suggests unique patterns of daily-life associations with alcohol use based on which

[4]One possibility to increase the initiation-phase base rate of drinking is to restrict analyses to observations occurring after a certain time of day. We re-analyzed Models 3 and 4 this way, first restricting analyses to observations occurring after 12pm and then 5pm. For both restrictions, the pattern of results reported here stayed the same.

type of coping is endorsed (Gorka, Hedeker, Piasecki, & Mermelstein, 2017). Future work distinguishing these types of coping may further clarify mixed findings in the literature.

Conclusions

Findings from the current study offer support for the motivational model, suggesting that drinking motives interact with relevant affective states to predict drinking. We found that high NA accumulated throughout the day was associated with subsequent drinking for individuals high on coping motives. Notably, the phase of drinking episode (i.e., the initiation versus continuation) moderated relations among accumulated PA throughout the day, enhancement motives, and subsequent drinking. Thus, this study also proposes suggestions for methodological improvements for predicting drinking in daily life. Studying drinking patterns in individuals prone to affect dysregulation and problem drinking may help daily-life investigations capture adequate variability in these constructs within only a few weeks. In addition, a combination of cumulative-average affect aggregation and considering phase of drinking allows for the examination of differential momentary patterns across the drinking episode. These analytic strategies may provide insight on how affect *while* drinking contributes to the decision to continue drinking. Awareness of an individual's motives as well as their affect leading up to and during drinking may prove to be useful intervention targets for problematic alcohol use.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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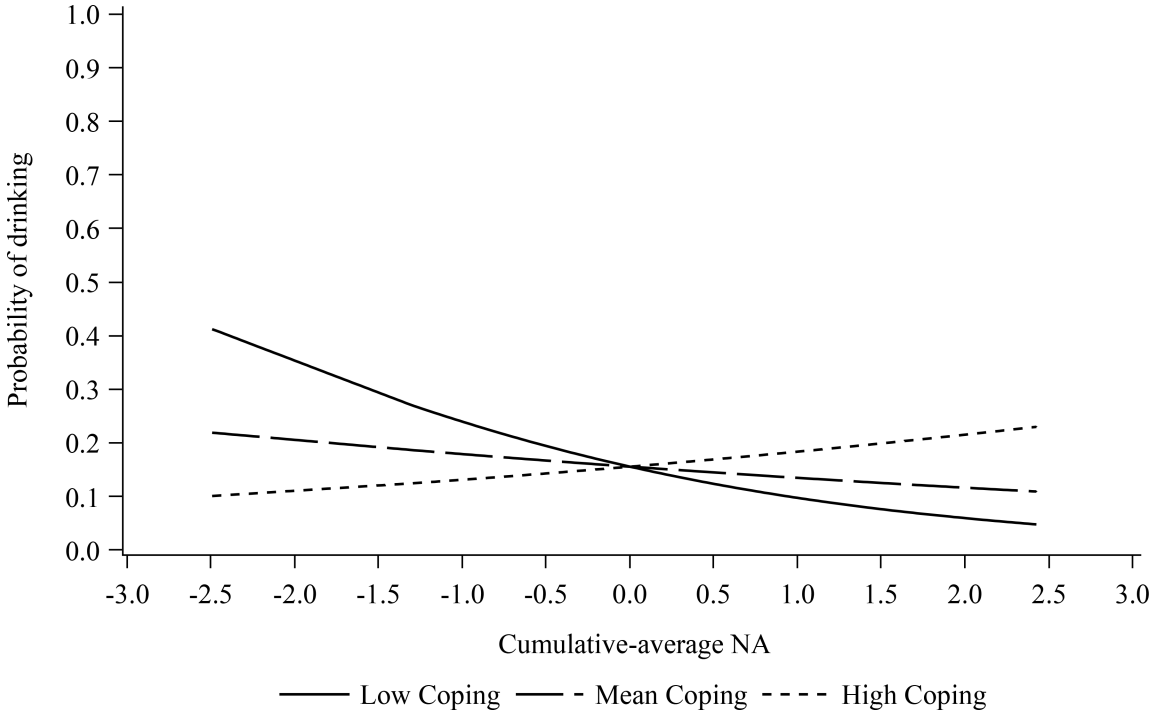

Figure 1.

Illustration of the effect of cumulative-average NA on momentary drinking, presented by level of baseline coping (+/− 1 SD from the mean). Parameters used to generate the plot were extracted from Table 2.

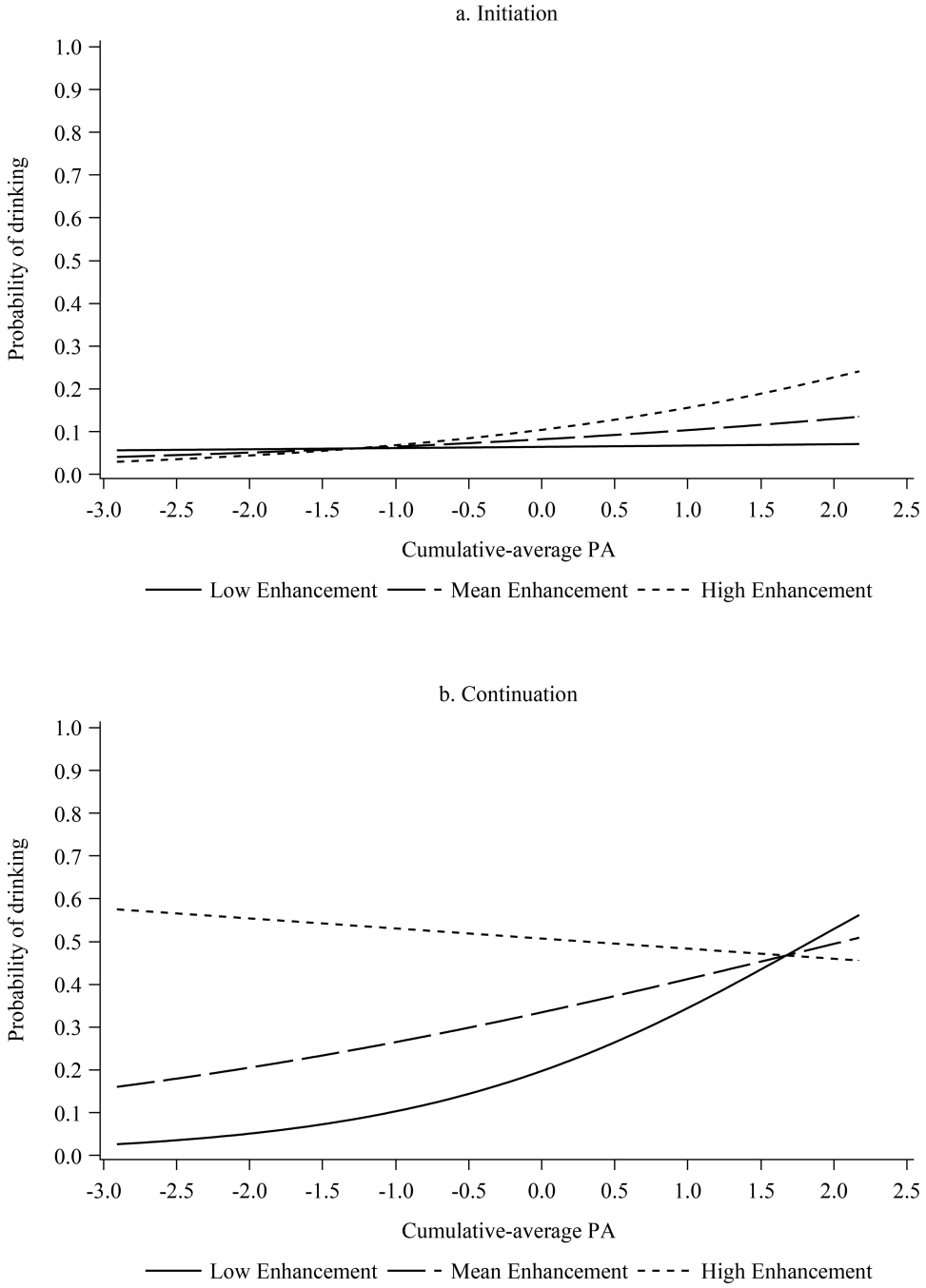

Figure 2.

Illustration of the effect of cumulative-average PA on momentary drinking, presented by level of baseline enhancement (+/− 1 SD from the mean) for a) the initiation phase of drinking and b) the continuation phase of drinking. Parameters used to generate the plot were extracted from Table 5.

Table 1.

Demographic data and co-occurring personality disorders for the total sample of 54 BPD participants.

	N	%
Ethnicity		
Caucasian	45	83.3%
Other	4	7.4%
African-American	3	5.6%
Hispanic	1	1.9%
Asian-American	1	1.9%
Marital Status		
Single or never married	39	72.2%
Married	7	13.0%
Divorced or separated	7	13.0%
Cohabitating	1	1.9%
Annual Income		
$0 to $25,000	42	77.8%
$25,001 to $50,000	6	11.1%
$50,001 to $75,000	2	3.7%
$75,001 to $100,000	2	3.7%
Above $100,000	2	3.7%
Current Axis-I Comorbidity		
Any Anxiety Disorder	35	64.8%
Any Mood Disorder	22	40.7%
Any Substance Use Disorder	21	38.9%
Any Eating Disorder	4	7.4%
Current Axis-II Comorbidity		
Any PD other than BPD	28	51.9%
Antisocial PD	11	20.4%
Avoidant PD	9	16.7%
Obsessive Compulsive PD	8	14.8%
Narcissistic PD	5	9.3%
Paranoid PD	6	11.1%
Schizotypal PD	1	1.9%
Dependent PD	2	3.7%
Histrionic PD	1	1.9%
Schizoid PD	0	0.0%

Note. PD = personality disorder, BPD = Borderline personality disorder.

Table 2.

Odds ratios and confidence intervals for coping and NA predicting momentary drinking (Model 1).

Effect	*OR*	*95% CI*	*p*
Intercept	0.05	[0.03, 0.07]	<.001
Main effects			
Momentary NA	0.71	[0.52, 0.99]	.042
Cumulative-average NA	0.84	[0.59, 1.22]	.336
Person NA	1.37	[1.00, 1.88]	.047
Coping	1.00	[0.97, 1.03]	.994
Interaction			
Cumulative-average NA × Coping	**1.08**	**[1.01, 1.15]**	**.023**
Covariates			
Age	0.98	[0.96, 1.00]	.018
Gender	0.64	[0.47, 0.85]	.003
Day of week (Reference = Saturday)			
Sunday	0.82	[0.56, 1.22]	.334
Monday	0.50	[0.32, 0.79]	.003
Tuesday	0.37	[0.24, 0.58]	<.001
Wednesday	0.68	[0.43, 1.06]	.087
Thursday	0.60	[0.40, 0.89]	.011
Friday	0.65	[0.46, 0.94]	.021
First day in the study	2.92	[1.70, 5.00]	<.001
Hour after wake	1.26	[1.23, 1.29]	<.001

Note. OR = odds ratio. CI = confidence interval. Effect of primary interest in bold.

Table 3.

Odds ratios and confidence intervals for enhancement and PA predicting momentary drinking (Model 2).

Effect	*OR*	*95% CI*	*p*
Intercept	0.03	[0.02, 0.05]	<.001
Main effects			
Momentary PA	1.77	[1.46, 2.13]	<.001
Cumulative-average PA	1.44	[1.11, 1.86]	.007
Person PA	1.18	[0.97, 1.43]	.089
Enhancement	1.17	[1.11, 1.22]	<.001
Interaction			
Cumulative average PA × Enhancement	**1.03**	**[0.94, 1.13]**	**.498**
Covariates			
Age	0.99	[0.97, 1.00]	.095
Gender	0.77	[0.56, 1.04]	.085
Day of week (Reference = Saturday)			
Sunday	0.86	[0.59, 1.25]	.424
Monday	0.50	[0.32, 0.79]	.003
Tuesday	0.35	[0.23, 0.55]	<.001
Wednesday	0.64	[0.42, 0.99]	.045
Thursday	0.60	[0.49, 0.88]	.010
Friday	0.63	[0.43, 0.90]	.012
First day in the study	3.03	[1.85, 4.98]	<.001
Hour after wake	1.27	[1.24, 1.30]	<.001

Note. OR = odds ratio. CI = confidence interval. Effect of primary interest in bold.

Table 4.

Odds ratios and confidence intervals for coping, NA, and phase predicting momentary drinking (Model 3).

	Initiation			Continuation		
Effect	***OR***	***95% CI***	***p***	***OR***	***95% CI***	***p***
Intercept	0.04	[0.03, 0.06]	<.001	0.28	[0.18, 0.44]	<.001
Main effects						
Momentary NA	0.87	[0.64, 1.19]	.399	0.87	[0.64, 1.19]	.399
Cumulative-average NA	0.87	[0.61, 1.23]	.419	1.12	[0.59, 2.13]	.733
Person NA	1.43	[1.08, 1.89]	<.001	1.43	[1.08, 1.89]	.014
Coping	0.98	[0.95, 1.00]	.080	1.06	[1.02, 1.10]	.003
Phase	7.08	[5.61, 8.94]	<.001	0.14	[0.11, 0.18]	<.001
Interactions						
Coping × Phase	1.09	[1.04, 1.14]	<.001	0.92	[0.88, 0.96]	<.001
Cumulative-average NA × Phase	1.29	[0.62, 2.71]	.500	0.77	[0.37, 1.62]	.500
Cumulative-average NA × Coping	1.04	[0.97, 1.12]	.234	1.16	[1.01, 1.32]	.030
Cumulative-average NA × Coping × Phase	**1.11**	**[0.95, 1.30]**	**.192**	**0.90**	**[0.77, 1.05]**	**.192**
Covariates						
Age	0.97	[0.96, 0.99]	<.001	0.97	[0.96, 0.99]	<.001
Gender	0.70	[0.55, 0.90]	.006	0.70	[0.55, 0.90]	.006
Day of week (Reference = Saturday)						
Sunday	0.70	[0.55, 1.12]	.174	0.70	[0.55, 1.12]	.174
Monday	0.59	[0.39, 0.88]	.009	0.59	[0.39, 0.88]	.009
Tuesday	0.46	[0.31, 0.68]	<.001	0.46	[0.31, 0.68]	<.001
Wednesday	0.79	[0.54, 1.16]	.226	0.79	[0.54, 1.16]	.226
Thursday	0.68	[0.47, 0.97]	.036	0.68	[0.47, 0.97]	.036
Friday	0.73	[0.52, 1.02]	.063	0.73	[0.52, 1.02]	.063
First day in the study	2.46	[1.57, 3.84]	<.001	2.46	[1.57, 3.84]	<.001
Hour after wake	1.17	[1.14, 1.20]	<.001	1.17	[1.14, 1.20]	<.001

Note. OR = odds ratio. CI = confidence interval. Initiation and Continuation columns represent parallel effects from the same model but recoding the phase of drinking. Phase was coded initiation = reference (0) for the Initiation column, and continuation = reference (0) for the Continuation column. Effect of primary interest in bold.

Table 5.

Odds ratios and confidence intervals for enhancement, PA, and phase predicting momentary drinking (Model 4).

	Initiation			Continuation		
Effect	***OR***	***95% CI***	***p***	***OR***	***95% CI***	***p***
Intercept	0.03	[0.02, 0.04]	<.001	0.15	[0.10, 0.23]	<.001
Main effects						
Momentary PA	1.80	[1.47, 2.21]	<.001	1.80	[1.47, 2.21]	<.001
Cumulative-average PA	1.29	[1.02, 1.63]	.031	1.40	[0.89, 2.18]	.143
Person PA	1.21	[1.03, 1.42]	.021	1.21	[1.03, 1.42]	.021
Enhancement	1.08	[1.04, 1.12]	<.001	1.24	[1.17, 1.31]	<.001
Phase	5.62	[4.51, 6.99]	<.001	0.18	[0.14, 0.22]	<.001
Interactions						
Enhancement × Phase	1.14	[1.08, 1.21]	<.001	0.87	[0.82, 0.93]	<.001
Cumulative-average PA × Phase	1.08	[0.68, 1.71]	.738	0.93	[0.59, 1.46]	.738
Cumulative-average PA × Enhancement	1.06	[0.99, 1.14]	.093	0.88	[0.78, 1.00]	.055
Cumulative-average PA × Enhancement × Phase	**0.83**	**[0.73, 0.95]**	**.006**	**1.20**	**[1.06, 1.37]**	**.006**
Covariates						
Age	0.98	[0.97, 1.00]	.015	0.98	[0.97, 1.00]	.015
Gender	0.87	[0.67, 1.13]	.301	0.87	[0.67, 1.13]	.301
Day of week (Reference = Saturday)						
Sunday	0.80	[0.57, 1.11]	.173	0.80	[0.57, 1.11]	.173
Monday	0.58	[0.40, 0.86]	.007	0.58	[0.40, 0.86]	.007
Tuesday	0.40	[0.28, 0.59]	<.001	0.40	[0.28, 0.59]	<.001
Wednesday	0.73	[0.51, 1.03]	.074	0.73	[0.51, 1.03]	.074
Thursday	0.70	[0.49, 0.98]	.041	0.70	[0.49, 0.98]	.041
Friday	0.71	[0.51, 0.99]	.044	0.71	[0.51, 0.99]	.044
First day in the study	2.57	[1.67, 3.97]	<.001	2.57	[1.67, 3.97]	<.001
Hour after wake	1.19	[1.16, 1.23]	<.001	1.19	[1.16, 1.23]	<.001

Note. OR = odds ratio. CI = confidence interval. Initiation and Continuation columns represent parallel effects from the same model but recoding the phase of drinking. Phase was coded initiation = reference (0) for the Initiation column, and continuation = reference (0) for the Continuation column. Effect of primary interest in bold.