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Daily mood-drinking slopes as predictors: A new take on drinking motives and related outcomes

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Abstract

Motivational models of alcohol consumption have articulated the manner in which positive and negative experiences motivate drinking in unique social contexts (e.g., [Cooper, Frone, Russell & Mudar, 1995](#)). Daily process methodology, in which daily events, moods and drinking behaviors are reported daily or multiple times per day, has been used to examine behavioral patterns that are consistent with discrete motivations. We advance the notion that repeated patterns of drinking in various social contexts as a function of positive or negative mood increases can provide evidence of individual-level if-then drinking signatures, which in turn can predict drinking-related outcomes. The purpose of this study was to examine the utility of slopes to predict longer term drinking motivations and alcohol problems, employing a daily process study of non-clinical moderate alcohol drinkers (N=47; 49% women). Participants responded to thrice daily interviews administered via handheld computer for 30 days, followed by a longitudinal telephone survey for 12 months. Participants' daily mood-drinking relationships were extracted from HLM and employed as predictors of 12-month outcomes in multiple regression analyses. Daily mood-drinking patterns demonstrated significant variability across persons, such that moderate drinkers could be reliably differentiated based on those patterns in terms of distinct drinking-related outcomes. Among the results, negative mood-solitary drinking slopes were associated with lower subsequent coping motives; yet, positive mood-solitary drinking slopes were predictive of higher coping and lower social motives. Conversely, positive mood-social drinking associations were predictive of higher enhancement motives and b-MAST scores. Results are interpreted in light of motivational models of consumption.

phrases: drinking motives, moderate drinking, mood-drinking slopes, daily process methodology, slopes-as-predictors

According to motivational models of alcohol consumption (e.g. [Cooper, Frone, Russell, & Mudar, 1995](#); [Cox & Klinger, 1988](#)), individuals drink to enhance positive emotional experiences and to cope with negative emotional experiences. Indeed, drinking behaviors are thought to be psychologically distinct with unique antecedents and consequences, and occurring in distinct social contexts. For example, it has been shown that experience-enhancement drinking is more closely associated with drinking in social than solitary settings, whereas coping-related drinking is more closely associated with solitary contexts (e.g., [Cooper et al., 1992](#), [Cooper, 1994](#); [Mohr et al., 2001](#)). Further, research has demonstrated that drinking motives significantly and uniquely predict alcohol abuse and alcohol-related problems, in some cases over and above levels of alcohol consumption (e.g., [Cooper et al., 1992](#); [Cooper et al., 1995](#); [Neighbors, Lee, Lewis, Fossos, & Larimer, 2007](#)).

Daily process methodology, in which daily events, moods and drinking behaviors are reported daily or multiple times per day, has been used to examine behavioral patterns that are consistent with distinct motivations for drinking. For example, studies have considered whether people drink more at times when negative experiences are greater relative to times when negative experiences are lesser ([Mohr et al., 2001](#); [Mohr et al., 2005](#); [Swendsen et al., 2000](#); [Hussong, Galloway, & Feagans, 2005](#)). These findings are consistent with one primary tenet of the Tension-reduction Hypothesis (TRH; [Conger, 1956](#)), which states that people drink when distressed. Such drinking behavior is reinforced due to alcohol's effectiveness at alleviating distress, as described by the other tenet of the TRH (also referred to as stress-response dampening; e.g., [Sher, 1987](#)). Drinking to enhance positive experiences is relatively less well-understood, though a similar mechanism is proposed whereby drinking enhances short-term positive affect, thereby reinforcing drinking behavior (e.g., [West & Sutker, 1990](#)). Importantly, daily process studies examining both positive and negative pathways have linked those experiences to distinct drinking behaviors, with negative experiences being more typically associated with solitary consumption and positive experiences predicting social consumption (e.g., [Mohr et al., 2001](#)). This methodology has the added benefit of enabling the investigation of the temporal relationships whereby mood changes occur prior to drinking behavior (e.g., [Affleck, Zautra, Tennen, & Armeli, 1999](#); [Tennen, Suls, & Affleck, 1991](#)).

Inherent in the daily process approach is the ability to study within-person mood-drinking slopes. Using repeated (diary) measures of both moods and drinking for each participant, multilevel regressions estimate an intercept and slope of that person's moods and drinking, which is equivalent to running a unique regression equation for each person ([Snijders & Bosker, 1999](#)). With person-centered data, these slopes demonstrate the extent to which Emily, for example, who is feeling sadder than she normally does at the end of a bad day might choose to drink more than usual at home alone. Evan, on the other hand, who is feeling similarly sadder than usual might instead choose to go directly home and forgo his usual post-work happy hour with friends, thereby drinking less than he typically does. In each case, behavioral consistency is revealed over time in terms of how individuals respond one way in a given set of situational and emotional contexts, but differently in another. The pattern of relationship between a given mood and drinking behavior is established on the basis of repeated observations over time, resulting in a slope estimate that is positive, negative or neutral (i.e., no relationship).

At the same time, clear individual differences can emerge from these investigations, as is revealed in our example of Emily and Evan. Different types of people may respond differently to the same socio-emotional context. Indeed, this argument is consistent with [Mischel and Shoda's \(1995\)](#) seminal work in which they describe personality as a series of stable yet distinctive if-then situation-behavior signatures. Whereas traditional personality work had presumed that personality or stable individual differences were revealed in cross-situational consistency, Mischel and Shoda argued that researchers have to match the expected behavior with a given context. That is, an Extravert might not be extraverted in every context (especially ones where it might not be socially appropriate), but rather those that specifically call for or afford extraverted behavior. In the same way, we argue that it is revealing to consider repeated patterns of drinking in various social contexts as a function of discrete moods as evidence of individual-level if-then drinking signatures.

We advance the notion that these within-person associations (if-then drinking signatures) can be considered as predictors of outcomes. As endorsement of drinking motives has been linked with subsequent alcohol-related outcomes, we believe within-person slopes describing mood and subsequent drinking behavior can also predict outcomes. Returning to our example, we might expect that Emily's increased drinking on a sadder mood day might be more problematic in the long-term than Evan's decreased drinking on a sad day. Indeed, individuals reporting drinking to cope with stress demonstrate greater levels of consumption ([Cooper et al., 1995](#)) or frequency of drinking to intoxication ([Tyssen, Vaglum, Aasland, Gronvold, & Ekeberg, 1998](#)) than their counterparts and report a higher prevalence of alcohol problems ([Cooper et al., 1995](#)). Those who endorse drinking to enhance positive experiences also demonstrate greater alcohol use. Such motives are also typically associated with alcohol-related problems, though that relationship is at least partially mediated by the greater alcohol use that enhancement motives engender (e.g., [Cooper et al., 1995](#); [Stewart, Loughlin, Rhyno, 2001](#)). However, to our knowledge no study has examined the extent to which

actual daily drinking patterns (as evidenced in within-person slopes) predict subsequent outcomes. So, for example, to what extent do daily negative mood-drinking patterns predict later alcohol-related problems?

As Nesselroade and colleagues have effectively demonstrated, intraindividual variability, such as the day-to-day fluctuations between moods and drinking captured in our within-person mood-drinking slopes, independently and uniquely predicts outcomes, over and above mere levels of a particular variable (such as mean levels of mood or drinking, or even mean endorsement of drinking motives). Indeed, studies examining within-person variability in factors that are dynamic, with substantial fluctuation (e.g., pain, mood) have shown they can reliably predict significant health outcomes including well-being and mortality (Nesselroade, 2004; Nesselroade & Salthouse, 2004). Typically, studies employing daily process methodology pool individual slope estimates to provide average within-person associations for a variety of motivated drinking patterns (i.e., stress-related or positive experience-enhancement drinking), thereby obscuring the individual patterns of responding. Efforts to glean any differences in drinking patterns typically come in the form of tests for moderation effects by subgroups (e.g., women, Extraverts), where the within-person slopes are modeled as the outcomes. It is this approach that has been applied to link daily experience-drinking patterns to endorsement of discrete drinking motives. For example, the question of whether people who more strongly endorse drinking-to-cope motives also drink more on a daily basis in response to negative experience has been of focal interest (e.g., Mohr et al., 2001; Mohr et al., 2005; Todd et al., 2003, 2005). Yet, this previously employed approach does not allow researchers to predict later outcomes from within-person slopes while controlling for baseline or initial levels of the outcome variable. It is important to control for baseline effects on the outcome, so that any effects we observe on the follow-up outcome levels are independent of preliminary levels of that variable (Cohen, Cohen, West & Aiken, 2003). For example, associations between within-person slopes at an earlier time point predicting drinking motive endorsement at a later time point (while controlling for initial levels of that motive), have yet to be explored.

Modeling within-person associations as predictors is novel. We are aware of only a few such studies that have employed within-person slopes as predictors. In the most relevant pair of studies (Cohen et al., 2008; Gunther, Cohen, Butler, & Beck, 2005), researchers used within-person negative affect reactivity (i.e., same-day and next-day negative affect response to daily stressors) to predict responsiveness to cognitive therapy, finding that those participants who had greater next-day spillover responded less quickly to therapy. Together, these arguments support the notion that mood-related drinking slopes, as captured by daily process methodology, can be used to predict outcomes, over and above baseline levels.

Given that previous research on drinking motives and outcomes (e.g., Cooper et al., 1995) has revealed a unique relationship between coping motives and alcohol problems, we predicted that individuals with stronger negative mood-solitary drinking slopes would demonstrate more negative outcomes relative to those with weaker slopes. At the same time, individuals with stronger positive mood-social drinking slopes (consistent with enhancement motives) may also demonstrate higher levels of negative outcomes relative to their counterparts with weaker slopes, which is likely due to the relatively larger amounts of alcohol they consume. We also examined the extent to which within-person slopes were directly associated with endorsement of drinking motivations over a longer period; motivations which are theorized to underlie behavioral drinking patterns. Typically, studies examining correspondence between motive endorsement and drinking patterns look at drinking motivations immediately preceding daily diaries (e.g., Todd et al., 2003; Mohr et al., 2005; see also Mohr et al., 2009). However, there is an emerging interest in considering the longer term interrelationships among motives and drinking behavior. Recently, Crutzen, Kuntsche, and Schelleman-Offermans (2012) demonstrated positive relationships between drinking motives and subsequent drinking behavior (3 months later), and reciprocally, the predictive influence of drinking behavior on subsequent motives. Crutzen et al. (2012) describe these interrelationships as being consistent with a feedback process, whereby drinking behavior informs drinking motives, which in turn influence subsequent drinking behavior as described by motivational models (see also Cox & Klinger, 1988; Kuntsche, Knibbe, Gmel, & Engels, 2006).

Thus, the purpose of this study was to investigate the extent to which positive and negative mood-drinking slopes were predictive of drinking motives and alcohol-related problems one year after a 30-day diary

period, while controlling for initial levels of each outcome variable. One focus of our work is to better understand drinking motives and drinking behavior in the general adult population, relationships which are less well-understood than among problem drinkers ([Crutzen et al., 2012](#)). As such, we explicitly recruited a non-clinical sample of participants for the present study, excluding individuals who met criteria for alcohol abuse or dependence and retaining those who were drinking at or above daily recommended levels for consumption (e.g., [Dufour, 1999](#)). This provided for the consideration of whether potentially risky behavior (e.g., drinking above recommended limits, drinking more on higher negative mood days) might predict onset of later problems. Participants reported on moods and drinking behavior multiple times per day to allow for estimation of temporal associations, whereby mood fluctuations preceded drinking behavior.

Method

Participants

Participants were 49 moderate-to-heavy drinkers (49% women) recruited from a North American metropolitan area using Internet/community bulletin boards and newspapers. Eligible individuals did not meet alcohol abuse criteria (within 5 years) or lifetime dependence, report recent use of illicit substances, or demonstrate significant signs of clinical depression/suicidality. In terms of daily drinking patterns, moderate-to-heavy drinking was defined as at least 2 drinks per day on average, and 6+ per week for women; and 3 drinks per day and 12+ per week for men (see [Dufour, 1999](#)). Participants were 36 years old on average ($SD=17.32$) and at least 21 years old at the time of informed consent and most were European-American (89%). Whereas 40% were married or cohabiting, another 47% were never married and 13% were divorced/widowed. A majority of participants worked (78%), 56% of which worked full-time, with a median annual income of \$27,001 - \$44,000.

Study Overview

Potential participants were first screened via a brief telephone survey (which included the brief MAST; [Pokorny, Miller, & Kaplan, 1972](#)), and then a second in-person meeting during which they completed the Computerized Diagnostic Interview Schedule-IV (C-DIS; [Robins et al., 2000](#)). If eligible, they completed the informed consent process and an initial baseline web-based survey, and were then trained with the handheld electronic interviewer (ELI) device. Following the in-person meeting, participants answered surveys three times per day (i.e., 10:00-11:30 a.m., 4:00-5:30 p.m. and 8:30-10:00 p.m.) for 30 days by responding to the audible alert that was programmed to sound randomly within each time window. A vibration feature was also offered by the Palm Pilot model used in the present study (Tungsten T3), providing a silent alert/delay for up to three hours. Participants could also briefly delay the survey if unable to complete the survey when the alarm sounded. Each electronic survey took approximately 5 minutes to complete. Following the 30-day diary study, participants were enrolled in a follow-up study in which they were interviewed via telephone every 3 months until the 12-month follow-up. For purposes of the present study, we focused our analyses on the 12-month follow-up data, given that this final follow-up session included all of the key study outcome variables. Further, the 12-month window offered the most conservative test we had available for our slope predictors.

Daily Process Procedure and Measures

Of the 49 individuals who were consented to the study, 47 (96%) provided usable ELI data. Two individuals (1 man, 1 woman) provided ELI data that was determined to be unusable because of values that could not be interpreted and corrupt data files that could not be restored due to apparent technical malfunctions with the handheld device they used. Compliance to the daily protocol was computed by dividing the total possible daily surveys (47 individuals \times 90 surveys = 4230) into the actual number of completed surveys (3510), resulting in a compliance rate of 83%. This rate is comparable to the rate achieved in other published daily process studies ([Hufford, Shields, Shiffman, Paty, & Balbanis, 2002](#);

[Mohr et al., 2005](#)). A majority (28 participants) completed at least 85% of the possible 90 surveys; while one person completed 28% of the possible surveys (i.e., just over 1 week of data).

Positive and Negative Moods

Participants rated their current mood on a range of 10 *positive* and *negative mood* items taken from the Positive and Negative Affect Schedule (PANAS; [Watson & Clark, 1994](#)) and mood circumplex ([Larsen & Diener, 1992](#)). Positive mood example items included *enthusiastic*, *happy*, and *relaxed*. Negative mood included such items as *sad*, *angry* and *nervous*. Discrete negative moods were aggregated to create a composite negative mood score for each time interval; similar procedures were followed to create a positive mood score. Due to the nested structure of the data, it was appropriate to obtain a within-day level of internal consistency for each interview. Internal consistencies at day 7 for the morning, afternoon, and evening interview were .75, .74, and .72, respectively. Similarly, at day 15, internal consistencies were .78, .75, and .64. Finally, at day 23 internal consistencies were .72, .73, and .82.

Alcohol Consumption

Participants entered the number of alcoholic drinks they consumed during each interval, according to drinking context. Participants were instructed on how to identify number of standard drinks ([Sobel & Sobel, 1992](#)), with one drink equaling one 12-oz. beer, one 5-oz. wine, and one 1 ½ oz. hard liquor ([Dufour, 1999](#)). Response options ranged from 0 drinks to 12 drinks, and greater than 12 drinks for each location. After indicating whether drinking occurred in a *home* or *away* context, participants further specified (checking all that applied) whether they were “Alone,” “Interacting with others who were drinking,” “Interacting with others who were not drinking,” “Not interacting and others were not drinking,” or “Not interacting and others were drinking.” In the case of multiple interacting contexts, participants were asked to specify the number of drinks consumed in each interacting context. The question timeframe varied by time of interview, such that the morning interview probed drinking occurring last night¹; the early evening interview probed drinking today; and the (later) evening interview probed drinking since the last interview.

For purposes of the present study, analyses examined drinking at home alone (i.e., Drinks Home Alone) and drinking away while interacting with others who are also drinking (i.e., Drinks Away/Others) as the most common drinking contexts and also those that best correspond to solitary and social drinking, respectively (see [Mohr et al., 2001](#)). We determined that there were too few cases of solitary drinking falling outside of the home alone context to include in this analysis. That is, there were only 15 drinks consumed in 8 instances across all participant days for drinks at home while not interacting with others, which precluded our ability to determine if these drinks were statistically distinct from drinks home alone before combining them. Similarly, there were 37 drinks consumed across 27 occasions of drinking away while interacting with others who were not drinking (the other potential social context represented in our data). Interpretation of this category of drinking may be distinct, given social influence processes present when drinking with others who are also drinking (e.g., [Bullers, Cooper & Russell, 2001](#)); as such, consistent with previous practice ([Mohr et al., 2001](#)) we did not include these drinks in our assessment of social drinking. This approach affords the clearest interpretation of the slopes. Further, because the interview probed all drinking that occurred (in all contexts), it was also possible to detect when participants drank in both social and solitary contexts at home or away from home during one time period. Preliminary data analysis revealed that there were a total of 64 drinks at home consumed in multiple combinations of social interaction partners and a total of 72 drinks away from home. Because the purpose of the present paper was to consider the unique antecedents of drinking in particular contexts, it was important not to introduce ambiguity by allowing for varying combinations of social interaction partners (see [Mohr et al., 2001](#)). Thus, time periods during which drinking occurred across multiple drinking contexts were excluded from slope estimates.

Twelve-Month Follow-up Procedure and Measures

Twelve months after the completion of the daily process study, 41 of the original participants responded to a telephone interview. The survey lasted approximately 45-60 minutes and examined a variety of health and well-being outcomes. Overall compliance for the twelve-month survey (84%) was comparable to other longitudinal studies investigating alcohol consumption (e.g., 74.7% of community sample adults; [Aneshensel & Huba, 1983](#); 80% of mature adults; [Perreria & Sloan, 2001](#)). The eight participants who did not participate in the twelve-month survey either withdrew from the study due to time constraints or were unable to be contacted via email or phone. No significant differences emerged, however, between those participants who completed the survey and those who did not across all participant characteristic variables (e.g., gender, income level).

Drinking Motives

Drinking motives were assessed via the Drinking Motives Questionnaire (DMQ; [Cooper et al., 1992](#)). The DMQ is a 15-item frequency measure with good internal consistency that examines social ($\alpha=.80$), coping ($\alpha=.82$), and enhancement ($\alpha=.88$) drinking motives using 5 items each. Participants were asked to indicate “how often do you drink” for each motive on a 5-point frequency scale (0 = *Never*, 4 = *Very Often*). Sample items include “I drink to be sociable” for the social drinking motive, “I drink to relax” for the coping drinking motive, and “I drink to get high” for the enhancement drinking motive. Items were also administered in the baseline survey (prior to the start of the daily diary), using the same reference of “how often do you drink,” with internal consistencies of: social ($\alpha=.80$), coping ($\alpha=.76$), and enhancement ($\alpha=.88$).

Alcohol-related Problems

The 10-item brief *Michigan Alcohol Screening Test (b-MAST)*; [Pokorny et al., 1972](#)) was administered to assess alcohol-related problems. Participants indicated the presence or absence of each problem by answering yes or no for each of the 10-items in the checklist, such that affirmative responses for these items indicated alcohol-related problems. Example items include: “Have you ever lost friends, girlfriends/boyfriends because of drinking?” and “Have you ever had delirium tremens (DTs), severe shaking, heard voices or seen things that weren’t there after heavy drinking?”

Quantity of Drinking

Current drinking level (at the 12-month follow-up) was assessed in terms of typical number of drinks per day in the past 30 days (DDD) and largest number of drinks per day in the past 30 days (Max-DDD) ([Armor, Polich & Stambul, 1978](#); see also [Sobell and Sobell, 1995](#)). Participants indicated number of drinks in a free response format for each item.

Data Analyses

Due to the nested structure of the daily data (multiple observations within persons) and because participants provided different numbers of observations (due to missing diary interviews), we used the Hierarchical Linear Modeling (HLM) program (v6.0; [Raudenbush, Bryk, Cheong, & Congdon, 2004](#)) to compute within-person mood-drinking slopes. Specifically, each participant’s drinking intercept is modeled, along with their average mood-drinking slope, which is estimated from the (up to) 60 daily observations recorded per person. In other words, this analytic technique produces an intercept and slope for each individual that is constructed into the equivalent of a unique regression equation for each person (see [Park et al. 2004](#) for an example). Further, this program is designed to retain all cases (no listwise or pairwise deletion), and weights cases by the number of data points ([Raudenbush & Bryk, 2002](#)). Thus, our within-person slopes represent a consistent pattern of response (drinking in relation to mood changes) based on repeated observations over time.

In order to obtain the individual within-person slopes, we modeled number of drinks as an outcome of person-centered values for t-1 positive and negative moods, controlling for time of day and day of week effects (see [Bryk & Raudenbush, 1992](#), p. 151). In addition, upon examination of the frequencies of the daytime and evening drinking behaviors it became evident that most participants did not drink during the daytime/work hours. This is not surprising as 78% were employed and likely did not have the opportunity to report daytime drinking at home because they were working; consequently, the dataset contained structural zeros which did not contribute to the likelihood function or model fitting ([Berger & Zhang, 2005](#)). In addition, empirical evidence has indicated that in samples of moderate-to-heavy drinkers the vast majority of the drinking takes place in the evening hours (see [Swendsen et al., 2000](#)). As a result, the second daily interview was not included as an assessment of drinking in this analysis, resulting in a total of 60 potential observations per person as noted above. Thus, two timeframes were retained: daytime moods predicting early evening consumption, and early evening moods predicting later evening consumption.

Slopes were modeled as random effects, and were therefore allowed to vary across individuals. We used a Poisson sampling model in our multilevel regression analysis, which is specifically designed for count outcome data, such as number of alcoholic drinks ([Raudenbush & Bryk, 2002](#); see also [Mohr et al., 2001](#)). Finally, we extracted individual mood-drinking slopes from the HLM residuals file ([Raudenbush & Bryk, 2002](#)) and then merged them with the follow-up data. This enabled us to model within-person mood-drinking slopes as predictors of future drinking motive levels and alcohol-related problems, while controlling for pre-diary differences in initial levels of the outcome variables, in an ordinary least-squares (OLS) regression analysis.

Results

Prior to conducting the OLS regression analysis, it was critical to first inspect the HLM results for evidence of significant variability in within-person slopes, which would indicate the presence of individual differences in slopes ([Raudenbush & Bryk, 2002](#); [Snijders & Bosker, 1999](#)). Variance components for both positive mood- and negative mood-Drinks Home Alone slopes were significant (.270, $p < .05$ and 1.16, $p < .01$, respectively). Similarly, the variance components for moods predicting Drinks Away/Others were also significant (.21, $p < .05$ and .34, $p < .001$, for Negative and Positive mood-Drinks Away/Others relationships, respectively). Thus, with significant variance components for all mood-drinking slopes (i.e., connoting the presence of individual differences in each mood-drinking slope), it was appropriate to proceed with our slopes-as-predictors analysis.

Descriptive Statistics

Participants consumed a mean of 1.71 ($SD=1.31$) Drinks Home Alone per evening (across the two drinking intervals) during the 30-day study, with a range of 1-9 drinks. They consumed a mean of 2.97 ($SD=2.56$) Drinks Away/Others per evening during this same period (range of 1-17 drinks). Total number of drinks across all social contexts (including those not probed in this investigation) ranged from 1-30 on drinking evenings ($M=2.94$, $SD=2.98$). Number of drinking evenings ranged from 3-30 across the all social contexts ($M=17.66$, $SD=7.30$), with participants recording Drinks Home Alone on 6.97 evenings ($SD=7.83$), and Drinks Away/Others on 6.25 evenings ($SD=4.12$). Thirty-two of our daily participants consumed Drinks Home Alone, whereas 44 consumed Drinks Away/Others during the 30-day period. At the 12-month follow-up, participants reported drinking an average of 2 drinks per day ($SD=1.3$), with a mean maximum of 6.1 drinks on a day during the past 30 days ($SD=4.2$; range=1-18). Four participants reported drinking less than 1 drink per day.

As an additional source of descriptive information, we inspected the pooled within-person slope estimates generated in HLM. Results revealed that the average within-person Negative Mood-Drinks Home Alone association was significant and positive ($b=.56$, $p < .05$). Thus, the typical person in our sample drank more at home alone on days with higher negative mood (compared to days with lower negative mood). By contrast, the average within-person slope for Positive Mood-Drinks Home Alone was not significant ($b=-$

.11, $p > .10$). The average within-person associations for both mood-drinking away relationships were significant. On average, participants drank more away following increases in positive and negative moods ($b=.63$ and $b=.73$, $ps < .001$, respectively) relative to times when such moods were lower. Finally, we also considered the potential presence of outliers by inspecting the standardized mood-drinking scores. In no case was there a standardized score lower than -3.29 or greater than 3.29 (Tabachnik & Fidell, 2007), allowing us to proceed with the subsequent data analysis.

We also examined potential individual or demographic differences in mood-drinking slopes in HLM. First of all, there was no significant gender or marital status difference revealed among all four mood-drinking slopes. Differences emerged, however, as a function of parent status for both mood-Drinks Away/Others slopes ($\gamma = 1.23$, $p < .01$ and $\gamma = 1.55$, $p < .05$, for positive and negative mood-drinking slopes respectively). Specifically, parents had significantly stronger Positive Mood-Drinks Away/Others slopes ($b=2.00$, $p < .001$) relative to non-parents ($b=.76$, $p < .01$). Similarly, parents experienced stronger Negative Mood-Drinks Away/Others slopes ($b=2.42$, $p < .01$) relative to non-parents ($b=.87$, $p < .01$). Mood-Drinks Home Alone relationships, however, were similar for parents and non-parents. Analyses also revealed that age significantly moderated both Positive and Negative Mood-Drinks Away/Others slopes ($\gamma = .03$, $p < .01$ and $\gamma = .05$, $p < .01$, respectively), such that older participants were more likely to engage in Positive and Negative Mood-Drinks Away/Others ($b=2.38$ and 3.48 , $p < .001$) compared to their younger counterparts ($b=1.37$ and 1.91 , $p < .001$). There were no significant differences in mood-drinking slopes based on employment status, hours of work per week, number of adults living in the home, education or income level.

Finally, an inspection of correlations between mood-drinking slopes (see Table 1), reveals significant and positive associations between the two mood-drinking slopes for a given drinking context. Specifically, those participants who engaged in more Positive Mood-Drinks Home Alone, also drank more home alone when negative mood was higher. Similarly, those who drink away with others tended to do so in response to both increases in negative and positive mood. Correlations with baseline and follow-up outcome variables, along with mean levels of all study variables are provided in Table 1.

	M	SD	1	2	3	4	5	6	7	8	9	
1. Coping Motives (Initial)	2.19	.72										
2. Social Motives (Initial)	3.51	.82	.28 [†]									
3. Balance Motives (Initial)	2.85	.81	.35 ^{***}	.41 ^{***}								
4. Coping Motives (12 Months)	2.29	.80	.38 ^{***}	.29 [†]	.36 [†]							
5. Social Motives (12 Months)	3.19	.72	.28 [†]	.32 [†]	.35 [†]	.35						
6. Balance Motives (12 Months)	2.69	.84	.65 ^{***}	.27 [†]	.66 ^{***}	.51 ^{***}	.47 ^{***}					
7. MAST (Initial)	.46	1.14	-.01	-.03	-.06	.27	-.16	-.32				
8. MAST (12 Months)	1.73	3.43	.05	-.17	-.09	.27	-.16	.21	.25			
9. DDD (12 Months)	2.03	3.32	.34 [†]	.02	.19	.39 [†]	.06	.33 [†]	-.05	-.31		

Table 1
Intercorrelation matrix and descriptive statistics

Prediction from Mood-drinking Slopes

Linear regressions were performed in which 12-month follow-up outcomes were regressed first on the baseline (i.e., prior to daily study) level of the outcome variable, as well as concurrent drinking level. In a second step, mood-drinking slopes were entered into the regression equation. Analyses were conducted separately for Drinks Home Alone and Drinks Away/Others.

Drinking Motives

Our first set of outcomes examined the relationship between mood-drinking slopes and drinking motives, as depicted in [Table 2](#). Specifically, we regressed 12-Month Follow-up coping motives on DDD and baseline motives, $F(2, 36) = 5.31, p < .05$. In the second step, the inclusion of mood-Drinks Home Alone slopes resulted in a significant model [$F(4,34)=6.66, p < .001$], with a significant increase in adjusted R^2 from model 1 of .19 to .37, $F(2,34) = 6.42, p < .01$. As shown in [Table 2](#) under Model 2, people with stronger Negative Mood-Drinks Home Alone slopes reported significantly lower levels of coping motives compared to those with weaker such slopes ($b=-.61$). Conversely, those with stronger Positive Mood-Drinks Home Alone slopes reported significantly higher levels of coping motives a year later compared to their counterparts ($b=1.02$). Mood-Drinks Away/Others slopes (Model 3) did not reveal a similar pattern; the increase of Drinks Away/Others slopes did not significantly increase the adj. R^2 from Model 1 (.19 vs. .20)[$F(2,34) = 1.29, p > .10$].

Predictors	Coping Motives			Social Motives			Enhance Wt	
	b	t	SPE ²	b	t	SPE ²	b	t
Model 1:								
DDD-Post 30	.18	1.52	.08	.03	.37	.00	.14	1.83 [†]
Motives-Base	.32	1.82 [†]	.07	.36	1.96 [†]	.10	.67	5.49 ^{***}
Model 2:								
DDD-Post 30	.18	2.17 [†]	.08	.01	.09	.00	.12	1.64
Motives-Base	.22	1.45	.03	.51	2.78 [†]	.17	.65	5.19 ^{***}
Pos. Mood-Drinks Home Alone	1.02	2.39 [†]	.09	-.23	-2.76 [†]	.15	.05	.32
Neg. Mood-Drinks Home Alone	-.61	-3.47 ^{***}	.29	.14	.73	.08	-.20	-1.26

[Table 2](#)
12-Month Drinking motives as a function of baseline motives and concurrent DDD (Model 1) and mood-drinking slopes (Model 2).

In the next set of analyses, we regressed 12-month follow up social motives on drinks per drinking day (DDD) and baseline motives [$F(2,36) = 2.02, p > .10$], revealing only a marginal relationship between baseline and 12-month social motives. The inclusion of Drinks Home Alone slopes in Model 2 resulted in a significant model [$F(4,34)=3.04, p < .05$, and a significant increase in adj. R^2 from .05 to .18 at $F(2,34) = 3.76, p < .05$. As depicted in [Table 2](#), individuals with stronger Positive Mood-Drinks Home Alone slopes reported significantly lower endorsement of social motives at follow-up than those with weaker such slopes ($b=-1.23$). Mood-Drinks Away/Others slopes (Model 3) did not reveal a similar pattern, as Model 3 was not significant at $F(4,34)=1.92, p > .10$.

We then regressed 12-month follow-up enhancement motives on DDD and baseline motives [$F(2,36)=19.32, p < .001$], revealing a significant association between baseline and follow-up enhancement levels. The subsequent inclusion of mood-Drinks Home Alone slopes did not significantly increase the adj. R^2 for enhancement motives (both .49)[$F(2,34)=.95, p > .10$], such that mood-Drinks Home Alone associations were not associated with follow-up levels of enhancement motives. However, inclusion of mood-Drinks Away/Others relationships in Model 3 did increase the adj. R^2 (.49 vs. .55)[$F(2,34)=3.20, p = .054$]; the model was significant at $F(4,34)=12.44, p < .001$. In the case of enhancement motives, stronger Positive Mood-Drinks Away/Others relationships were associated with significantly higher levels of enhancement ($b=.90$). Conversely, stronger Negative Mood-Drinks Away/Others relationships were predictive of significantly lower levels of enhancement at follow-up ($b=-.74$).

Because of the previously documented relationships between parental status and age and our slopes (in the descriptive statistics section), we reran the above models where significance had been achieved, including those variables as control variables. The results were highly similar to the models reported above; in no case did significance or interpretation of effects change. In sum, mood-drinking slopes were significantly predictive of follow-up levels of all three drinking motives. Mood-Drinks Home Alone slopes were associated with endorsement of both coping and social motives, depending on mood valence, whereas mood-Drinks Away/Others slopes were associated with endorsement of enhancement motives.

b-MAST

Although our sample was a relatively healthy one (i.e., screened for alcohol-related problems at baseline), we considered it worthwhile to investigate whether they might show significant levels of problems at follow-up (as assessed via the b-MAST). Recall that participants were screened for drinking levels, such that they were drinking at or above recommended daily limits (as described above). At baseline, fully 84% of our sample attained a b-MAST score of 0, with zero of our participants scoring at 6+ (i.e., clinically significant). At the 12-Month Follow-up, 71% scored 0, 19.5% scored between 2-5, and over 9% ($n=4$) scored 6+. Thus, there was some evidence for alcohol-related problems at follow-up among a subset of participants, although the actual number of individuals affected was relatively small. Indeed, a paired samples t -test revealed a significant difference in b-MAST scores from baseline ($M=.46$, $SD=1.14$) to follow-up ($M=1.73$, $SD=3.45$) at $t(41)=-2.43$, $p < .05$. We examined participant drinking levels as a function of 12-Month b-MAST scores, finding that groups were significantly different at $F(2,38) = 8.18$, $p=.001$, such that those with clinically significant b-MAST scores of 6+ drank a significantly larger amount on their Max-DDD days ($M=13$, $SD=6.22$) compared to those who had sub-clinical scores ($M=5.37$, $SD=4.44$) or a 0 on the b-MAST ($M=5.31$, $SD=2.93$). Thus, we included the Max-DDD as a control variable in the regression analysis.

In the first model examining b-MAST scores, we regressed 12-Month Follow-up b-MAST scores on baseline b-MAST (collected during the telephone screening) and Max-DDD (see [Table 3](#)). Model 1 was significant at $F(2,37)=7.59$, $p < .01$, whereby Max-DDD but not baseline b-MAST scores were significantly associated with Follow-up scores. The inclusion of mood-Drinks Home Alone did not significantly improve the adj. R^2 (.25 vs. .27)[$F(2,35)=1.32$, $p > .10$]. Thus, neither mood-Drinks Home Alone associations were significantly associated with increases in b-MAST scores. Yet, the inclusion of mood-Drinks Away/Others did significantly increase the adj. R^2 (.25 vs. .41)[$F(2,35)=5.87$, $p < .01$], with a model significance of $F(4,35)=7.73$, $p < .001$. As revealed in [Table 3](#), stronger Positive Mood-Drinks Away/Others slopes were significantly predictive of follow-up b-MAST scores ($b=7.41$).

Predictors	b	t	sig ²
Model 1:			
Max DDD	.46	3.45 ^{***}	.02
MAST-base	-.76	1.35	.08
Model 2:			
Max DDD	.56	3.70 ^{***}	.00
MAST-base	-.77	1.56	.08
Pos.Mood-Drinks Home Alone	2.23	.86	.02
Neg.Mood-Drinks Home Alone	.83	.79	.04
Model 3:			
Max DDD	.56	3.70 ^{***}	.00
MAST-base	-.77	1.56	.08
Pos.Mood-Drinks Home Alone	7.41	2.81 ^{**}	.01
Neg.Mood-Drinks Home Alone	1.16	.43	.34

[Table 3](#)
12-Month MAST as a function of concurrent Maximum DDD and MAST-base (Model 1) and mood-drinking slopes (Models 2 and 3).

As with drinking motives models, we reran the significant MAST model including parental status and age as control variables. Once again, the Positive Mood-Drinks Away/Others finding remained significant with the inclusion of parental status and age.

Discussion

Our results affirm the use of within-person slopes as an individual difference factor to predict alcohol-related outcomes over time. Significant variance was revealed in all within-person slopes we examined, thereby documenting the presence of individual differences in the extent to which people drink in different

social contexts in response to a given mood. Both positive- and negative- mood-drinking patterns were predictive of outcomes, depending on social context of consumption, though findings are sometimes counterintuitive. For example, negative mood-drinking home alone relationships were associated with weaker endorsement of coping motives at follow-up. Conversely, positive mood-drinking home alone relationships were associated with stronger endorsement of coping motives and weaker endorsement of social motives. Interestingly, positive mood-drinking away slopes were predictive of higher follow-up b-MAST scores and stronger enhancement motives. Negative mood-drinking away slopes were only predictive of (weaker) enhancement motives.

Although endorsement of coping motivations is typically associated with negative outcomes (e.g., [Cooper et al., 1995](#)), in our study, individuals who showed stronger negative mood-solitary drinking relationships did not demonstrate significant alcohol-related problems (on the b-MAST) at the one year follow-up. Further, individuals with stronger negative mood-solitary drinking slopes endorsed weaker coping motives one year later, compared to their counterparts. Our results join a growing body of research (e.g., [Mohr et al., 2010](#); [Todd et al., 2005](#)) comparing mood-drinking slopes and coping motives, finding that although slopes are related to motives, they are not typically in the expected direction, such that those who endorsed stronger coping motives would also show a stronger within-person negative experience-drinking relationship. Instead, these findings point to the likelihood that the mood-drinking slopes are not directly capturing drinking to cope (particularly as motives are not inferred on the daily level), but rather capturing drinking that occurs as a by product of the stress and coping process – one that happens to be potentially adaptive, at least in a non-clinical sample². Instead, we propose that negative mood-solitary drinking patterns may be more indicative of a related process, such as work recovery ([Meijman, & Mulder, 1998](#); [Repetti, 1992](#)), in which some people socially withdrew on more stressful days to rejuvenate. For individuals who are heavier drinkers or who are developing alcohol problems, such a pattern would likely be related to increasing alcohol problems. Thus, it is important not to generalize our findings to samples beyond the non-clinical general population (a sample screened for significant mental health issues or suicidality).

Another potential explanation can be gleaned from the stress-response dampening (SRD) effects of alcohol (e.g., [Sher, 1987](#)), as described by one of the tenets of the Tension-reduction Hypothesis ([Conger, 1956](#)). That is, people drink *because* they perceive that it relieves stress. What our individual differences may be capturing, in part, is the extent to which alcohol is effective in alleviating an individual's negative moods. Daily process research has shown that solitary drinking tends to exacerbate, rather than ameliorate negative moods ([Armeli et al., 2003](#)) due to alcohol myopia ([Steele & Josephs, 1990](#)) wherein solitary engagement would focus one's cognitive resources more acutely on the stressor instead of distracting one's attention away from it (thereby alleviating the stress). Thus, our participants who engaged in more solitary drinking on a stronger negative mood day may have found it to be relatively ineffective, in which case they reported subsequently lower levels of coping motives than their counterparts. There are also other individual differences, such as personality and physiology that contribute to differences in SRD effects (for reviews see [Greeley & Oei, 1999](#); [Sayette, 1999a, 1999b](#); [Sher, 1987](#)). Such differences may partly explain these findings, such that those with greater SRD effects are those with stronger (positive) relationships to coping motives and related problems. Future research should study the role of SRD in determining outcomes associated with mood-drinking slopes.

Our results also revealed that mood-drinking away with others (i.e., social drinking) slopes were predictive of subsequent levels of enhancement motives, whereby positive mood relationships were associated with higher levels of enhancement motives, as would be expected. Further, negative mood relationships were associated with lower levels of subsequent enhancement motives. Our results are consistent with the notion that enhancement motives are driven by “predispositions to seek positive rewards” ([Cooper, Kuntsche, Levitt & Barber, 2010](#)), or in the case of the present study, to continue or prolong a positive experience. People drink to enhance to the extent that they hold expectancies that drinking will enhance their emotional experience ([Cooper et al., 1995; 2010](#)). Further, positive mood-drinking away was significantly predictive of higher b-MAST scores, which coincides with research linking enhancement motivations to alcohol abuse ([Cooper et al., 1992; 1995](#)). At the same time, such relations are thought to occur due to level of consumption; once level is accounted for, enhancement typically does not relate directly to alcohol

problems ([Cooper et al., 1992](#)). In line with this potential, our drinking levels for away with others were higher than solitary drinking levels. Yet, stable patterns of drinking to enhance could represent a lack of more adaptive mood regulation strategies ([Cooper et al., 2010](#)); ultimately repeated reinforcement of alcohol to boost positive mood, in turn, could lead to the development of alcohol-related problems. Accordingly, [Cooper et al. \(2010\)](#) present correlations between chronic enhancement motive endorsement and low levels of conscientiousness, which among other things represents low levels of self-discipline and self-control.

In addition, we examined positive mood-solitary drinking relationships which are not typically hypothesized or anticipated, as experience-enhancement has historically been associated with social drinking, as described above. Yet, a recent review of studies has revealed more variability in the social settings associated with enhancement drinking, in which drinking to enhance one's positive (internal) emotional experience is not synonymous with social drinking contexts ([Cooper et al., 2010](#)). Indeed in the present study, the average within-person association for positive moods and drinking at home alone was negative and nonsignificant. Yet, we also found significant variability in those slopes, such that some individuals demonstrated positive slopes. Theoretically speaking, those patterns could be interpreted as consistent with enhancement motivations, which are internally focused to enhance positive emotional experiences. For those drinking strictly in response to positive mood increases (and not for social lubrication), the social context may be less relevant. However, our positive mood-solitary drinking slopes were not related to enhancement motives at follow-up, as might be expected. Yet, these slopes were related to coping motives (positively) and inversely related to social motives. Returning to alcohol myopia ([Steele & Josephs, 1990](#)) as an explanation, drinking in solitary contexts can be rewarding in the short term when in a positive mood, because it is effective at bolstering mood in this context. Yet, once the behavior becomes rewarded, people may be less likely to seek others when in a good mood, the longer term effect of which is to reduce social support and thereby harm coping efforts.

Indeed, it may be that the positive mood-drinking home alone results are a marker for potential relationship deficits that prevent one from drinking to enhance positive experiences or celebrate with others. This is consistent with current theorizing on positive relationship processes including capitalization, which involves the sharing of positive events and states between significant others ([Langston, 1994](#)). Successful capitalization has been shown to have benefits for both the individual's well-being and the quality of the relationship, which may then feed back into future capitalization ([Gable, Reis, Impett, & Asher, 2004](#)). Attempts to capitalize that receive a non-responsive reaction from the partner do not seem to yield these same benefits ([Maisel & Gable, 2009](#)). Therefore, we theorize that participants who engage in more positive mood-related solitary drinking may be suffering from a lack of capitalization. They may have weaker social networks, such that even if they want to share their positive mood with someone they may have no one in the home to share it with and/or no one is available to call upon (e.g., [Peplau & Perlman, 1979](#)), therefore they may engage in solitary drinking. As further evidence of this, positive mood-related home alone drinking was associated with lower reported social motives for drinking at follow-up, indicating that these individuals are not as likely to engage in socially-motivated drinking. They also demonstrated increases in coping motivations, which suggest that drinking in this context is related to a coping process. Future research should consider the mood-drinking slopes in relation to coping skills and relationship characteristics.

Finally, it might be tempting to conclude that positive mood-solitary drinking and positive mood-social drinking patterns are manifestations of the same process, or a function of approach motivations (i.e., behavioral activation systems; [Gray, 1970](#); [Cooper et al., 2010](#)). However, our results are consistent with Cooper et al.'s ([1995](#); [2010](#)) contention that positive moods do not always lead to drinking to enhance; indeed, it is the purposeful seeking of positive reward that underlies drinking to enhance. In the present study, positive mood-social drinking relationships may indicate drinking in search of positive rewards, given the association with enhancement motives. Yet, positive mood-solitary drinking may be a distinct pattern, given the absence of association with enhancement motives and positive association with coping motives; one which is implicit or outside awareness and more closely tied to coping processes. Together, these findings support Cooper and colleagues' assertion that drinking behavior represents multiple fundamentally distinct behaviors, with unique antecedents and consequences.

In terms of individual differences in mood-drinking slopes, we revealed that parents and older individuals experienced stronger positive mood-and negative mood-drinking away slopes (compared to non-parents and younger individuals). Further, the correlation between parent status and age was .73, indicating that both differences are a function of the same process, whereby parents (who, as a group, are older than non-parents in our sample) were presumably seeking more opportunities to drink away from home in both mood contexts. Supplemental analyses revealed that such individual differences did not contribute to the mood-drinking slope predictions reported here. Thus, our slope-outcome findings were not a byproduct of demographically-related drinking behavior patterns. So, for example, positive mood-social drinking patterns were not related to MAST outcomes, because older individuals were more likely to engage in such a behavior. However, the potential for individual differences in slopes and for moderators of slope-outcome relations is worthy of future exploration. Given our view of mood-drinking slopes as a stable if-then drinking signature, based on personality theory (e.g., [Mischel & Shoda, 1995](#)), a logical question emerges in terms of how these drinking patterns relate to other documented personality traits. For instance, neuroticism and extraversion (particularly the sensation-seeking facet) are clearly associated with drinking, related motives and drinking patterns (e.g., [Carney et al., 2000](#); [Cooper et al., 2010](#); [Cooper et al., 1995](#); [Mohr et al., 2001](#)); yet, we anticipate that personality and our mood-drinking patterns would uniquely predict outcomes of interest. Theoretically, individual differences, such as personality are considered more distal predictors of drinking behavior, the effects of which are mediated by drinking motives ([Cooper et al., 1995](#)). Daily process research examining the link between personality and daily drinking patterns (such as these) reveals sometimes inconsistent patterns of association (i.e., the relationship between extraversion and drinking patterns; [Carney et al., 2000](#); [Mohr et al., 2001](#)). Further, these studies have shown that, in cases where personality is significant, it often contributes to drinking outcomes over and above the positive or negative experience predictors, thereby supporting the likelihood that personality is distinct from mood-drinking relationships.

Limitations and Future Directions

Though this sample of moderate drinkers mostly appears unlikely to develop alcohol problems based on the data collected, 12 months may not be adequate to state that conclusively; additional follow-up with these participants beyond 12 months might or might not show different patterns of problems (see [Sher et al., 1996](#)). Also, the sample was chosen quite selectively, with those who had past or present substance abuse, current depression, or who used illicit drugs, screened out, thereby restricting the generalizability of these findings beyond the non-clinical general adult population. For those with greater psychological and alcohol-related risk factors (not present in this sample), negative mood-related home alone drinking might still be risky. Although there are restrictions to generalizability, by including information about drinking context, by using a daily diary method to examine the within-day relationship between moods and drinking, and by using those within-person slopes to predict follow-up outcomes, these data offer an in-depth portrait of the sample that was chosen. Thus, we offer a unique perspective on day-to-day and longer term drinking patterns.

An additional limitation concerns the use of similar reference points for the baseline and follow-up DMQ assessments, not explicitly defining distinct time frames at each interview. Thus, there may have been overlap between the baseline and 12-month follow-up assessments in the motives on which they were reflecting. Yet, with over a year separating assessments and moderate-to-large correlations emerging between the two time points ($r_s = .32-.66$), none of which approached multicollinearity, we believe these values were not representing the same phenomena. Thus, we determined that it was reasonable to include the baseline and follow-up values in the same analysis, particularly due to the reason which follows. Specifically, another consideration in our analysis was the potential presence of suppression, whereby the magnitude of the bivariate correlations between slopes and outcomes was in some cases different from the regression weights presented in [Tables 2 and 3.3](#). Indeed, we identified two potential cases that required further inspection. Following procedures recommended by Cohen, Cohen, Aiken and West ([2003](#), p. 78), we examined whether r_{12} was smaller than the product of r_{Y1} and r_{Y2} . These analyses revealed potential suppression in the case of Positive Mood-Drinks Home Alone slopes predicting coping motives, and Positive Mood-Drinks Away/Others slopes predicting enhancement motives. Although there is no test at the present time to statistically compare the magnitude of correlations and a regression weight to determine

the presence of suppression ([Smith, Ager & Williams, 1992](#); [Tabachnik & Fidell, 2007](#)), the potential leads to a key recommendation from [Cohen et al. \(2003\)](#). Specifically, they caution that the omission of suppressor variables (e.g., the present study's baseline variables) would lead to an underestimation of the predictor-outcome relationship (i.e., slopes as predictors of outcome variables). They argue that when suppression is present, the bivariate correlations between x and y are “misleadingly small” ([Cohen et al., 2003](#)). As such, researchers who are interested in employing our approach should evaluate the potential for suppression, particularly with baseline levels of the outcome variables.

Thus, employing daily slopes to predict follow-up variables is a potentially useful technique for future research interested in understanding the interrelationships of psychosocial factors and health outcomes over time and may help explicate the relationships between within-person patterns in the short-term context and their longer-term health outcomes. Researchers interested in examining change or trajectories of outcomes over time could employ the slopes as predictors in a growth curve analysis, modeling the slopes as main effects or interaction effects (see [Curran, Bauer & Willoughby, 2004](#)). In sum, our daily mood-drinking patterns demonstrated significant variability across persons, such that moderate drinkers could be reliably differentiated based on those patterns in terms of distinct outcomes. In doing so, we revealed potentially problematic patterns, not previously identified (i.e., positive mood-social and solitary consumption), that indicate subsequently poorer outcomes.

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Footnotes

¹In contrast with moods, discrete events such as number of drinks consumed can be reliably measured the following day (e.g., [Reis & Gable, 2000](#); [Shiffman, 2000](#)). Indeed, comparisons between daily reports and BAC are relatively high within a 24-hour period ([Perrine et al., 1995](#)).

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