

A Longitudinal Analysis of Drinking Motives Moderating the Negative Affect-Drinking Association Among College Students

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We examined among college students ($N = 530$; 276 women) the moderating effects of avoidance (coping) and appetitive (social-enhancement) drinking motives on the within-person associations between anxious and depressive affect and drinking frequency and quantity. Once per year for up to 4 years participants completed standard measures of drinking motives and retrospective reports of affect and drinking in the previous month. In addition, each year they completed a 30-day daily diary of affect and drinking. Results from models examining both the retrospective and aggregate daily data indicated that individuals with high compared with low social-enhancement motives showed stronger positive associations among changes in monthly negative affect and drinking frequency. Weak evidence was found for the predicted moderating effects of coping motives, although some results indicated that its effects were contingent on levels of social-enhancement motives. Our findings suggest that appetitive drinking motives might play an integral role in stress- and negative-affect related drinking among college students.

Keywords: drinking motives, negative affect-related alcohol use

Research has consistently demonstrated that college students' reports of drinking for coping reasons (i.e., drinking to cope [DTC]) motivation) are robust predictors of alcohol-related problems (Carey & Correia, 1997; Neighbors, Lee, Lewis, Fossos, & Larimer, 2007; Read, Wood, Kahler, Maddock, & Palfai, 2003; Simons, Gaher, Correia, Hansen, & Christopher, 2005). There is less evidence, however, that drinking patterns among high DTC motivation students, compared with others, is consistent with tension-reduction/self-medication theory; specifically, that such individuals show increased alcohol use during to periods of increased stress and negative affect (NA). Most notable are recent studies using microlongitudinal (i.e., daily) designs that examine how daily or within-day changes in stress and NA relate to discrete instances of alcohol use and how these within-person associations relate to individual differences in DTC motivation levels. The central prediction in such studies is that high DTC motivation individuals, compared to others, should be more likely to drink (or

drink relatively more than their average levels) on days characterized by higher levels of stress and NA. Support for this prediction is inconsistent at best (Armeli, Todd, Conner, & Tennen, 2008; Hussong, Galloway, & Feagans, 2005; Park, Armeli, & Tennen, 2004; cf., Mohr et al., 2005).

In the present study, we further examined among college students the moderating effects of DTC motives on the within-person association between NA and alcohol use. Specifically, we examined whether stronger moderating effects of DTC motives might be observed by examining (a) a level of analysis that might be more sensitive to various temporal patterns in which NA might affect alcohol use and (b) the possible additive and moderating effects of social and enhancement drinking motives in this process. We focused on anxious and depressive NA because they represent two core affective states in models of tension-reduction/self-medication and are thought to be proximal mediators of the effects of stressors on drinking (Greeley & Oei, 1999).

Immediate Versus Delayed Effects of Negative Affect on Drinking

Multiple factors influence individuals' decisions to drink and the immediacy with which they drink upon experiencing elevated stress and NA. For example, the availability of alcohol might be an important delimiting factor (Higgins, 1976). This might be particularly so among college students—especially underage drinkers (Wechsler, Lee, Nelson, & Kuo, 2002)—whose access to alcohol is limited and whose drinking is primarily clustered toward the end of the week (Del Boca, Darkes, Greenbaum, & Goldman, 2004). Limited access to alcohol for college students could hinder its immediate use as a coping strategy, thus attenuating associations in

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models focusing on relatively brief periods of time, such as those examined in most daily studies.

Coping-related drinking is also posited to be a function of the availability of alternative coping strategies and the expectation that alcohol use will serve a useful function with respect to the situation (Abrams & Niaura, 1987; Higgins, 1976). Accordingly, many common anxiety-eliciting experiences for college students, such as studying for exams, meeting assignment/project deadlines, and excessive workloads (Abouserie, 1994; Kohn & Frazer, 1986) would be unlikely to lead to *proximal* (e.g., same-day) alcohol use. Indeed, the pervasive expectation that alcohol use results in cognitive and physical impairment (Goldman, Del Boca, & Darkes, 1999) would make it an undesirable immediate coping strategy for such situations.

In contrast to the aforementioned scenarios, alcohol use might precede or co-occur with other anxiety-eliciting situations commonly experienced by college students, such as evaluative social interactions (Higgins & Marlatt, 1975; Kidorf & Lange, 1999). Alcohol's perceived anxiolytic (Goldman et al., 1999) and social disinhibiting (Labouvie & Bates, 2002) effects and its use as a method to self-handicap performance (Berglas, 1987) might make it especially desirable in such situations. Moreover, evaluative interpersonal encounters might be common during periods (e.g., late in the week, on weekends) and in contexts (e.g., bars, parties) in which alcohol is freely available (Carrigan & Randall, 2003). Thus, anxiety emanating from different sources might have qualitatively different effects on proximal drinking, in some cases increasing its likelihood and in other cases decreasing its likelihood.

Other theoretical models posit that aversive situations could, in the short-term, inhibit drinking, but increase it at more distal points in time. For example, Volpicelli's (1987) Endorphin Compensation Hypothesis (ECH) states that exposure to stressors (mainly low control, anxiety-producing situations) results in short-term increases in endorphin levels followed by deficits in endorphin levels after such situations subside. The ECH posits that individuals learn to compensate for reduced endorphinergic activity by consuming alcohol, which can stimulate opiate receptor activity. The ECH explicitly predicts that drinking levels should decrease during stressful periods and increase only after stress has subsided.

Similar predictions regarding the effects of stress/NA on drinking can be gleaned from Muraven and Baumeister's (2000) model of self-regulation. Their model posits that certain forms of active coping (e.g., focusing attention on problems, actively constraining behavior) and emotion-focused coping (e.g., attempts to reduce negative affect) deplete self-control resources, resulting in a lack of self-control in subsequent situations. Thus, college students who experience an array of stressors (e.g., academic, social, financial) and associated NA might be more vulnerable for engaging in drinking or drinking beyond their normal limits in situations where alcohol is freely available. Drinking because of stress/NA induced self-control resource depletion might occur proximal to the onset of the stress and coping process or after a sustained period of heightened stress/NA.

Consistent with models positing unstructured delayed effects of NA on alcohol use Armeli et al. (2008) found that individuals high in DTC motives, compared to others, drank relatively earlier during weeks characterized by increased levels of anxiety. In contrast, they found no moderating effects of DTC motives on

day-level affect-drinking level associations. These findings along with the theories outlined above, and the inconsistent results from daily studies focusing on a narrow level of analysis (e.g., same-day effects), raise the possibility that stronger moderating results for DTC motives might be obtained by examining NA-drinking level covariation at a higher level of analysis. Assessment of mean levels of NA and drinking occurring within a larger temporal window might be more sensitive to the complex array of temporal links related to these processes.

Appetitive Drinking Motives and Negative Affect-Drinking Contingencies

The inconsistent moderating effects of DTC motives found in previous studies also might be due to the possibility that part of the link between stress/NA and drinking is related to other motivational mechanisms. Several of the previously mentioned frameworks invoke, either as a core or secondary mechanism, appetitive motivational processes. For example, drinking in response to anxiety caused by interpersonal evaluation is likely to take place in social and celebratory contexts (Carrigan & Randall, 2003; Stewart, Morris, Mellings, & Komar, 2006). More generally, evidence indicates that most drinking among college students tends to be social in nature (Christiansen, Vik, & Jarchow, 2002; Mohr et al., 2005). Drinking in such contexts is believed to be influenced by motives regarding the enhancement of positive affective experiences (i.e., drinking to enhance [DTE]) and interpersonal interaction (i.e., drinking to socialize [DTS]). Thus, drinking in response to social-evaluative anxiety might be more prevalent among individuals with high DTE and DTS motives because (a) they might be more likely to be in social drinking contexts and (b) their strong expectations of alcohol's disinhibiting and social lubricating effects (Cooper, 1994; Labouvie & Bates, 2002). Indeed, Stewart et al. (2006) found among college students fear of negative evaluation related to DTS motivation.

The appetitive motivational underpinnings are even more apparent in the ECH in which the primary motivating factor posited is seeking opiate-like stimulation. Such motivation would be more consistent with DTE motives (e.g., drinking to get "high," because its fun) than DTC motives (e.g., drinking to forget problems). Strong endorsement of such appetitive drinking motives might reflect a greater sensitivity to reduced endorphinergic activity and a propensity to seek stimulation via alcohol use during such periods. Accounting for the moderating effects of appetitive drinking motives on stress/NA drinking relations might reduce error variance and increase the power for tests of the moderating effect of DTC motives. Moreover, DTC and appetitive drinking motives might combine in a synergistic fashion, producing the strongest stress/NA-drinking association among individuals high on both factors.

The Present Study

The relatively weak findings found in studies examining the moderating effects of DTC motives on daily or within-day associations between stress/NA and alcohol use might be due to several factors. First, among college students the effects of NA on drinking might be relatively unstructured in terms of its temporal unfolding and more reliably captured by levels of analysis larger

than the day. Specifically, drinking as a consequence of increased stress/NA might occur quickly after its onset (e.g., same-day) or after 1 or 2 days, or after an even longer period of time of accumulated stress/NA. Second, the link between stress/NA and alcohol use also might be partly appetitive in nature. Failure to account for variation associated with the possible moderating effects of appetitive motives (i.e., DTE and DTS motives) on the relationship between NA and drinking—or higher-level interactions among appetitive and avoidant drinking motives—might obscure the moderating effects of DTC motives.

To address these issues, we had college students report their anxious and depressive affect and alcohol use once a year for up to four years. Each year we assessed NA and drinking using two measurement methods covering two separate time periods: retrospective reports for the previous month and daily reports for 30 days. This design allowed us to examine (a) whether drinking motives moderated the association between changes in mean NA and drinking levels at the month level of analysis and (b) whether our findings generalized across time and method. Our primary hypothesis was that individuals with stronger DTC, DTE and DTS motives, compared to others, should demonstrate stronger positive associations between changes in anxious and depressive affect (i.e., deviations from one's mean level) and drinking levels. We also examined whether DTC motives interacted with appetitive drinking motives (i.e., DTE and DTS); we expected that the moderating effects of DTC motives on negative affect-drinking associations would be stronger (more positive) among individuals who have stronger appetitive motives. To examine whether our models were more sensitive to the proposed processes described than previous daily studies, we also examined these associations at the daily level of analysis using the daily diary data.

Method

Participants

We recruited 575 college students through the University of Connecticut Introductory Psychology subject pool who reported drinking alcohol at least twice in the past month (measured during prescreening).¹ Introductory Psychology is a core university course that is the most heavily subscribed (nonrequired) course at the university. Enrollment per academic year exceeds 3000 students, who are diverse in majors. The subject pool participants in our recruitment year were similar to the overall student body in SAT performance (1167 vs. 1168 campus-wide) and in ethnic composition (14% minority [non-Caucasian] vs. 17% campus-wide). Analyses are reported for a final sample of 530 (52% women; 86% Caucasian) who had at least one year of data. Inclusion of all participants, regardless of the number of waves, is consistent with recent recommendations for maximizing the accuracy of parameter estimates derived from maximum likelihood-based models (see Singer & Willett, 2003, pp. 146–148; see also Newman, 2003). At the start of the study participants had a mean age of 18.76 years ($SD = 1.09$); most were freshmen (57%), followed by sophomores (33%) and junior or beyond (10%).

Procedure

As part of a longitudinal study of daily experience and health-related behavior, participants completed a one-time (i.e., baseline)

survey and a 30-day daily diary each year for up to 4 years using a secure Web site. Participants completed the baseline survey approximately one month following the start of the fall (61% of participants) or spring (39% of participants) semester. Included in this survey were measures of drinking motives, recent depression and anxiety symptoms, and recent alcohol use (in the previous 30 days). We refer to the alcohol and affect assessments collected during this baseline survey as retrospective measures. Approximately two weeks after completing the baseline assessment, participants completed the daily diary portion of the study. Each day for 30 days, participants accessed a secure Web site and completed a brief survey between the hours of 2:30 and 7:00 PM. This time window was selected to coincide with most undergraduate students' naturally occurring end of school day, but before they began their activities for that evening and to avoid having participants report when they might be under the influence of alcohol. Relevant to our study participants were asked about their affective states, as well as their alcohol consumption from the past evening (i.e., after the previous day's survey) and current day (i.e., up to reporting time). Participants were paid for both the baseline surveys and the daily diary portions of the study.

To summarize our design we used two different methods (retrospective and daily diary reporting) each year for up to four years to assess NA and alcohol use. Thus for each person we had up four observations (for each method) at the month level of analysis. For the diary data, month-level values were derived by calculating mean levels across the 30-day reporting periods. The daily diary portion of our study also provided us with up to 120 observations of NA and alcohol use (combining the four diary periods) at the day level of analysis.

For the final analyses we retained data from years in which individuals had a daily survey compliance rate of ≥ 15 days. Of the 575 people who initially enrolled in the study, 35 did not participate in the daily diary phase or did not meet the minimum daily diary requirement in at least one year. From the remaining 540 individuals, we limited analyses to data from the years in which participants were still undergraduates; this further reduced our sample size by two to 538. Eight additional students were excluded because they had missing data for baseline measures or because of evidence of severe response bias in their baseline and/or daily reporting.

In the final sample of 530, 34% provided data for 4 years, 35% for 3 years, 17% for 2 years, and 14% for 1 year. Freshmen and sophomores (in year 1 of the study) comprised 99% and 94% of the respondents completing four and three waves of assessments, respectively. Seventy-five percent of freshmen and sophomores (in year 1 of the study) completed 3 or more waves of assessment; 83% of the juniors (in year 1 of the study) completed 2 or 3 waves of assessment, and 100% of the seniors and 5th year and beyond students (in year 1 of the study) completed one or two waves of assessment. Compliance for daily diary reporting across all years was 83.8%.

There were no differences between the final sample and excluded participants in terms of age, class year, ethnic composition, DTC motivation, and baseline measures of depression and anxiety

¹ A subset of the data from the first two waves (yearly assessments) was used in Armeli et al. (2008).

symptoms. The two groups did differ on sex, $\chi^2(1) = 14.0, p < .01$; retrospective drinking frequency, $t(568) = 2.36, p = .019$; retrospective drinking quantity, $t(568) = 2.29, p = .022$; and social-enhancement motivation, $t(567) = 2.40, p = .017$. The excluded group contained relatively more men (77%), drank more frequently ($M = 2.77 [SD = 1.15]$ vs. $M = 2.33 [SD = 1.11]$), drank more per occasion ($M = 5.53 [SD = 2.61]$ vs. $M = 4.65 [SD = 2.32]$), and had higher social-enhancement motivation ($M = 3.38 [SD = 0.77]$ vs. $M = 3.04 [SD = 0.85]$).

Measures

Drinking motives. In the baseline survey each year participants completed the Motivations for Alcohol Use scale (Cooper, 1994). We examined the coping, enhancement and social motives subscales. Responses were made using a 5-point scale (1 = *almost never/never* to 5 = *almost always/always*) regarding how often they drink for various reasons. Internal consistency estimates across the multiple years were high; α s ranged from .88 to .90 for coping, .90 to .92 for enhancement, and .84 to .86 for social. Year to year test-retest correlations among the motives were also high, ranging from .56 to .65 for coping, .58 to .60 for social and .58 to .66 for enhancement. We calculated composite motive scores across all years by averaging together the corresponding scales. Finally, similar to previous studies (e.g., Cooper, Frone, Russell, & Mudar, 1995), we created a composite drinking to socialize or enhance (DTSE) motive scale because of the high correlation between the scales ($r = .87$).

Retrospective depression and anxiety symptoms. In the baseline survey each year participants completed the Beck Depression Inventory (BDI; Beck & Beck 1972) and the State-Trait Anxiety Inventory (STAI; Spielberger, 1983). The 13-item short form of the BDI is a widely used measure of depressive symptoms. Participants were asked to describe how they were feeling during the past week using a 4-point scale (ranging from 0 to 3). The STAI is a 20-item measure of general and long-standing anxiety. Participants were asked to respond regarding how they “*feel in general*” using a 4-point scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*).² Internal consistency estimates across the multiple years were high; α s ranged from .83 to .86 for the BDI and from .91 to .93 for the STAI.

Retrospective drinking level. In the baseline survey each year participants reported the frequency of drinking occasions over the past 30 days; responses were made using a 7-point scale (0 = “zero,” 1 = “1–2,” 2 = “3–5,” 3 = “6–9,” 4 = “10–19,” 5 = “20–39,” 6 = “40 or more”). Participants also reported the amount of drinks consumed per drinking occasion in the last 30 days; responses were made using a 10-point scale (0 = “no drinks,” 1 = “1 drink,” to 9 = “9 or more drinks”).

Daily alcohol use. In the daily survey participants reported the number of alcoholic drinks they consumed the previous night and up to reporting time that day. A drink was defined as equal to one 12-oz can or bottle of beer, one 5-oz glass of wine, one 12-oz wine cooler or 1.5-oz measure of liquor straight or in a mixed drink. Responses were made by clicking one of 17 response options ranging from 0 to 15, and then >15 (recoded as 16). We computed a month-level drinking frequency by recoding the number of drinks to a “0” if no drinks were consumed or “1” if any drinks were consumed for the entire day and taking the mean of the

available 30 days for each person-year. We also created a measure of drinking quantity (i.e., drinks per drinking day) by taking the mean of the number of drinks consumed on drinking days. For diary periods in which individuals did not drink, drinks per drinking days were set to zero.

Daily negative affect. In the daily survey participants reported on their current affect states using a 5-point scale (1 = “*not at all*” to 5 = “*extremely*”). Daily depressive affect was assessed with the items “*sad*” and “*dejected*,” and daily anxious affect was assessed with the items “*jittery*” and “*nervous*”; we computed composite scores by averaging together the appropriate items each day (day-level α s across all person-days were .75 and .74 for depressive and anxious affect, respectively). Finally, we computed month-level affect scores for each year by calculating the mean affect score for the available days.

Results

Descriptive Statistics

Table 1 shows the descriptive statistics and correlations for the study variables of interest. The values represent mean levels across all available assessment waves. We found a strong positive correlation between DTC and DTSE motives. However, DTC motives were moderately correlated, in the positive direction, with both retrospective and mean daily negative affective states, whereas DTSE motive showed weak positive or no associations with these variables. In contrast, DTSE motives, compared with DTC motives, showed stronger positive associations with the drinking outcomes. The mean daily diary and retrospective drinking measures were positively correlated and showed little or no association with the negative affect measures.

We also examined whether the NA and drinking variables had substantial within-person variation at the month level of analysis. Specifically, we calculated intraclass correlations (ICCs) on our retrospective and month-level daily diary aggregates; these ICC values convey the proportion of the total variation due to individual differences. The ICCs were as follows: retrospective anxiety = .65, retrospective depression = .43; diary depressive affect = .58, diary anxious affect = .63, retrospective drinking frequency = .52, retrospective drinking intensity = .62, diary frequency = .53, and diary drinks per drinking day = .64. As these values indicate, a considerable portion of the variation in all of the measures (ranging from 35% for retrospective anxiety to 57% for retrospective depression) was attributable to within-person differences in monthly levels.

Multilevel Regression Models

Month-level models. We estimated multilevel regression models using HLM software (v6.03; Raudenbush, Bryk, Cheong, & Congdon Jr., 2004) to test our hypotheses. We first examined how mean motive levels (across all years) moderated the within-

² Although both the STAI and the BDI do not focus on the previous 30 days, we believe that they reflect anxious and depressive symptoms, respectively, occurring during the timeframe covered by the drinking questions.

Table 1
Descriptive Statistics and Correlations

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11
1. Sex	—	—											
2. Age	18.88	1.14	-.11										
3. DTC	2.04	0.81	.00	-.02									
4. DTSE	3.04	0.88	-.05	-.07	.62								
5. BDI	0.31	0.26	.08	.01	.38	.12							
6. STAI	2.05	0.38	.04	.04	.39	.06	.70						
7. Mean daily depression	1.37	0.39	-.01	-.04	.33	.12	.37	.41					
8. Mean daily anxiety	1.50	0.44	.00	-.07	.27	.11	.32	.34	.73				
9. Retrospective drinking frequency	2.34	1.13	-.19	.05	.27	.55	-.01	-.08	.05	-.02			
10. Retrospective drinking intensity	4.70	2.39	-.35	-.03	.26	.48	-.06	-.10	.04	.03	.70		
11. Mean daily diary drinking frequency	0.22	0.15	-.26	.07	.21	.40	.01	-.04	.08	.05	.69	.60	
12. Mean daily diary drinks per drinking day	4.60	2.74	-.37	-.08	.20	.39	-.09	-.15	.09	.07	.59	.79	.58

Note. DTC = drinking to cope; DTSE = drinking to socialize and enhance; BDI = Beck Depression Inventory; STAI = State-trait Anxiety Inventory. All values (except sex and age) reflect mean levels over all available years. Sex: males = -1, females = 1; Age = age in first year of the study. Correlations .09 or greater are significant at the .05 alpha level.

person associations between month-level NA and drinking outcomes (either retrospective reports or mean daily diary reports). In all models drinking motives are treated as stable, person-level (i.e., level 2) predictors and anxious and depressive affect are treated as time-varying (i.e., level 1) predictors.

The NA variables were person-mean centered in all models (i.e., each person's overall NA mean [based on all available waves] was subtracted from each monthly value); this was done to examine how deviations from individuals mean levels were related to changes in drinking levels. This centering approach yields unbiased estimates of the within-person associations of interest (see Bryk & Raudenbush, 1992, pp. 117–122). DTC and DTSE were grand-mean centered and a multiplicative term was created to test their interactive effect. We also included sex (coded *males* = -1, *females* = 1), overall mean levels (across all waves) of NA (grand-mean centered) and participant's age (a time-varying covariate that was grand mean-centered) as control variables. Only the intercept variance components were retained in all models.

Results for the models predicting drinking frequency from depressive and anxious affect are shown in Table 2. Across all four models, DTSE motives moderated the NA-drinking frequency association. Figure 1 shows the form of the interactions between DTSE motives and depressive affect from the mean daily diary and retrospective models (the form of the interactions for the corresponding anxious affect models were similar). Among high DTSE motives individuals (1 *SD* above the mean), in both models, relative increases in depressive affect were associated with greater drinking frequency; in contrast, among low DTSE motive individuals (1 *SD* below the mean), relative increases in depressive affect were associated with lower drinking frequency.³

By contrast, DTC motives showed patterns opposite to prediction. Also shown in Table 2, in all four models the interactions between NA and DTC motives were negative in direction, although significant only in the models examining mean daily diary depression and retrospective anxiety. Alternatively stated, for individuals with higher DTC motivation levels, the association between NA and drinking frequency was less positive and/or more negative (i.e., *less* drinking during periods of relatively high negative affect for high DTC motivated individuals). We also found a

significant three-way interaction between DTC motives, DTSE motives and changes in anxious affect; this effect was significant in the mean daily diary model and marginally significant in the retrospective model. Figure 2 shows the form of this interaction between the motives and mean daily diary anxiety. As shown, individuals with high levels of DTC motivation showed a positive relationship between anxiety and drinking frequency, but only if they had high levels of DTSE motivation. In fact, individuals with low levels of DTSE motivation and high levels of DTC motivation displayed a negative relationship between anxiety and drinking frequency.

Results for the same models predicting drinking quantity are shown in Table 3. We found a significant three-way interaction between DTC motives, DTSE motives, and depressive affect, but opposite in direction to the interactions found in predicting drinking frequency. This effect was significant in the retrospective model and was marginally significant in the mean daily diary model. The form of the interaction (for the retrospective model) is shown in Figure 3; individuals high in DTC motivation, but low in DTSE motivation showed the strongest positive association between changes in depressive affect and drinking quantity, although such individuals tended to drink less overall than high DTC/high DTSE individuals.

Day-level models. We next examined whether the findings from our month-level models were similar to results from models examining the associations at the day-level of analysis. Specifically, we estimated 3-level multilevel models using the daily diary

³ To examine whether the observed moderating effects of DTSE motives were due to drinking levels, we included a drinking level composite (derived from the retrospective drinking variables) in the models predicting monthly mean diary data drinking. We used the retrospective drinking composite as a level 2 predictor of monthly mean diary data drinking because we did not want to construct a predictor variable (for drinking level) derived from the outcome variable. As expected, retrospective drinking level was highly related to monthly mean diary drinking, but it did not moderate the association between changes in monthly negative affect and drinking frequency. Moreover, the moderating effects of DTSE drinking motives were unchanged. Thus, the moderating effects of DTSE motives were not due to drinking level.

Table 2

Month-Level Multilevel Regression Results for Drinking Frequency as a Function of Negative Affect and Drinking Motives

	Diary			Retrospective		
	<i>B</i>	<i>t</i>	<i>p</i>	<i>B</i>	<i>t</i>	<i>p</i>
Mean depress	0.021	1.035	.302	−0.164	−0.894	.372
Age	0.038	13.623	<.001	0.106	5.193	<.001
Sex	−0.031	−5.413	<.001	−0.153	−3.778	<.001
DTC	−0.013	−1.281	.201	−0.109	−1.464	.144
DTSE	0.074	8.410	<.001	0.777	12.907	<.001
PC depress	0.012	0.684	.494	0.100	0.648	.517
DTC × DTSE	−0.005	−0.600	.548	−0.031	−0.534	.593
PC depress × DTC	−0.044	−2.012	.044	−0.334	−1.585	.113
PC depress × DTSE	0.056	2.605	.010	0.385	2.185	.029
PC depress × DTC × DTSE	0.029	1.563	.118	−0.095	−0.576	.564
Mean anxiety	0.010	0.632	.527	−0.250	−2.172	.030
Age	0.038	13.860	<.001	0.104	5.094	<.001
Sex	−0.031	−5.394	<.001	−0.153	−3.825	<.001
DTC	−0.011	−1.090	.277	−0.059	−0.781	.435
DTSE	0.074	8.286	<.001	0.749	11.867	<.001
PC anxiety	−0.010	−0.683	.495	−0.049	−0.383	.702
DTC × DTSE	−0.005	−0.553	.580	−0.043	−0.745	.457
PC anxiety × DTC	−0.031	−1.474	.141	−0.444	−2.278	.023
PC anxiety × DTSE	0.060	3.157	.002	0.463	2.750	.006
PC anxiety × DTC × DTSE	0.046	2.646	.009	0.230	1.643	.100

Note. depress = depressive affect; DTC = drinking to cope; DTSE = drinking to socialize and enhance; PC = person-mean centered. Sex: males = −1, females = 1; *B*s = unstandardized beta coefficients.

data (i.e., days nested within years nested within persons). We examined as outcomes any drinking occurring on a given night (binary) and the number of drinks consumed on drinking days (specifically, evenings during which participants drank) as a function of daytime NA and controlling for any drinking during the daytime.⁴ Data were aligned so that drinking reported on day *t* + 1 (for the previous night) were predicted by affect reported on day *t*. For the drinks per drinking day models, 28 individuals did not report drinking and thus were excluded from the analyses. Similar to the models examined above, we person-mean centered daily NA (a time-varying level 1 predictor) and we included sex and mean levels of corresponding NA and participants' age as covariates. We also included six day of the week dummy codes (with Sunday coded 0 [reference day] and each day coded 1) to control for weekly drinking patterns. We estimated multilevel logistic regressions for the any drinking models and standard multilevel linear regressions for the drinks per drinking day models.⁵

Table 4 shows the results from these models. For brevity, we report only the conditional effects of the NA variables and their interactions with drinking motives; the results for the main effects of the motives and covariates (not shown) were basically the same as those reported for the month-level models. As shown in Table 4, the only significant interaction was for DTSE motives in the drinks per drinking day model; specifically, higher DTSE motive individuals decreased their drinking on days characterized by increased depressed affect, whereas low DTSE individuals showed a slight positive association between depressive affect and drinks consumed on drinking days (see Figure 4).

Discussion

We found evidence for the predicted moderating effect of social-enhancement drinking motives at the month level of anal-

ysis such that high social-enhancement drinkers showed the strongest positive association between changes in negative affect and drinking frequency. In contrast, we found little evidence for the predicted moderating effects of drinking to cope motives across both levels of analysis. In fact, several findings indicated that high coping motive drinkers, compared to others, showed decreased drinking frequency during periods marked by increased negative affect. Some evidence was found for the interactive effects of social-enhancement and coping motives in predicting negative affect-drinking relations, but the form of these effects was complicated and they differed across affect type and drinking outcomes.

Our findings at the month level of analysis showing that high social-enhancement motive individuals displayed the strongest positive associations between changes in negative affect and drinking frequency were replicated across time (i.e., two different reporting periods per year) and reporting method (i.e., one-time retrospective reports vs. daily diary reporting). Although we did not test these mechanisms expressly, the data are nonetheless consistent with models of social anxiety-related drinking and with theories positing mechanisms other than negative reinforcement regarding the link between stress and negative affect and alcohol use. Specifically, our findings showing more positive associations

⁴ We examined only night-time drinking as an outcome because instances of daytime drinking (before daily reports) were extremely rare (3% of the person days).

⁵ Although the use of linear models for count outcomes such as drinks per drinking day can be problematic, inspection of the residuals from our models indicated no problems with normality assumptions. Furthermore, our model did not produce negative predicted values, a common problem found in linear models of counts.

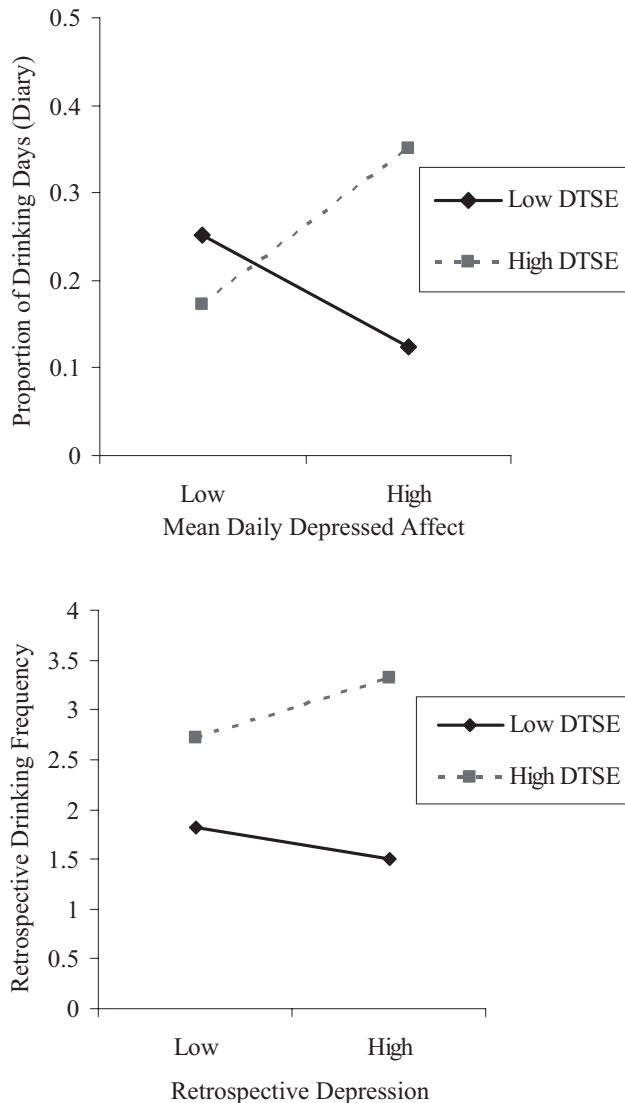


Figure 1. The relationship between month-level depressive affect and drinking frequency as a function of social-enhancement motives.

between negative affect and drinking among high social enhancement individuals, compared to others, might reflect the use of alcohol during anxiety-evoking social-evaluative interactions and/or subsequent to periods of elevated stress and negative affect, possibly in an effort to stimulate endorphinergic activity or as a result of reduced self-control.

It should be noted that the predicted moderating effects of social-enhancement motives were found in relation to drinking frequency, but not with drinking quantity. This might reflect the possibly confounded nature of drinking frequency with increased social participation in general. More specifically, college students' social activities often involve frequenting bars or social gatherings where alcohol is available. One possibility is that after periods of increased negative affect, high social-enhancement motive individuals, who tend to be more extroverted and high in sensation seeking (Kuntsche, Knibbe, Gmel, & Engels, 2006), might seek

out social/celebratory situations as a means to stimulate endorphinergic activity. Although this pattern is generally consistent with endorphin compensation, it remains unclear as to whether alcohol is used directly to stimulate endorphinergic activity or whether it is simply a by-product of increased social behavior in general.

The interactive effects of social-enhancement motives and negative affect might reflect multiple mechanisms at play at different stages of the process. For example, coping with increased negative affect could result in decreased self-control (e.g., Muraven & Baumeister, 2000) and increased social behavior (e.g., going out with friends more often than usual), which in turn might increase exposure to social-evaluative situations (e.g., mixed-sex environments at bars or parties). Once in these environments high social-enhancement individuals, more so than others, might be more likely to initiate drinking because of their strong expectations of alcohol's disinhibiting and social lubricating effects (Cooper, 1994; Labouvie & Bates, 2002). Further research is needed to test these interpretations.

That we did not find comparable moderating effects of social-enhancement motives in the day-level models predicting drinking days suggests that examination of affect and drinking at a larger level of analysis (in our case a temporal window of approximately a month) might be more sensitive to delayed effects of negative affect on this aspect of drinking. Indeed, the only interaction found in our day-level models indicated that high compared to low social-enhancement drinkers consumed relatively *less* on drinking days characterized by increased depressed affect. It should be noted, however, that the differential findings across level of analysis are not necessarily incompatible. The day-level results might simply represent a small segment or snapshot of the dynamic processes linking negative affect and drinking. As explained previously, drinking occasions influenced by endorphin compensation or resource depletion for high social-enhancement motive individuals more likely than not would be characterized by positive, and not negative, affective states. The findings from our day-level model simply indicate that once in a drinking context, individuals with stronger social-enhancement motives drink relatively less if they are experiencing increased depressed affect that day. That we did not find this effect with daily anxiety might be due to the

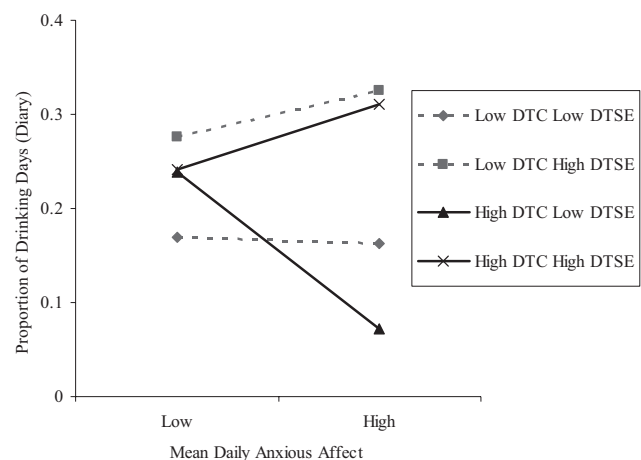


Figure 2. The relationship between month-level anxious affect and drinking frequency as a function of social-enhancement and coping motives.

Table 3
Month-Level Multilevel Regression Results for Drinking Quantity as a Function of Negative Affect and Drinking Motives

	Diary			Retrospective		
	<i>B</i>	<i>t</i>	<i>p</i>	<i>B</i>	<i>t</i>	<i>p</i>
Mean depress	0.358	1.074	.284	−0.892	−2.512	.013
Age	−0.084	−1.823	.068	−0.230	−5.830	<.001
Sex	−0.920	−9.201	<.001	−0.770	−9.274	.000
DTC	−0.220	−1.176	.241	0.069	0.415	.678
DTSE	1.310	8.673	<.001	1.262	9.699	<.001
PC depress	−0.095	−0.635	.525	0.270	0.980	.328
DTC × DTSE	−0.044	−0.145	.885	−0.111	−0.972	.332
PC depress × DTC	0.412	1.084	.279	0.750	1.730	.083
PC depress × DTSE	−0.651	−1.603	.109	0.028	0.080	.936
PC depress × DTC × DTSE	−0.412	−1.680	.093	−0.546	−2.257	.024
Mean anxiety	0.182	0.691	.490	−0.805	−3.324	.001
Age	−0.090	−1.988	.047	−0.232	−5.809	<.001
Sex	−0.924	−9.185	<.001	−0.776	−9.405	<.001
DTC	−0.183	−1.013	.312	0.163	0.977	.329
DTSE	1.297	8.571	<.001	1.199	9.157	<.001
PC anxiety	−0.051	−0.202	.840	−0.065	−0.253	.800
DTC × DTSE	−0.088	−0.586	.558	−0.140	−1.222	.223
PC anxiety × DTC	0.076	0.167	.867	−0.176	−0.454	.649
PC anxiety × DTSE	−0.510	−1.436	.151	0.159	0.486	.627
PC anxiety × DTC × DTSE	−0.068	−0.220	.826	−0.080	−0.284	.776

Note. depress = depressive affect; DTC = drinking to cope; DTSE = drinking to socialize and enhance; PC = person-mean centered. Sex: males = −1, females = 1; *B*s = unstandardized beta coefficients.

possibly contradictory effects of anxiety emanating from different sources; for example drinking quantity among high social-enhancement drinkers might increase as a function of social-evaluative anxiety but decrease as a function of other forms of anxiety (e.g., impending academic deadlines/tasks). Future research would do well to tease out these different types of anxiety to better test these assertions.

In contrast to the findings for social-enhancement motives, our predictions for the moderating effects of coping motives were not well supported. On the contrary, several of the two-way interactions between coping motives and changes in negative affect at the month level of analysis indicated that individuals with stronger coping mo-

tives showed decreased drinking frequency during periods of elevated negative affect. Although we did find some support for the predicted interactive effects of coping motives and depressive affect in predicting drinking quantity, the effects were qualified by an interaction with social enhancement motives. Specifically, individuals with high coping motives, but low social enhancement motives, demonstrated the strongest positive association between changes in depressive affect and drinks per drinking day.

The contradictory findings across the drinking outcomes (i.e., decreasing frequency vs. increasing quantity on drinking occasions during periods of elevated negative affect) might be explained by (a) the aforementioned association between social participation and drinking frequency and (b) unmeasured correlates of drinking to cope motivation. Specifically, coping motives have been found to be positively related to trait level social avoidance (Lewis et al., 2008; Stewart et al., 2006) which has been found to be related to decreased drinking frequency among college students (Eggleston, Woolaway-Bickel, & Schmidt, 2004; Ham & Hope, 2005; Lewis et al., 2008; Stewart et al., 2006). High levels of social avoidance might be especially prevalent among individuals high in coping motives and low in social enhancement motives. One possibility is that increased anxious or depressive affect among this subgroup might intensify social vulnerabilities, making them even less likely to attend social gatherings in which drinking might occur. Alternatively, relative increases in anxiety among high coping/low social enhancement motives individuals, more so than others, might reflect spikes in social anxiety thus leading to decreased social participation and drinking frequency. By contrast, the drinking quantity findings are more consistent with traditional tension reduction/self-medication frameworks. Specifically, when high coping/low social enhancement motives do drink during periods of increased depressive affect, they might drink

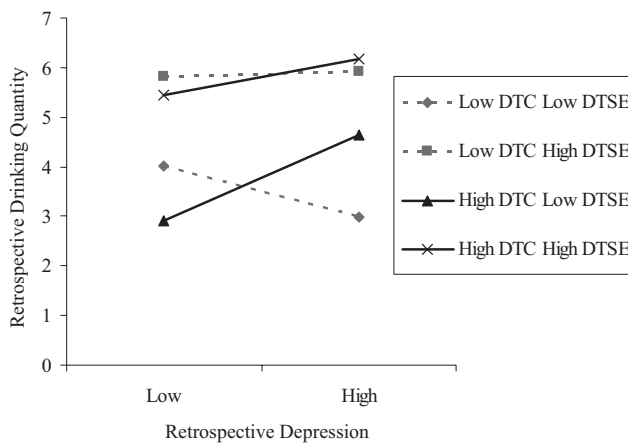


Figure 3. The relationship between month-level depressive affect and drinking quantity as a function of social-enhancement and coping motives.

Table 4

Day-Level Multilevel Regression Results for the Moderating Effect of Motives on the Negative Affect-Drinking Associations

	Any drinking			Drinks per drinking day		
	<i>B</i>	<i>t</i>	<i>p</i>	<i>B</i>	<i>t</i>	<i>p</i>
PC daily depress	−0.118	−2.676	.008	−0.110	−1.167	.244
PC daily depress × DTC	0.047	0.712	.476	0.114	0.691	.489
PC daily depress × DTSE	−0.046	−0.793	.428	−0.268	−2.080	.037
PC daily depress × DTC × DTSE	−0.018	−0.330	.741	−0.002	−0.025	.980
PC daily anxiety	−0.106	−2.429	.015	0.132	1.512	.130
PC daily anxiety × DTC	0.008	0.127	.899	−0.058	−0.431	.666
PC daily anxiety × DTSE	−0.009	−0.154	.878	−0.078	−0.705	.480
PC daily anxiety × DTC × DTSE	−0.004	−0.064	.949	0.055	0.484	.628

Note. *B*s = unstandardized beta coefficients; PC = person-mean centered; depress = depressive affect; DTC = drinking to cope; DTSE = drinking to socialize and enhance.

relatively more than usual as a method of self-medication. Given the unpredicted nature of these effects, replication is warranted.

There were several limitations to our study. Although the results from our month-level models for the moderating effects of social-enhancement motives were consistent with predictions, inferences regarding the causal ordering of affect and drinking are weak. One alternative interpretation is that during periods of increased drinking frequency various aspects of individuals' lives are neglected (e.g., academics, relationships), causing increased negative affect. However, an explanation of why this relation would vary as a function of social-enhancement drinking motives is not readily apparent. Our study also was limited by its homogenous nature in terms of ethnicity (primarily Caucasian) and university setting. Future studies need to examine these processes in more diverse populations.

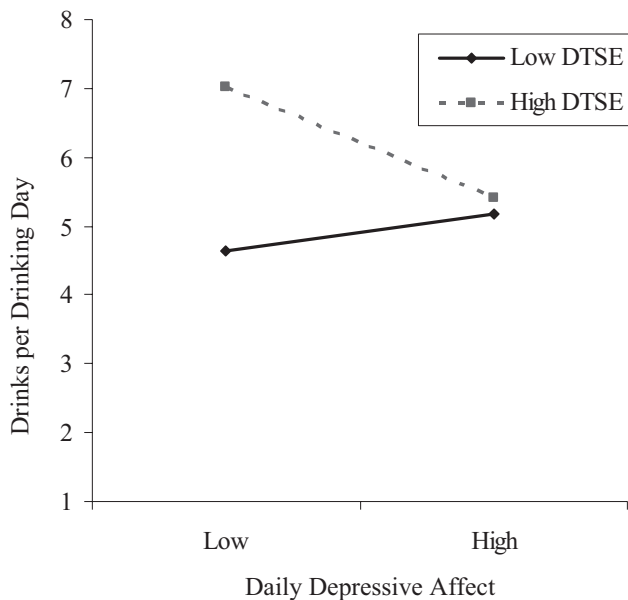


Figure 4. The relationship between day-level depressive affect and number of drinks on drinking days as a function of social-enhancement motives.

These limitations notwithstanding, our findings raise important issues about (a) the nature of the processes linking trait level motivational tendencies to the actual unfolding of the affect-drinking process and (b) examining these phenomena a multiple levels of analysis to gain a deeper understanding. It should be noted that the purpose of our study was not to suggest that intensive longitudinal approaches (i.e., day- and occasion-level models) were inherently flawed, but to make clear that the processes at play might be more complex than what can be detected by examining simple relations between affective states and drinking at such micro levels of analysis. Our focus on affect and drinking occurring during larger temporal intervals (i.e., up to a month) might have been more sensitive in capturing both immediate and delayed effects. However, more complex models focusing on the day- or week-levels of analysis should be able to capture these effects if specified correctly. For example, in addition to affective states, daily assessments could include the nature of stressful experiences (e.g., academic, social-evaluative) and the degree to which such events require self-control (e.g., focused attention; suppressing competing activities). Daily or event contingent reports of drinking could also include assessments of the social contexts in which the drinking takes place, and ultimately individuals' stated reasons for drinking during these discrete episodes.

In conclusion, our findings add to a growing literature suggesting that the effects of stress and negative affect on college students' alcohol use is complex. Our findings indicate that the link between these constructs, most likely, are governed by both avoidance and appetitive mechanisms, and that future research should account for individuals differences related to both of these processes when attempting to model these associations.

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