Drinking-to-Cope Motivation and Negative Mood—Drinking Contingencies in a Daily Diary Study of College Students

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ABSTRACT. Objective: This study examined whether global drinking-to-cope (DTC) motivation moderates negative mood–drinking contingencies and negative mood–motivation contingencies at the daily level of analysis. **Method:** Data came from a daily diary study of college student drinking ($N = 1,636$; 53% female; $M_{\text{age}} = 19.2$ years). Fixed-interval models tested whether global DTC motivation moderated relations between daily negative mood and that evening's drinking and episodic DTC. Time-to-drink models examined whether global DTC motivation moderated the effects of weekly negative mood on the immediacy of drinking and DTC in the weekly cycle. **Results:** More evening drinking occurred on days characterized by relatively higher anxiety or anger, and students were more likely to report DTC on days when they experienced greater sadness. However, only the daily Anxiety $\times$ Global DTC

Motivation interaction for number of drinks consumed was consistent with hypotheses. Moreover, students reported drinking, heavy drinking, and DTC earlier in weeks characterized by relatively higher anxiety or anger, but no hypothesized interactions with global DTC motivation were found. **Conclusions:** Results indicate that negative mood is associated with increased levels of drinking and drinking for coping reasons among college students but that the strength of these relations does not differ by global levels of DTC motivation. These findings raise the possibility that global DTC measures are insufficient for examining within-person DTC processes. Further implications of these results are discussed, including future directions that may determine the circumstances under which, and for whom, DTC occurs. (*J. Stud. Alcohol Drugs*, 75, 606–614, 2014)

MOTIVATIONAL MODELS OF ALCOHOL USE have provided a valuable framework for understanding the psychology underlying drinking and drinking-related problems (Cooper et al., 1995). These models posit that people drink for specific reasons in various contexts—most notably to socialize with other people, maintain or enhance positive emotions, or dampen negative emotions. Evidence generally indicates that the effects of such motives on drinking-related problems are indirect via drinking level; however, multiple studies have found that drinking to cope (DTC) with negative emotions, more so than other drinking motives, has a direct effect on problems (for a review, see Kuntsche et al., 2005). The prominence of DTC motivation as a risk factor for drinking-related problems (Carpenter and Hasin, 1999) underscores the need to further validate whether individuals who report these reasons for drinking at the global level do indeed drink for such reasons and show maladaptive drinking patterns at the event level. We addressed this issue using a daily diary study of college students, a population that reports high levels of both drinking and DTC (Jackson et al., 2005; Park and Levenson, 2002; Wechsler et al., 2002).

To capture this dynamic process relating mood, motivation, and alcohol use, many researchers have turned to micro-longitudinal methods (Bolger and Laurenceau, 2013) to determine whether drinking motives—usually measured in a global, traitlike fashion (e.g., Carver et al., 1989; Cooper, 1994)—moderate within-person associations between negative mood and drinking level. The majority of these studies have used what has been called a fixed-interval approach, in which current or recent mood is used to predict drinking within a fixed period (e.g., that evening or the next day; Armeli et al., 2008). From a motivational perspective, one would expect stronger positive contingencies between negative mood and drinking levels among people who report higher global DTC motivation. To date, however, tests of this hypothesis using the fixed-interval approach have produced inconclusive results (Armeli et al., 2010; Carney et al., 2000; Grant et al., 2009; Hussong et al., 2005; Mohr et al., 2005; Park et al., 2004; Todd et al., 2003, 2005).

One possible reason for these inconsistent findings is that alcohol use, especially among college students, adheres to a weekly cycle in which the preponderance of drinking occurs on weekends (i.e., Friday and Saturday nights; Armeli et al., 2008; Littlefield et al., 2012). When students who report high global DTC motivation experience a negative mood early in the week, they may not drink immediately—despite being motivated to do so—because of social norms or responsibilities (Arbeau et al., 2011). Instead, DTC motivation may manifest as an acceleration of the weekly cycle (i.e., drinking sooner in the week than one usually would),

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an effect that could not be captured by the fixed-interval approach.

To account for these cyclical processes, micro-longitudinal data may be modeled with a time-to-drink approach that examines whether global DTC motivation and negative mood interact to predict drinking initiation (Armeli et al., 2008; Littlefield et al., 2012). These models obviate the temporal restrictions imposed by the fixed-interval approach—that mood will only predict proximal alcohol use—and instead allow mood to predict drinking that might occur at the earliest opportunity. Similar to studies using a fixed-interval approach, however, results from time-to-drink analyses are mixed. Armeli et al. (2008) showed that college students who reported higher DTC motivation drank sooner during weeks marked by relatively higher anxiety versus weeks with lower anxiety, whereas drinking onset showed the opposite pattern among students with lower DTC motivation. In contrast, Littlefield et al. (2012) found no evidence among college students of Negative Mood $\times$ DTC Motivation interactions using weekly time-to-drink models, failing to replicate the results of Armeli et al. (2008).

The inconsistent findings cast doubt on the utility of both fixed-interval and time-to-drink approaches in understanding DTC processes. To explain the lack of consensus, researchers have identified a multitude of potential methodological limitations, such as failing to determine the appropriate time course to model for the DTC process (Littlefield et al., 2012). The possibility remains, however, that individuals who report higher global DTC motivation simply may not show stronger contingencies between negative mood and drinking level than individuals who report lower DTC motivation. Inferring that associations generally observed between DTC motivation and alcohol use/problems at the between-person level (e.g., Cooper et al., 1995; Simons et al., 2005) exist similarly at the within-person level may be an example of an ecological fallacy (Curran and Bauer, 2011). It is only by disaggregating between- and within-person effects using micro-longitudinal data that we can assess whether the psychological process proposed by motivational models is accurate.

To further investigate these issues, the current study tested whether global DTC motivation moderates negative mood–drinking contingencies using a sample of more than 1,600 college students, which provided us with far more power than prior studies to detect what may be small effects. Furthermore, we assessed DTC motives for each drinking episode and examined whether mood–motive contingencies vary by global levels of DTC motivation. It is possible that Negative Mood $\times$ Global DTC effects are present for drinking motives but not drinking level; in other words, individuals who report different levels of global DTC motivation may not drink different amounts when experiencing a negative mood but may drink for different reasons. Such a finding could help explain the direct relations between global DTC

motives and drinking problems observed in previous cross-sectional analyses (Cooper et al., 1995; Simons et al., 2005). In one of the few studies to examine within-person drinking motives, college students who endorsed higher global DTC motivation reported more coping-related drinking on days marked by higher negative affect (Arbeau et al., 2011). Most prior work, however, has not measured episodic DTC, thus neglecting an important construct assumed to mediate negative mood–drinking contingencies (e.g., Cooper et al., 1995). To test our hypotheses, we used both fixed-interval and time-to-drink models to analyze data from a daily diary study of college student drinking. In accordance with motivational models of alcohol use, we expected the relations between daily mood and that evening's level of and motives for drinking (fixed-interval approach), and between weekly mood and the onset of drinking events (time-to-drink approach), would be stronger among students who reported higher global DTC motivation.

Method

Participants

Procedures were approved by the institutional review board at the University of Connecticut. As part of a project examining daily experiences and alcohol use, 1,818 students were recruited over nine semesters (spring 2008–spring 2012) through the undergraduate psychology participant pool and an email-based campus-wide announcements system. Extending recruitment across 5 years lowers the likelihood that results are attributable to the particular circumstances of any given semester. To be eligible, students had to be at least 18 years old, had consumed alcohol at least twice in the past 30 days, and had never undergone treatment for alcohol problems (measured during prescreening). Data from five students were omitted because of reports of treatment seeking at baseline, and data from 177 students were omitted because of unacceptable protocol compliance (<15 daily reports), leaving a final sample for analysis of 43,018 daily surveys (88% compliance) completed by 1,636 students. The sample was 53% female; 80% European American, 12% Asian American, 4% African American, 4% Latino, and 1% Native American or other; with an average age of 19.2 years ($SD = 1.4$). These students, on average, drank on 5.89 days ($SD = 4.36$) in the 30 days before baseline. Students included in the final sample engaged in heavy episodic drinking (HED; defined as four or more drinks for women and five or more drinks for men; National Institute on Alcohol Abuse and Alcoholism, 2004) on fewer days in the 30 days before baseline than students who were omitted ($M = 3.66$, $SD = 3.78$, vs. $M = 4.39$, $SD = 4.01$), $t(1809) = -2.47$, $p = .01$; reported marginally lower global DTC motivation ($M = 1.82$, $SD = 0.83$, vs. $M = 1.95$, $SD = 0.87$), $t(1809) = -1.95$, $p = .051$; and were more likely to be female, $\chi^2(1) = 21.29$, $p < .001$.

Procedure

Approximately 1 month following the start of the semester, students provided informed consent and completed an online baseline survey containing demographics (e.g., gender, age, and race/ethnicity) and a variety of behavioral and personality measures (e.g., typical alcohol use, global drinking motives). Approximately 2–4 weeks after baseline, and always on a Wednesday, students began the daily diary study. For the purposes of the current analyses, this brief survey contained measures of daily mood; alcohol use; and, when students did use, drinking motives. Each day for 30 days, students accessed the survey via a secure website between 2:30 P.M. and 7:00 P.M. This time window was selected to coincide with the end of the school day for most undergraduate students but before they would likely begin their evening activities, including alcohol use. If participants missed that day's survey, they could contact the researchers to complete it up to noon the next day. In addition, when students missed a survey, they were queried at their next log-in about their drinking behavior for up to 3 days prior, which contributed 5,259 additional drinking reports (12.2% of reports) that included 1,293 evening drinking episodes (14.4% of episodes). Students were paid and, when applicable, provided with classroom credit for both the baseline survey and the daily diary study.

Baseline measures

Global drinking motivation was measured with a slightly modified version of the Drinking Motives Questionnaire–Revised (DMQ-R; Cooper, 1994). Specifically, two original coping items were simplified to address a single reason for drinking (i.e., “because it helps you when you feel depressed,” “to feel more self-confident”). Instructions read: “Thinking of all the times you drink, how often would you say that you drink for each of the following reasons?” and participants responded on a scale from 1 (*almost never/never*) to 5 (*almost always/always*) to five items each for coping ($\alpha = .86$), enhancement ($\alpha = .90$), and social motives ($\alpha = .92$). Because enhancement and social motivation were not a primary focus of these analyses and they were highly collinear ($r = .76$), these scales were combined ($\alpha = .94$) (cf. Armeli et al., 2010).

Typical alcohol use was calculated using retrospective reports of frequency of use, frequency of HED, and typical drinks per day (adapted from Wechsler et al., 2002). Participants reported the number of days in the past 30 days in which they consumed any alcohol and consumed 4+/5+ drinks. To curtail positive skew in these variables, we recoded reports of 16 or more drinking days to a value of 16 (2.3% of sample) and reports of 13 or more HED days to a value of 13 (2.4% of sample). Participants also reported the typical number of drinks they consumed for each day of the

week in the past 3 months, which were averaged together. These three variables were standardized and combined ($\alpha = .91$).

Daily or episodic measures

Evening alcohol use was measured by asking students how many standard alcoholic drinks they consumed the night before (i.e., after completing yesterday's survey, or after 6:00 P.M. yesterday if they did not complete a survey) both in social (i.e., while interacting with others) and nonsocial settings (i.e., alone or not interacting with others). Students were reminded each day that a standard drink was defined as one 12-oz. can or bottle of beer or wine cooler, one 5-oz. glass of wine, or a 1-oz. measure of distilled spirits straight or in a mixed drink. Responses were given on a 17-point scale (0 to 15, in 1-drink increments, with an option for >15), and summed to indicate their total drinks consumed. Daytime alcohol use was measured in the same manner with reference to “from the time you woke up until now.” These responses were dichotomized to indicate whether any daytime drinking had occurred.

Episodic DTC motives were assessed for each drinking event that students reported. Students were asked, “Why did you drink last night?” and responded with a 0 (*no*), 1 (*somewhat*), or 2 (*definitely*) to five items adapted from the DMQ-R (e.g., “To forget my ongoing problems/worries”; Cooper, 1994). Responses were averaged together ($\alpha = .80$, calculated across person-days). Drinking motives were only assessed for on-time reports of alcohol use; therefore, models examining episodic DTC motives as an outcome included more missing data than other models.

Positive and negative mood were measured by asking students how they felt that day from the time they awoke until taking the daily survey. Using a scale from 1 (*not at all*) to 5 (*extremely*), students rated mood adjectives chosen by the researchers based on Larsen and Diener's (1992) circumplex model of emotion and the Positive and Negative Affect Schedule–Expanded (Watson et al., 1988). Sadness was assessed with “sad,” “unhappy,” and “dejected” ($\alpha = .83$), anxiety with “anxious” and “nervous” ($\alpha = .72$), anger with “angry” and “hostile” ($\alpha = .76$), and positive mood with “happy,” “enthusiastic,” “content,” and “cheerful” ($\alpha = .89$) (α 's calculated across person-days).

Analysis

To test whether global DTC motivation moderated negative mood–drinking and negative mood–motive contingencies, we used two different analytic approaches. Because of the nonindependence of data from the daily diary (i.e., repeated measures) design, hypotheses were tested using multilevel modeling with HLM 6.08 (Raudenbush et al., 2004). All models were estimated using restricted maximum likeli-

hood, and all random slopes were fixed to zero to facilitate model convergence. First, we examined the effect of daily mood on that evening's level of and reasons for drinking (measured the next day) and whether this association varied as a function of global DTC motivation (i.e., fixed-interval approach). Second, we used discrete-time hazard models (Barber et al., 2000) to examine the additive and interactive effects of weekly negative mood and global DTC motivation in predicting the onset of drinking behaviors in the weekly cycle (see Armeli et al., 2008; Littlefield et al., 2012). For parsimony, daily negative mood predictors that showed no significant effects across levels of analysis (i.e., between- or within-person main effects or cross-level interactions with global DTC motivation) were trimmed from the final models.

Fixed-interval models. Four different evening drinking outcomes were examined in separate models, three of which were dichotomous and estimated using a Bernoulli distribution: whether any drinking occurred, whether HED occurred, and whether students reported any episodic DTC motives for that evening's drinking (i.e., a mean score greater than 0). The fourth outcome, number of drinks consumed, was estimated with a Poisson distribution for count data. In all models, daily predictors of drinking outcomes (i.e., the Level 1 model) included negative mood (i.e., anxiety, anger, and sadness), positive mood, weekend (0 = weeknight; 1 = Friday or Saturday night), and whether any drinking occurred during that day (0 = no, 1 = yes). Daily mood variables were person-mean centered; thus, the effects represented differences in drinking behavior based on deviations from each individual's average mood over the study month (Enders and Tofighi, 2007). Between-person effects (i.e., the Level 2 model) included gender (-1 = male, 1 = female), global DTC and social/enhancement motivation, and the aggregated daily values for negative and positive moods. Including the aggregated values allowed us to disambiguate the within-person and between-person effects of daily mood on drinking outcomes (Curran and Bauer, 2011; Raudenbush and Bryk, 2002). Global drinking motives and aggregated mood scores were grand-mean centered. Finally, to test the primary effects of interest, we modeled cross-level interactions between daily negative mood and global DTC motivation, and simple slopes were calculated for significant interactions using procedures outlined by Preacher et al. (2006).

Time-to-drink models. Multilevel discrete-time hazard models (Barber et al., 2000) estimated the time from the start of the week to each of three distinct drinking events: first drink, first HED, and first drinking event with any reported episodic DTC motives. Based on the typical pattern of college student alcohol use in which drinking is relatively low on weeknights and peaks on Friday and Saturday nights, we specified weeks as beginning on Sunday (Armeli et al., 2008). For each drinking event, a separate person-period file was created in which students contributed data for each day up to and including the first event of that week; weeks

without a drinking event that contributed seven entries were right censored. Because diaries began on a Wednesday and ended on a Thursday, data were only used from the three full weeks (i.e., Sunday to Saturday) collected for each student. Furthermore, weeks were omitted from the analysis if missing drinking data were present before the occurrence of a drinking event (time to drink: 147 weeks [3.0%]; time to HED: 175 weeks [3.6%]; time to DTC: 2,002 weeks [40.7%]). To avoid losing weeks, missing values for daily mood were person-mean imputed.

Drinking events were dummy coded (0 = day without drinking event; 1 = day with drinking event), and these codes served as outcomes in models estimated using a Bernoulli distribution. The Level 1 intercept in these models did not include an intercept at Level 2; instead, dummy codes for each day of the week included at Level 1 served as seven unique intercepts across the weekly cycle. Weekly mood (i.e., anxiety, anger, sadness, and positive mood) served as time-varying covariates at the within-person level and were person-mean centered. These values were calculated as the average, cumulative mood reported since Sunday of the current week (Armeli et al., 2008). For example, weekly anxiety on a Tuesday was the average of anxiety reported on Sunday, Monday, and Tuesday of that week. This approach models drinking behavior as a function of the accumulation of weekly mood, not just today's mood, and relates the measurement of mood to the weekly drinking cycle that appears to "restart" on Sundays. At the between-person level, we included gender (effect coded), typical drinking, global DTC and social/enhancement motivation, and aggregated mood scores (the latter four variables were grand-mean centered). Finally, we tested our main hypotheses with cross-level interactions between weekly negative mood and global DTC motivation to determine whether mood-contingent onset of each drinking event varied based on students' self-reported typical drinking motives.

Results

Descriptive statistics

Means, standard deviations, and correlations between study variables are shown in Table 1. During the diary portion of the study, students reported 8,950 evening drinking episodes, an average of 5.5 episodes per student ($SD = 4.2$). Students also, on average, engaged in HED 3.4 times ($SD = 3.3$) and reported episodic DTC motives 2.0 times ($SD = 2.6$) during the study. In addition, intercept-only models were tested for each outcome to calculate intraclass correlations (assuming a threshold model that fixed residual variances to 1.0 for count variables and $\pi^2 / 3$ for dichotomous variables; Snijders and Bosker, 1999). These values indicate the proportion of total variability in the measure at the between-person level: number of drinks = .622; any drinking = .181;

TABLE 1. Descriptive statistics and correlations

	<i>M (SD)</i>	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Gender ^a	—	—										
2. DTC motivation ^b	1.82 (0.83)	.01	—									
3. Social/enhance motivation ^b	3.04 (1.03)	-.04	.52***	—								
4. Typical drinking ^c	0.00 (0.92)	-.19***	.25***	.48***	—							
5. Daily number of drinks ^d	1.17 (1.31)	-.30***	.18***	.35***	.68***	—						
6. Number of drinking days ^d	5.46 (4.16)	-.16***	.14***	.33***	.60***	.79***	—					
7. Number of HED days ^d	3.38 (3.34)	-.17***	.18***	.39***	.70***	.90***	.82***	—				
8. Number of DTC days ^d	1.99 (2.60)	-.04	.36***	.32***	.35***	.46***	.58***	.50***	—			
9. Avg. daily anxiety ^{d,e}	1.73 (0.54)	.17***	.22***	.10***	-.02	-.06*	-.06*	-.06*	.23***	—		
10. Avg. daily anger ^{d,e}	1.30 (0.39)	.00	.24***	.09***	.08**	.07**	.00	.02	.21***	.58***	—	
11. Avg. daily sadness ^{d,e}	1.41 (0.43)	.09***	.28***	.09***	.02	.00	-.02	-.02	.26***	.69***	.78***	—
12. Avg. daily positive mood ^{d,e}	2.68 (0.65)	.12***	-.14***	.05*	.02	.01	.02	.04	-.05*	.02	-.07**	-.16***

Notes: *N* = 1,636. DTC = drinking to cope; HED = heavy episodic drinking; avg. = average. ^a1 = male, 1 = female; ^bDrinking Motives Questionnaire–Revised (Cooper, 1994), 1 (*almost never/never*) to 5 (*almost always/always*); ^cbased on standardized values; ^daggregated daily values; ^e1 (*not at all*) to 5 (*extremely*). **p* ≤ .05; ***p* ≤ .01; ****p* ≤ .001.

HED = .229; any episodic DTC motives = .286. Intraclass correlations were also calculated for each daily mood variable: sadness = .438; anxiety = .397; anger = .433; positive mood = .507. These figures indicate a significant amount of within-person variability in both our main predictors and outcomes of interest.

Fixed-interval models

Results for the fixed-interval models are presented in Table 2. Significant and positive associations were found between daily anger and number of drinks consumed, any

drinking, and any HED; daily anxiety and both number of drinks consumed and any drinking; and daily sadness and any episodic DTC motives. In testing the primary hypotheses, 3 of the 12 daily Negative Mood × Global DTC Motivation cross-level interactions were significant, but only one was consistent with the hypotheses. As depicted in Figure 1, the relation between daily anxiety and number of drinks consumed was positive for students with higher DTC motivation (simple slope: *b* = 0.053, *p* < .001) but null for students with lower DTC motivation (simple slope: *b* = 0.011, *p* = .38). In the other significant cross-level interactions (not pictured), positive relations between daily negative mood and drinking

TABLE 2. Results from multilevel fixed-interval models predicting evening drinking outcomes

Variable	No. of drinks <i>b</i> (<i>n</i> = 41,018) ^a	Any drink OR (<i>n</i> = 41,018) ^a	Any HED OR (<i>n</i> = 41,018) ^a	Any DTC OR (<i>n</i> = 40,133) ^a
L1 slopes				
Daily anxiety ^b	0.032***	1.052*	1.050†	—
Daily anger ^b	0.053***	1.079*	1.091*	—
Daily sadness ^b	—	—	—	1.245***
Daily positive mood ^b	0.187***	1.262***	1.313***	1.106**
Weekend ^c	1.771***	9.800***	11.643***	7.873***
Any day drinking ^d	0.436***	5.442***	2.812***	2.765***
L2 covariates				
Gender ^e	-.0237***	0.871***	0.837***	0.936†
DTC motivation ^f	-0.074†	0.960	0.973	1.362***
Social/enhance motivation ^f	0.591***	1.556***	1.867***	1.489***
Aggregate anxiety ^f	-0.246***	0.829**	0.739***	—
Aggregate anger ^f	0.238**	1.049	1.224†	—
Aggregate sadness ^f	—	—	—	2.018***
Aggregate positive mood ^f	0.083†	1.049	1.091	0.972
L1 × L2 interactions				
Daily Anxiety × DTC	0.025**	1.016	1.002	—
Daily Anger × DTC	-0.106**	0.945	0.930†	—
Daily Sadness × DTC	—	—	—	0.915*

Notes: *N* = 1,631. Dashed lines indicate effect trimmed from final model. No. = number; HED = heavy episodic drinking; DTC = drinking to cope; OR = odds ratio; L1 = Level 1; L2 = Level 2. ^aNumber of observations; ^bperson-mean centered; ^c0 = weeknight; 1 = weekend; ^d0 = no day drinking, 1 = any day drinking; ^e1 = male, 1 = female; ^fgrand-mean centered.

p* ≤ .05; *p* ≤ .01; ****p* ≤ .001; †*p* < .10.

FIGURE 1. Fixed-Interval Daily Anxiety $\times$ Global Drinking To Cope (DTC) motivation interaction for number of drinks consumed. High/low values represent ± 1 SD, respectively; *** $p < .001$.

outcomes were stronger among students with lower DTC motivation versus those with higher DTC motivation, contrary to predictions.

Time-to-drink models

Figure 2 shows the unadjusted hazard (top panel) and survival curves (middle panel) for the three drinking events. As expected, all three outcomes showed relatively low hazard from Sunday through Wednesday, with escalating hazard on Thursday and Friday, and a decrease in hazard from Friday to Saturday. On average in a given week, 32% of the sample did not drink and 45% did not experience HED or report episodic DTC motives. Results from the final hazard models are in Table 3 (sadness was trimmed from all models and is not displayed). Students engaged in all drinking behaviors earlier in weeks characterized by relatively higher anxiety or anger (with the exception that weekly anger did not predict time to HED). In testing the main hypotheses, only one interaction emerged. As displayed in Figure 2 (bottom panel), all students drank for coping reasons earlier in weeks characterized by relatively higher anger, but this effect was stronger among students lower in global DTC motivation compared with students higher in DTC motivation, again contradicting the hypotheses.

Discussion

The current study used fixed-interval and time-to-drink models to examine whether college students' global reports of DTC motivation moderated relations between temporally proximal negative mood and both level of drinking and drinking motives. We found evidence of mood–drinking contingencies such that students were more likely to drink, drank more, and drank sooner in the week when experiencing more negative moods. Similarly, students were more likely to report episodic DTC and drank for coping reasons earlier in the week when experiencing more negative moods, providing indirect evidence that they used alcohol as a

FIGURE 2. Hazard and survival curves from time-to-drink models, including Weekly Anger $\times$ Global Drinking To Cope (DTC) motivation interaction for time-to-DTC. High/low values represent ± 1 SD, respectively; HED = heavy episodic drinking.

means of alleviating or avoiding these emotions. However, neither mood–drinking nor mood–motive contingencies were consistently moderated by global DTC motivation, failing to support the hypotheses. In the lone exception, only students who reported higher DTC motivation consumed more drinks on days characterized by higher than typical anxiety. However, this difference represented a very small effect, with a 2-SD increase in daily anxiety predicting an increase of approximately 0.02 drinks consumed. Moreover, this was the only interaction out of 21 tested across both types of analyses that was clearly consistent with motivational models of alcohol use, a finding that could be attributable

TABLE 3. Results from multilevel time-to-drink models

Variable	Time to first drink		Time to first HED		Time to first DTC	
No. of individual people included in the model	1,631		1,630		1,376	
No. of observations included in the model ^a	26,052		29,060		17,186	
	<i>b</i>	OR	<i>b</i>	OR	<i>b</i>	OR
L1 effects						
Anxiety ^b	0.164**	1.179	0.234**	1.264	0.241**	1.273
Anger ^b	0.257**	1.292	—	—	0.507***	1.660
Positive mood ^b	0.354***	1.424	0.426***	1.533	0.288***	1.334
L2 effects						
Gender ^c	-0.049†	0.952	-0.028	0.972	-0.053	0.948
Typical drinking ^d	0.704***	2.022	0.944***	2.570	0.760***	2.137
DTC motivation ^d	-0.062	0.940	-0.023	0.977	0.154*	1.167
Social/enhance motivation ^d	0.150***	1.162	0.201***	1.223	0.239***	1.270
Aggregate anxiety ^d	-0.005	0.995	-0.076	0.927	0.248**	1.282
Aggregate anger ^d	-0.118	0.889	—	—	-0.003	0.997
Aggregate positive mood ^d	0.043	1.044	0.045	1.046	-0.057	0.945
L1 × L2 interactions						
Anxiety × DTC	0.032	1.033	0.005	1.005	0.095	1.100
Anger × DTC	-0.140	0.869	—	—	-0.272*	0.762

Notes: Dashed lines indicate effect trimmed from final model. HED = heavy episodic drinking; DTC = drinking to cope; no. = number; OR = odds ratio; L1 = Level 1; L2 = Level 2. ^aEach person provides up to 30 observations; ^bperson-mean centered; ^c-1 = male, 1 = female; ^dgrand-mean centered.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$; † $p < .10$.

to chance. These results fail to replicate earlier reports using the fixed-interval approach (Mohr et al., 2005; Todd et al., 2005) and support Littlefield et al. (2012), who failed to replicate the time-to-drink findings observed in Armeli et al. (2008). Importantly, our failure to find the anticipated interactions is not likely due to being underpowered, as this study included a sample at least 10 times larger than those used in most prior research.

We offer several interpretations of these null effects. Evidence from the general coping literature indicates that people are particularly poor at relating how they cope with negative experiences (Schwartz et al., 1999; Todd et al., 2004), and global DTC measures may suffer from these same difficulties. For instance, individuals who report high global DTC motivation may misattribute their drinking to coping processes when, in fact, drinking may be the cause of their negative moods. Thus, negative mood–drinking contingencies reported by this group would be precipitated by the drinking itself and would manifest as stronger negative moods during or following consumption. Moreover, evidence from implicit priming studies indicates that college students who report high global DTC motivation show stronger links between negative moods and alcohol expectancies (Birch et al., 2004) and alcohol-related cues (Grant et al., 2007). Thus, strong endorsement of DTC motivation might reflect an awareness of negative mood–drinking contingencies driven by these automatic processes, where in actuality these individuals' drinking levels are not consistently preceded by relative increases in negative mood. Future studies using more fine-grained measurements of mood, motives, and

drinking are needed to test this interpretation (e.g., ecological momentary assessment; Shiffman et al., 2008).

Another interpretation stemming from people's inaccuracy in reporting how they cope is that individuals high in DTC motivation may not actually show greater covariation between negative mood and drinking than do individuals low in DTC motivation, despite perceiving such contingencies. Global DTC reports may be influenced by memory biases in that some individuals may be more likely to recall instances of drinking to cope when completing such measures. In fact, episodic reports of DTC following drinking days characterized by stronger negative moods did not differ by global DTC motives, further suggesting selective recall among some individuals. Moreover, most studies show positive correlations between all drinking motives at both the global and daily levels (e.g., Arbeau et al., 2011; Cooper, 1994), and further evidence shows no distinct typologies between individuals who drink to enhance versus those who drink to cope (Littlefield et al., 2013). Finally, some micro-longitudinal studies have indicated that individuals high in DTC motivation are more likely than those low in DTC motivation to drink across contexts (Grant et al., 2009; Todd et al., 2003). Together, these findings suggest that individuals who report that they drink to cope may drink a lot and for a lot of reasons, and other processes related to cognition or personality may drive their responding on global DTC measures. The repeated failure to find differing mood–drinking contingencies among individuals who report differing levels of DTC motivation, along with the current findings that global DTC did not moderate mood–motive contingencies, should raise

questions as to what exactly is measured by global DTC scales and why they predict drinking levels and problems at the global level (Kuntsche et al., 2005).

A third possibility is that global measures of DTC motivation do not accurately capture the role of this motivation in the drinking process. Such an approach assumes people generally drink for the same reasons across time and situations when, in fact, there is significant within-person variation in drinking motives and general coping strategies (Arbeau et al., 2011; Schwartz et al., 1999; Todd et al., 2004). Moreover, people who report DTC motivation possess a repertoire of other coping strategies that may be used in response to negative moods, especially when alcohol might not be available (Carver et al., 1989; Todd et al., 2004). Thus, DTC may be a circumscribed event that is difficult to identify and model within a brief timeframe. In light of these challenges, we recommend measuring coping motives at the daily or event level, as done in the current study, instead of relying solely on global or traitlike drinking motives (see also Arbeau et al., 2011). Such an approach may provide further insight into proximal mood–drinking and mood–motive contingencies, as well as how proximal drinking motives influence drinking levels and related consequences.

Likewise, our analytic approach may not be sensitive enough to capture the complex nature of mood–drinking contingencies. Models may need to simultaneously account for the effect of negative mood on proximal drinking, timing of drinking within the weekly cycle, and factors not examined in the present study (e.g., task accomplishment; Arbeau et al., 2011). Furthermore, other time courses for DTC processes have been proposed, such as time to drink within a single day (Todd et al., 2009), or following peak levels of emotions over the course of a month (Hussong, 2007). It is plausible that drinking is dependent on multiple cyclical patterns relating to mood, physiology, and behavior, and focusing on any one aspect of these contingencies might result in the attenuation of observed effects.

There are several limitations to this study worth addressing. First, the distribution of global DTC motivation was positively skewed, with 23% of the sample reporting no DTC motivation and 71% of the sample reporting a mean score less than 2. Furthermore, students with higher DTC motivation were marginally more likely to be omitted from the sample because of protocol noncompliance. The failure of the current study to find Negative Mood $\times$ DTC Motivation interactions may be partly due to the overall low levels of DTC commonly reported by college students; these results, therefore, may not generalize to noncollege populations. However, evidence from a community-based sample indicates that DTC motivation peaks around age 22 (at least among European Americans; Cooper et al., 2008), suggesting that inclusion of a wider distribution of scores may require recruitment of high-risk samples. Second, students were only able to report their mood at the time of the

daily survey, which may have obfuscated effects of discrete, intense emotional experiences on later drinking, especially if those experiences occurred after the daily survey but before or during a drinking episode. Future studies would benefit from measuring mood repeatedly during the day to obtain better coverage of the events and moods experienced by students (e.g., Todd et al., 2009). Finally, students retrospectively reported their drinking behavior the next day or (rarely) up to 3 days later. Although more intensive micro-longitudinal methods would allow for in vivo reporting of alcohol use and related cognitions, daily diaries are particularly well suited for measuring discrete behaviors such as drinking that, in general, occur at predictable and limited times of the day and are both distinct and memorable (Gunthert and Wenzel, 2012).

In conclusion, both fixed-interval and time-to-drink models found very limited evidence that college students who report high levels of global DTC motivation showed stronger covariation between daily or weekly negative mood and drinking-related outcomes. Although global DTC measures have been associated with higher alcohol use and drinking-related problems (e.g., Cooper et al., 1995; Simons et al., 2005), the proposition that individuals who report such motives are more likely to drink, to drink more, or to drink for coping reasons when experiencing negative moods may be an ecological fallacy (Curran and Bauer, 2011). Further study is needed at the within-person level to better understand the actual processes being detected by drinking motive measures, knowledge that can inform future prevention and intervention efforts.

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