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Daily-level Associations between Negative Mood, Perceived Stress, and College Drinking: Do Associations Differ by Sex and Fraternity/Sorority Affiliation?

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Abstract

Background—Individuals experiencing elevated negative mood and stress may drink to self-medicate, yet daily-level evidence for these associations is mixed.

Objective—To clarify daily associations between negative mood and perceived stress with alcohol use among high-risk college students and test whether these associations may vary by same-day versus next-day drinking, sex, and fraternity/sorority affiliation.

Methods—Frequently drinking college students ($n = 347$) participated in a daily diary study, which included daily morning and evening assessments that occurred for two weeks in four consecutive academic quarters. Multilevel zero-inflated Poisson regressions were conducted to examine the effects of daily negative mood and perceived stress on same-day and next-day drinking.

Results—Students with higher average negative mood and perceived stress across the sampled days reported a lower likelihood of drinking. Examination of daily-level associations showed that on days students experienced elevated negative mood and perceived stress, they were less likely to drink any alcohol the same day. However, days with elevated negative mood were associated with greater alcohol use the next day. Tests of cross-level interactions indicated that four daily-level associations between higher negative mood or perceived stress and reductions in drinking were found to be significant among females and students unaffiliated with fraternity/sorority only.

Conclusions/Importance—Among high-risk college drinkers, negative mood and perceived stress were associated with decreased risk of drinking, particularly among females and students unaffiliated with fraternity/sorority. Daily elevations in negative mood may lead to drinking on a subsequent day and the reason for this lagged effect warrants future research.

Keywords

negative affect; mood; perceived stress; coping; multilevel modeling

The transition from adolescence to young adulthood is characterized by increased opportunities and exposure to drinking (Arnett, 2005). National data indicate that drinking prevalence peaks among 18–25 years old, with 63.2% and 31.9% of college students engaged in past 30-day alcohol use and heavy episodic drinking (Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2016). College drinking is estimated to cause 1,800 deaths, 599,000 injuries and 696,000 physical assaults annually (Hingson, Zha, & Weitzman, 2009). College students who engage in frequent heavy episodic drinking are 13 to 19 times more likely to have a concurrent alcohol abuse or alcohol dependence diagnosis (Knight et al., 2002). Understanding when and for whom risk factors are predictive of college drinking is important to guide targeted prevention and intervention efforts.

The notion that individuals drink alcohol to cope with negative affect or stress is prevalent in the literature (Cooper, Frone, Russell, & Mudar, 1995; Greeley & Oei, 1999; Sayette, 1999). The internalizing pathway model posits that negative affect may interact with positive alcohol expectancies, personal skill deficits, and drinking to cope motives to predict alcohol use (Hussong et al., 2011). The developmental overload model theorizes that multiple transitions during young adulthood may act as stressors that overwhelm coping capacities and lead to increased drinking (Schulenberg & Maggs, 2002). While negative mood and perceived stress have been conceptualized as risk factors of drinking, mixed empirical evidence has been reported, with results varying based on whether and how within-person variations are modeled (Armeli, Todd, & Mohr, 2005).

Within-Person Associations between Negative Mood, Perceived Stress, and Drinking

Daily-level associations between negative mood and drinking may vary by developmental stage and drinking severity of the sample. Daily elevations in negative mood predicted increased drinking among adult heavy drinkers (Armeli et al., 2000; Doumas, 2012), and a similar pattern was found among frequently drinking college students aged 21 to 23 (Simons et al., 2005). However, among first-year college students, greater than average daily negative affect was associated with fewer drinking days in a week (Rankin & Maggs, 2006). A recent study by Patrick, Yeomans-Maldonado, and Griffin (2015) found that higher daily negative affect was associated with a lower likelihood of alcohol use or heavy episodic drinking among young adults who did not attend college. Among adolescents recruited from a clinical setting, Kauer et al. (2009) found that adolescents overall reported higher negative mood on drinking days compared to nondrinking days. Finally, no within-person associations between negative mood and drinking were found in a normative adolescent sample (Croke et al., 2013). Together, positive within-person associations between negative mood and drinking appear to be more consistent in older and higher risk samples as compared to younger and lower risk samples.

Prior research focusing on daily-level associations between perceived stress and drinking has utilized self-reported measures of perceived overall stress level or perceived stress attributed to specific stressful or negative events (Armeli et al., 2003; Carney et al., 2000; Cooper et al. 1992). After controlling for weekly trends, daily affect and coping, college students

consumed more alcohol on days with greater than average perceived overall stress level (Park, Armeli, & Tennen, 2003). However, different patterns were found in other samples. For example, Armeli et al. (2000) found that, among heavy drinking adult males, those who anticipated greater impairment from drinking drank less on relatively stressful days. In a different sample of heavy drinking adult males, Helzer et al. (2006) found that participants consumed more drinks on days when they had greater perceived overall stress level. Similar to prior research focusing on negative mood and drinking, these studies indicate that daily elevations in perceived stress may be positively associated with daily alcohol use only among individuals who have established history of heavy drinking.

Timing of Drinking, Sex, and Fraternity/Sorority Affiliation as Moderators

Individuals who consume alcohol after experiencing negative mood or stress may not do so immediately, either because they need to resolve a problem at hand first, or engage in alternative coping methods prior to resorting to drinking. A few prior studies have provided preliminary evidence that next-day drinking may represent an important and unique outcome of daily elevations in negative mood or perceived stress (e.g., Ayer et al., 2011; Grzywacz & Almeida, 2008; Harder et al., 2014; Helzer et al., 2006). In a heavy drinking adult sample, Ayer et al. (2011) showed that daily elevation in perceived stress predicted higher next-day drinking among males only. Using the same sample, Harder et al. (2014) reported that daily elevation in anger predicted higher next-day drinking also among males only. In a national sample of U.S. adults, Grzywacz and Almeida (2008) found that both perceived daily stress and cumulative stress over three days were associated with heavy episodic drinking. No similar study that we are aware of has tested possible effects of daily negative mood or perceived stress on next-day drinking among high-risk college students.

Fraternity/sorority affiliation is a robust risk factor for drinking and other health risk behaviors (Larimer et al., 1997; Scott-Sheldon, Carey, & Carey, 2008). Given disproportionate risk, college-level interventions targeting fraternity/sorority members have been previously suggested (Seo & Li, 2009). Fraternity/sorority members are embedded in a social environment that is conducive to drinking possibly through higher peer drinking norms and greater alcohol availability (Park, Sher, & Krull, 2009). Other research showed that fraternity/sorority members are also more likely to participate in student government, perform volunteer work, graduate on time, and have greater aspirations for graduate school (Routon & Walker, 2014). The unique combination of high demands for activity engagement and academic excellence, coupled with increased drinking norms and alcohol availability may put fraternity/sorority members at elevated risk for using drinking as a coping mechanism in face of negative mood and perceived stress. No prior research has tested this hypothesis using daily-level data.

The Current Study

This study has two goals. First, we examined the effects of daily negative mood and perceived stress on same-day and next-day drinking in a diverse sample of college freshmen, sophomores, and juniors. Second, we tested sex and fraternity/sorority affiliation as moderators of these associations. We hypothesized that daily elevations of negative mood

and perceived stress would predict greater likelihood and level of drinking, and that these associations would be stronger among males and students affiliated with fraternities/sororities.

Method

Participants and Procedures

We analyzed data from 347 college students who were attending a large public university in the Pacific Northwest. The mean age of this sample was 19.7 years old ($SD = 1.3$), with 53.6% female. Of these participants, 74.1% were White, 8.6% were Asian, 11.0% were multiracial, and 6.3% other race. Thirty-four participants (9.8%) self-identified as Hispanic or Latino(a). More than half (54.8%) of the participants were current members of a fraternity/sorority at baseline. The sample consisted of college freshmen (17.0%), sophomores (36.9%), and juniors (46.1%). Data collection and study procedures were approved by the university's Institutional Review Board.

Participants were recruited as part of a larger year-long study focusing on the daily associations between alcohol expectancies, alcohol use, and consequences. To ensure adequate variability in drinking, participants had to be frequent drinkers (i.e., reporting drinking at least twice per week in the past month) at the initial screening. Due to rolling enrollment and the 1-year length of this study, participants had to be a college freshman, sophomore, or junior (but not college senior) at screening. Additionally, participants had to have no study abroad plan in the next year, and had to own a cell phone with a monthly plan, and agreed to use the cell phone to receive text message reminders and complete daily surveys three times per day.

A total of 3,210 college students, who were randomly selected from the university's registrar's lists, completed the screening survey and received \$10 as compensation. Students who met all eligibility criteria ($n = 539$) were invited to complete a baseline survey and attend an in-person training session. Of the 516 students who completed the baseline survey, 352 (68.2% of those who met eligibility criteria) attended the in-person training session and started the daily portion of the year-long study. Students who did not participate in the daily portion of the study did not differ from those who participated on age, gender, and total drinks per week at baseline. Five participants were excluded from the current study due to missing data on fraternity/sorority affiliation ($n = 1$) or on negative mood/perceived stress and/or drinking ($n = 4$), resulting in an analytic sample of 347 frequent drinkers.

Data collection for the daily portion of this study was completed using an automated telephone system. Daily assessments occurred for two weeks (14 consecutive days) per quarter for a total of four quarters over the course of one year, yielding a total of 56 possible interview days. Participants were prompted to complete brief assessments (<10 minutes) three times per day: morning (9am-noon), afternoon (3-6pm), and evening (9pm-midnight). Participants were compensated \$2 for each completed assessment, plus a \$16 bonus if they completed 36 or more of the 42 possible assessments for each two-week period. To avoid overburdening participants, each assessment focused on a different set of variables. The morning assessment focused on yesterday's drinking and alcohol-related consequences. The

afternoon assessment focused on alcohol expectancies and plans for drinking (not utilized in the present manuscript). The evening assessment focused on the social context of evening activities as well as mood and stress variables, which were only available in the evening assessment. Thus, our measures of negative mood and perceived stress were drawn from the evening assessment, and drinking on a given day was drawn from the morning assessment on the next day.

Measures

Baseline Variables—Demographic characteristics included as covariates/moderators of the main analyses were age, sex, and fraternity/sorority affiliation. To better describe the study sample, sum scores from the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and the Alcohol Use Disorder Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders, & Monteiro, 2001) were reported.

Daily Negative Mood—Participants were asked to rate their daily negative mood in the evening assessment. Daily negative mood was measured by the average of four items, which included participants' self-ratings of loneliness, anger, irritability, and depression on the day of the assessment. The response options ranged from 1 = “*not at all*” to 9 = “*very much*”. Cronbach's alpha for this scale based on the person-level mean of each individual mood item was 0.90.

Daily Perceived Stress—Participants were asked to rate their daily overall stress level in the evening assessment. Perceived daily stress was measured by the average of two items, which included participants' self-ratings of feeling stressed and overwhelmed on the day of the assessment. The response options ranged from 1 = “*not at all*” to 9 = “*very much*”. Cronbach's alpha for this scale based on the person-level mean of each individual stress item was 0.89.

Same-Day and Next-Day Drinking—During the initial in-person training session, participants were instructed that one drink equals 12 oz. of beer (8 oz. of Canadian, malt liquor, or ice beers or 10 oz. of microbrew); 10 oz. of wine cooler; 4 oz. of wine; or 1 cocktail with 1 oz. of 100 proof liquor or 1 1/4 oz. of 80 proof liquor. An open-ended question was asked the next morning to assess the total number of alcoholic drinks consumed the previous day.

Study Period and Weekend—Study period (0 = “*1st quarter of daily reporting*”; 3 = “*4th quarter of daily reporting*”) and weekend (0 = “*Sunday to Wednesday*”; 1 = “*Thursday to Saturday*”) were also included as covariates in our multilevel models. For next-day models, weekend refers to whether the next day was a weekend day.

Statistical Analyses

We obtained descriptive statistics in SPSS and STATA, and conducted our primary analyses in Mplus 7.31 (Muthén & Muthén, 1998–2015). Multilevel modeling was used to account for the clustering of daily observations within individuals. Intercept only models were first estimated, with intraclass correlations of 0.11 for both same-day and next-day drinking,

indicating that 11% of the total variance in daily drinking was attributable to between-person individual characteristics as opposed to within-person daily variations. Covariates and predictors were then added in a stepwise fashion, leading to the full model with daily negative mood or perceived stress (person-centered), study period, and weekend included as level-1 predictors, and age, sex, Fraternity/sorority affiliation, and person-mean negative mood or perceived stress (grand mean centered) included as level-2 predictors. Parallel models were used to examine the effects of negative mood and perceived stress on drinking. Same-day and next-day drinking were examined in different models, resulting in a total of four multilevel models. Cross-level interactions were tested with level-2 sex and Fraternity/sorority affiliation predicting the level-1 slope of daily negative mood/perceived stress on drinking.

To account for the large preponderance of zeros (i.e., no drinking on a given day), we utilized zero-inflated Poisson (ZIP) multilevel models for all analyses, which best model fit compared to linear or Poisson regressions. ZIP models decompose the variance in drinking into two parts: the likelihood of *not drinking* and the level of drinking among those who drink.

Results

Descriptive Statistics

Descriptive statistics and bivariate correlations among between-level variables are presented in Table 1. Averaged across all days, negative mood and perceived stress were inversely associated with same-day and next-day drinking. In terms of baseline drinking level, the study sample had a mean AUDIT score of 13.71 ($SD = 5.47$), which was higher than the cutoff of 8 or above, indicating many students had some hazardous alcohol use (Babor et al., 2001). In terms of baseline mood level, the study sample had mean scores of 35.08 ($SD = 6.78$) and 22.44 ($SD = 6.68$) on the positive and negative subscales of the PANAS, respectively. These PANAS scores were comparable to past-year PANAS scores reported in the original scale validation study (positive scale: $M = 36.2$, $SD = 6.3$; negative scale: $M = 22.1$, $SD = 6.4$; Watson et al., 1988). For the multilevel ZIP models, there were a total of 12,365 and 11,300 daily observations for same-day and next-day drinking, respectively. Of all days assessed, zero number of drinks was reported on 65% of same days and 64% of next days.

Negative Mood and Drinking

The effects of negative mood on same-day and next-day drinking are presented in Table 2. Between-person analyses showed that college students further in their college career were more likely to report any drinking, but reported less alcohol use when they drank. On average, females reported consuming fewer drinks than males. Fraternity/sorority affiliated students reported consuming more drinks than students who were unaffiliated with fraternity/sorority. Within-person daily analyses showed that, after controlling for study period and weekend effects, days with greater than average negative mood were associated with greater likelihood of abstaining from drinking on the same day, but were associated with consuming more drinks on the next day. Supplementary analyses exploring the role of

covariates indicated that all main findings remained significant after excluding the covariates of age, sex, fraternity/sorority affiliation, and weekend drinking.

Perceived Stress and Drinking

The effects of perceived stress on same-day and next-day drinking are presented in Table 3. Between-person analyses showed similar covariate effects as in the negative mood model. Higher person-mean perceived stress was associated with a greater likelihood of abstaining from drinking. Within-person daily analyses showed that, after controlling for study period and weekend effects, greater than average perceived stress was associated with a greater likelihood of abstaining from drinking and consuming fewer drinks on the same day. Supplementary analyses indicated that the exclusion of age, sex, fraternity/sorority affiliation, and weekend drinking did not attenuate any significant findings.

Cross-Level Interactions by Sex and Fraternity/sorority Affiliation

Cross-level interactions are presented in Tables 4 (for negative mood) and 5 (for perceived stress). Greater than average negative mood was associated with consuming fewer drinks on the same day among students unaffiliated with fraternity/sorority ($b = -0.03$, $SE = 0.01$, $p = 0.02$), but not among students affiliated with fraternity/sorority ($b < 0.01$, $SE = 0.01$, $p = 0.88$). Greater than average perceived stress was more strongly associated with a greater likelihood of abstaining from drinking on the same day for females ($b = 0.21$, $SE = 0.02$, $p < 0.001$) than for males ($b = 0.12$, $SE = 0.02$, $p < 0.001$). Greater than average perceived stress was associated with consuming fewer drinks on the same day among students unaffiliated with fraternity/sorority ($b = -0.05$, $SE = 0.01$, $p < 0.001$), but not among students affiliated with fraternity/sorority ($b = -0.01$, $SE = 0.01$, $p = 0.69$). Greater than average perceived stress had a trending inverse association with next-day drinking level among students unaffiliated with fraternity/sorority ($b = -0.02$, $SE = 0.01$, $p = 0.07$), and was not associated with next-day drinking level among students affiliated with fraternity/sorority ($b = 0.01$, $SE = 0.01$, $p = 0.11$).

Discussion

In a sample of high-risk drinking college students, on average, having greater negative mood and perceived stress across the study period was associated with a lower likelihood of drinking. Daily-level analyses similarly showed that higher negative mood and perceived stress on a given day was associated with lower likelihood of drinking on that day. Thus, overall, we found little support for the notion that college students drink more in face of negative mood or perceived stress. The only exception to this general pattern is that daily negative mood (but not daily perceived stress) was positively associated with greater *next-day* drinking. This suggests that the lagged effects on the number of drinks consumed on the next day were specific to experiencing elevated negative mood on the previous day. It may be that academic work is a source of stress experienced by college students, and the expected cognitive impairment associated with drinking may prevent college students from drinking on any given day with greater stress as it may impair their performance on important coursework, assignments, and exams. In contrast, college students who experience negative mood may view drinking as a helpful way to deal with negative emotions because

drinking with friends offers the opportunity for social support. Although speculative, it is possible that asking friends out for drinks to talk about emotionally disturbing topics may require some planning (e.g., friends may not be immediately available on the same day), and thus may be more likely to occur only on the next day.

Students in the current study were more likely to abstain from drinking on days when they experienced greater than average daily negative mood and perceived stress. Elevations in daily negative mood and perceived stress may underscore the need for a person to “deal with the situation” on the same day (e.g., complete assignments or resolve an interpersonal conflict first), and so same-day drinking may be counterproductive. Although inconsistent with internalizing and developmental overload models of alcohol use, our current findings are similar to those reported in two prior studies of first-year college students (Rankin & Maggs, 2006) and young adults who did not attend college (Patrick, Yeomans-Maldonado, & Griffin, 2015). It is possible that daily elevations in negative mood may only be associated with increased drinking among older individuals with established problems with alcohol. Alternatively, variations in the measurement of negative mood may partially account for differences across studies. For instance, Swendsen et al. (2000) found that within-person daily elevation in nervousness was associated with increased drinking, whereas Hussong, Galloway, and Feagans (2005) found that college students with high coping motives drank more on days when they experienced moderate to high levels of fear and shyness. These findings imply that the associations between negative mood and drinking may vary depending on the utilized set of negative mood items.

Similarly, high-risk college students were more likely to abstain from drinking on the same day as they experienced greater than average perceived stress. This pattern of results is comparable to findings reported among heavy drinking adult males (Armeli et al., 2000; Helzer et al., 2006), suggesting that the effect of perceived stress (in contrast to negative mood) on drinking may be relatively similar in different samples with varied severity in alcohol problems. The perceived stress by sex cross-level interaction indicated that females are more likely than males to not drink on the same day when they experienced elevated daily perceived stress. It is possible that females expect more negative consequences from same-day drinking than males, and so they were less likely to drink on the same day (Nolen-Hoeksema & Hilt, 2006).

Fraternity/sorority affiliation moderated three within-person associations between daily negative mood or perceived stress and drinking. Elevations in daily negative mood and perceived stress were associated with less drinking among those unaffiliated with fraternity/sorority only, which may reflect a “floor effect” due to the overall higher drinking prevalence among fraternity/sorority affiliated students. Past research indicated that fraternity/sorority affiliated students are more vulnerable to increased drinking because of the drinking culture or perceived drinking norms within the Greek system (Larimer et al., 1997). Contrary to our hypothesis, daily negative mood and perceived stress were not robust risk factors for drinking likelihood and level even among fraternity/sorority affiliated students. Collectively, the current findings suggest that, among college students, risk pathways to drinking may not operate through internalizing mechanisms, and highlight the

importance of identify and focusing on alternative risk pathways for college students as intervention targets.

This study has several limitations. First, this sample consisted of frequently drinking college students who were neither representative of the entire college population nor the general population. Thus, our findings may not be generalized to individuals who are not frequent drinkers, who do not attend college, or individuals who are from a different age group. Second, we utilized a combined four-item measure of negative mood. As such, we did not test for potential differential associations between various negative emotions and the likelihood and level of same-day and next-day drinking. Third, given our primary interest in understanding predictors of same-day and next-day drinking, we only tested daily negative mood and perceived stress as predictors of drinking outcomes. The alternative direction of effects cannot be ruled out. Finally, we did not test drinking-to-cope motives (Hussong, Galloway, & Feagans, 2005; Hussong, 2007; O'Hara, Armeli, & Tennen, 2014) and avoidant coping strategies (Aldridge-Gerry et al., 2011; Cooper et al., 1992) as possible moderators of the negative mood or perceived stress and next-day drinking associations. Finally, we did not explicitly ask our study participants to report what prompted their negative mood or perceived stress, which could have provided greater insight into how to best interpret the current findings. Future research is needed to understand whether academic, interpersonal, or other factors may drive or explain the daily-level associations observed in the current study.

Despite these limitations, the current study offers insight into the mixed literature on negative mood, perceived stress, and drinking behaviors. Our findings are mostly inconsistent with the frequently held assumption that daily negative mood and perceived stress are significant precursors of drinking behaviors. Interpreted within the context of the broader literature, within-person associations between negative mood, perceived stress, and drinking behaviors may vary based on individuals' age and level of alcohol involvement. Our finding on next-day drinking also adds to a growing literature on potential lagged effects on drinking behaviors. Future research should test the cumulative effects of negative mood and perceived stress on drinking behaviors over time, and explore possible lagged effects on the weekly or quarterly level. Ultimately, an improved understanding of when and for whom negative mood and perceived stress may lead to elevated drinking will help clinicians identify intervention targets that are most relevant to their particular clients.

References

- Aldridge-Gerry AA, Roesch SC, Villodas F, McCabe C, Leung QK, Da Costa M. Daily stress and alcohol consumption: Modeling between-person and within-person ethnic variation in coping behavior. *Journal of Studies on Alcohol and Drugs*. 2011; 72(1):125–134. [PubMed: 21138719]
- Armeli S, Carney MA, Tennen H, Affleck G, O'Neil T. Stress and alcohol use: A daily process examination of the stressor–vulnerability model. *Journal of Personality and Social Psychology*. 2000; 78(5):979–994. [PubMed: 10821203]
- Armeli S, Tennen H, Affleck G, Kranzler HR. Does affect mediate the association between daily events and alcohol use? *Journal of Studies on Alcohol*. 2000; 61(6):862–871. [PubMed: 11188492]
- Armeli S, Tennen H, Todd M, Carney MA, Mohr C, Affleck G, Hromi A. A daily process examination of the stress-response dampening effects of alcohol consumption. *Psychology of Addictive Behaviors*. 2003; 17(4):266–276. [PubMed: 14640822]

- Arnett JJ. The developmental context of substance use in emerging adulthood. *Journal of Drug Issues*. 2005; 35(2):235–254.
- Ayer LA, Harder VS, Rose GL, Helzer JE. Drinking and stress: An examination of sex and stressor differences using IVR-based daily data. *Drug and Alcohol Dependence*. 2011; 115(3):205–212. [PubMed: 21146940]
- Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG. The alcohol use disorders identification test (AUDIT): Guidelines for use in primary care. World Health Organization, Department of Mental Health and Substance Abuse; 2001.
- Carney MA, Armeli S, Tennen H, Affleck G, O'Neil TP. Positive and negative daily events, perceived stress, and alcohol use: a diary study. *Journal of Consulting and Clinical Psychology*. 2000; 68(5): 788–798. [PubMed: 11068965]
- Colder CR, Chassin L. The stress and negative affect model of adolescent alcohol use and the moderating effects of behavioral undercontrol. *Journal of Studies on Alcohol*. 1993; 54(3):326–333. [PubMed: 8487542]
- Cooper ML, Russell M, Skinner JB, Frone MR, Mudar P. Stress and alcohol use: Moderating effects of gender, coping, and alcohol expectancies. *Journal of Abnormal Psychology*. 1992; 101(1):139–152. [PubMed: 1537960]
- Cooper ML, Frone MR, Russell M, Mudar P. Drinking to regulate positive and negative emotions: a motivational model of alcohol use. *Journal of Personality and Social Psychology*. 1995; 69(5):990–1005. [PubMed: 7473043]
- Crooke AH, Reid SC, Kauer SD, McKenzie DP, Hearps SJ, Khor AS, Forbes AB. Temporal mood changes associated with different levels of adolescent drinking: Using mobile phones and experience sampling methods to explore motivations for adolescent alcohol use. *Drug and Alcohol Review*. 2013; 32(3):262–268. [PubMed: 23432520]
- Doumas DM. Daytime predictors of evening alcohol use: Treatment implications for moderate to heavy drinkers. *Alcoholism Treatment Quarterly*. 2012; 30(1):78–90.
- Greeley J, Oei T. Alcohol and tension reduction. In: Leonard KE, Blane HT, editors *Psychological theories of drinking and alcoholism*. 2. New York: Guilford Press; 1999. 14–53.
- Grzywacz JG, Almeida DM. Stress and binge drinking: A daily process examination of stressor pile-up and socioeconomic status in affect regulation. *International Journal of Stress Management*. 2008; 15(4):364–380. [PubMed: 19578556]
- Harder VS, Ayer LA, Rose GL, Naylor MR, Helzer JE. Alcohol, moods and male–female differences: Daily interactive voice response over 6 months. *Alcohol and Alcoholism*. 2014; 49(1):60–65. [PubMed: 23847021]
- Helzer JE, Badger GJ, Searles JS, Rose GL, Mongeon JA. Stress and alcohol consumption in heavily drinking men: 2 years of daily data using interactive voice response. *Alcoholism: Clinical and Experimental Research*. 2006; 30(5):802–811.
- Hingson RW, Zha W, Weitzman ER. Magnitude of and trends in alcohol-related mortality and morbidity among U.S. college students ages 18–24, 1998–2005. *Journal of Studies on Alcohol and Drugs, Supplement*. 2009; (16):12–20. [PubMed: 19538908]
- Howard AL, Patrick ME, Maggs JL. College student affect and heavy drinking: Variable associations across days, semesters, and people. *Psychology of Addictive Behaviors*. 2015; 29(2):430–443. [PubMed: 25347017]
- Hussong AM. Predictors of drinking immediacy following daily sadness: An application of survival analysis to experience sampling data. *Addictive Behaviors*. 2007; 32(5):1054–1065. [PubMed: 16934413]
- Hussong AM, Galloway CA, Feagans LA. Coping motives as a moderator of daily mood–drinking covariation. *Journal of Studies on Alcohol*. 2005; 66(3):344–353. [PubMed: 16047523]
- Hussong AM, Jones DJ, Stein GL, Baucom DH, Boeding S. An internalizing pathway to alcohol use and disorder. *Psychology of Addictive Behaviors*. 2011; 25(3):390–404. [PubMed: 21823762]
- Johnston LD, O'Malley PM, Bachman JG, Schulenberg JE, Miech RA. Monitoring the Future national survey results on drug use, 1975–2015: Volume 2, College students and adults ages 19–55. Ann Arbor: Institute for Social Research, The University of Michigan; 2016.

- Kauer SD, Reid SC, Sanci L, Patton GC. Investigating the utility of mobile phones for collecting data about adolescent alcohol use and related mood, stress and coping behaviours: Lessons and recommendations. *Drug and Alcohol Review*. 2009; 28(1):25–30. [PubMed: 19320672]
- Knight JR, Wechsler H, Kuo M, Seibring M, Weitzman ER, Schuckit MA. Alcohol abuse and dependence among U.S. college students. *Journal of Studies on Alcohol*. 2002; 63(3):263–270. [PubMed: 12086126]
- Larimer ME, Irvine DL, Kilmer JR, Marlatt GA. College drinking and the Fraternity/sorority system: Examining the role of perceived norms for high-risk behavior. *Journal of College Student Development*. 1997; 38:587–598.
- Nolen-Hoeksema S, Hilt L. Possible contributors to the gender differences in alcohol use and problems. *The Journal of General Psychology*. 2006; 133(4):357–374. [PubMed: 17128956]
- O'Hara RE, Armeli S, Tennen H. Drinking-to-cope motivation and negative mood–drinking contingencies in a daily diary study of college students. *Journal of Studies on Alcohol and Drugs*. 2014; 75(4):606–614. [PubMed: 24988259]
- Park A, Sher KJ, Krull JL. Selection and socialization of risky drinking during the college transition: The importance of microenvironments associated with specific living units. *Psychology of Addictive Behaviors*. 2009; 23(3):404–414. [PubMed: 19769425]
- Park CL, Armeli S, Tennen H. The daily stress and coping process and alcohol use among college students. *Journal of Studies on Alcohol*. 2004; 65(1):126–135. [PubMed: 15000512]
- Patrick ME, Yeomans-Maldonado G, Griffin J. Daily reports of positive and negative affect and alcohol and marijuana use among college student and nonstudent young adults. *Substance Use & Misuse*. 2016; 51(1):54–61. [PubMed: 26683453]
- Rankin LA, Maggs JL. First-year college student affect and alcohol use: Paradoxical within-and between-person associations. *Journal of Youth and Adolescence*. 2006; 35(6):925–937.
- Routon PW, Walker JK. The impact of Greek organization membership on collegiate outcomes: Evidence from a national survey. *Journal of Behavioral and Experimental Economics*. 2014; 49:63–70.
- Sayette MA. Does drinking reduce stress? *Alcohol Research and Health*. 1999; 23(4):250–255. [PubMed: 10890821]
- Schulenberg JE, Maggs JL. A developmental perspective on alcohol use and heavy drinking during adolescence and the transition to young adulthood. *Journal of Studies on Alcohol, Supplement*. 2002; (14):54–70. [PubMed: 12022730]
- Scott-Sheldon LA, Carey KB, Carey MP. Health behavior and college students: Does Fraternity/sorority affiliation matter? *Journal of Behavioral Medicine*. 2008; 31(1):61–70. [PubMed: 17999173]
- Seo DC, Li K. Effects of college climate on students' binge drinking: Hierarchical generalized linear model. *Annals of Behavioral Medicine*. 2009; 38(3):262–268. [PubMed: 20087704]
- Simons JS, Gaher RM, Oliver MN, Bush JA, Palmer MA. An experience sampling study of associations between affect and alcohol use and problems among college students. *Journal of Studies on Alcohol*. 2005; 66(4):459–469. [PubMed: 16240553]
- Swendsen JD, Tennen H, Carney MA, Affleck G, Willard A, Hromi A. Mood and alcohol consumption: An experience sampling test of the self-medication hypothesis. *Journal of Abnormal Psychology*. 2000; 109(2):198–204. [PubMed: 10895557]
- Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*. 1988; 54(6):1063–1070. [PubMed: 3397865]

Table 1

Descriptive statistics and bivariate correlations among between-level predictors and drinking outcomes ($n = 347$)

	<i>M (n)</i>	<i>SD (%)</i>	1.	2.	3.	4.	5.
1. Age	19.71	1.25	1.00				
2. Female	(185)	(53.3%)	-0.09	1.00			
3. Fraternity/sorority affiliation	(191)	(55.0%)	-0.32***	-0.04	1.00		
4. Person-mean negative mood	3.47	0.99	-0.22***	0.14**	0.05	1.00	
5. Person-mean perceived stress	4.36	1.02	-0.16**	0.31***	0.04	0.65***	1.00
6. Person-mean same-day drinking	1.88	1.32	0.06	-0.31***	0.16**	-0.12*	-0.30***
7. Person-mean next-day drinking	1.98	1.40	0.04	-0.26***	0.21***	-0.13*	-0.18***

Note. Frequencies and percentages were reported for sex and fraternity/sorority affiliation. Means and standard deviations are presented for person-mean predictors and outcomes.

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$.

Table 2

The effects of daily negative mood on same-day and next-day drinking

Same-day drinking as outcome									
	Predicting no drinking			<i>p</i>	Predicting drinking level if drink			<i>z</i>	<i>p</i>
	<i>b</i>	<i>SE</i>	<i>z</i>		<i>b</i>	<i>SE</i>	<i>z</i>		
<u>Between-person level</u>									
Intercept	1.05	0.10	11.03	<0.001	1.62	0.05	35.29	<0.001	
Older	-0.22	0.04	-5.49	<0.001	-0.07	0.02	-3.19	<0.01	
Female	0.08	0.09	0.90	0.37	-0.28	0.04	-7.04	<0.001	
Fraternity/sorority affiliation	-0.04	0.09	-0.39	0.69	0.23	0.05	5.09	<0.001	
Person-mean negative mood	0.13	0.05	2.65	0.01	0.02	0.02	0.68	0.50	
<u>Within-person daily level</u>									
Study period	0.01	0.02	0.52	0.60	-0.06	0.01	-6.01	<0.001	
Weekend	-1.01	0.04	-22.98	<0.001	0.20	0.02	8.88	<0.001	
Daily negative mood	0.17	0.02	8.17	<0.001	-0.01	0.01	-1.25	0.21	
Next-day drinking as outcome									
	Predicting no drinking			<i>p</i>	Predicting drinking level if drink			<i>z</i>	<i>p</i>
	<i>b</i>	<i>SE</i>	<i>z</i>		<i>b</i>	<i>SE</i>	<i>z</i>		
<u>Between-person level</u>									
Intercept	1.03	0.09	10.99	<0.001	1.64	0.05	35.92	<0.001	
Older	-0.22	0.04	-5.15	<0.001	-0.06	0.02	-3.06	<0.01	
Female	0.07	0.09	0.80	0.42	-0.28	0.04	-7.21	<0.001	
Fraternity/sorority affiliation	-0.04	0.09	-0.46	0.65	0.25	0.04	5.70	<0.001	
Person-mean negative mood	0.15	0.05	2.99	<0.01	<0.01	0.02	0.02	0.98	
<u>Within-person daily level</u>									
Study period	0.01	0.02	0.41	0.68	-0.06	0.01	-5.86	<0.001	
Weekend	-1.06	0.05	-22.85	<0.001	0.19	0.02	8.39	<0.001	
Daily negative mood	<0.01	0.02	0.22	0.83	0.02	0.01	2.37	0.02	

Table 3

The effects of daily perceived stress on same-day and next-day drinking

	Same-day drinking as outcome							
	Predicting no drinking				Predicting drinking level if drink			
	<i>b</i>	<i>SE</i>	<i>z</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>z</i>	<i>p</i>
<u>Between-person level</u>								
Intercept	1.04	0.09	11.16	<0.001	1.61	0.05	34.95	<0.001
Older	-0.23	0.04	-5.63	<0.001	-0.07	0.02	-3.30	<0.01
Female	0.01	0.09	0.09	0.93	-0.28	0.04	-6.64	<0.001
Fraternity/sorority affiliation	-0.03	0.09	-0.32	0.76	0.23	0.05	5.08	<0.001
Person-mean perceived stress	0.18	0.05	3.68	<0.001	-0.01	0.03	-0.31	0.76
<u>Within-person daily level</u>								
Study period	0.03	0.02	1.59	0.11	-0.06	0.01	-6.08	<0.001
Weekend	-0.98	0.04	-22.43	<0.001	0.20	0.02	8.70	<0.001
Daily perceived stress	0.17	0.01	11.90	<0.001	-0.02	0.01	-3.55	<0.001
<u>Next-day drinking as outcome</u>								
	Predicting no drinking				Predicting drinking level if drink			
	<i>b</i>	<i>SE</i>	<i>z</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>z</i>	<i>p</i>
	<i>b</i>	<i>SE</i>	<i>z</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>z</i>	<i>p</i>
<u>Between-person level</u>								
Intercept	1.07	0.09	11.36	<0.001	1.63	0.05	35.89	<0.001
Older	-0.22	0.04	-5.30	<0.001	-0.06	0.02	-3.14	<0.01
Female	<0.001	0.09	0.04	0.97	-0.28	0.04	-6.80	<0.001
Fraternity/sorority affiliation	-0.04	0.09	-0.40	0.69	0.25	0.04	5.71	<0.001
Person-mean perceived stress	0.17	0.05	3.82	<0.001	-0.01	0.02	-0.48	0.64
<u>Within-person daily level</u>								
Study period	0.01	0.02	0.48	0.63	-0.06	0.01	-5.72	<0.001
Weekend	-1.06	0.05	-22.87	<0.001	0.19	0.02	8.48	<0.001
Daily perceived stress	<0.001	0.01	-0.03	0.98	<0.001	0.01	-0.08	0.94

Table 4
Negative mood and drinking: Cross-level interactions by sex and fraternity/sorority affiliation

	Same-day drinking as outcome					
	Predicting slope of negative mood on no drinking			Predicting slope of negative mood on drinking level if drink		
	<i>b</i>	<i>SE</i>	<i>z</i>	<i>p</i>	<i>b</i>	<i>p</i>
Intercept of random slope	0.18	0.04	4.87	<0.001	-0.05	0.02
Sex	0.05	0.04	1.25	0.21	<-0.01	0.02
Fraternity/sorority affiliation	-0.02	0.04	-0.61	0.54	0.04	1.97
						<0.05

	Next-day drinking as outcome					
	Predicting slope of negative mood on no drinking			Predicting slope of negative mood on drinking level if drink		
	<i>b</i>	<i>SE</i>	<i>z</i>	<i>p</i>	<i>b</i>	<i>p</i>
Intercept of random slope	-0.02	0.03	-0.57	0.57	0.02	0.02
Sex	0.01	0.03	0.29	0.77	-0.02	0.02
Fraternity/sorority affiliation	0.03	0.03	0.93	0.35	<-0.01	0.02
						0.95

Note. Preliminary analyses explored sex by fraternity/sorority affiliation interactions on random slope of negative mood on drinking. Because these interactions were all not significant, they were excluded from the final analyses. The significant cross-level interaction is highlighted in **bold**.

Table 5
Perceived stress and drinking: Cross-level interactions by sex and fraternity/sorority affiliation

	Same-day drinking as outcome					
	Predicting slope of perceived stress on no drinking			Predicting slope of stress perceived on drinking level if drink		
	<i>b</i>	<i>SE</i>	<i>z</i>	<i>p</i>	<i>b</i>	<i>p</i>
Intercept of random slope	0.14	0.03	5.05	<0.001	-0.07	-4.19 <0.001
Sex	0.08	0.03	2.87	<0.01	<-0.01	-0.23 0.82
Fraternity/sorority affiliation	0.03	0.03	1.16	0.25	0.07	0.02 4.44 <0.001

	Next-day drinking as outcome					
	Predicting slope of perceived stress on no drinking			Predicting slope of perceived stress on drinking level if drink		
	<i>b</i>	<i>SE</i>	<i>z</i>	<i>p</i>	<i>b</i>	<i>p</i>
Intercept of random slope	<0.01	0.02	0.19	0.85	-0.02	-1.60 0.11
Sex	0.01	0.02	0.61	0.54	0.01	0.47 0.64
Fraternity/sorority affiliation	-0.04	0.02	-1.51	0.13	0.03	0.01 2.23 0.03

Note. Preliminary analyses explored sex by fraternity/sorority affiliation interactions on random slope of stress on drinking. Because these interactions were all not significant, they were excluded from the final analyses. Significant cross-level interactions are highlighted in **bold**.