BINGE ANGST: AN INVESTIGATION OF AFFECTIVE DISTRESS THE DAY AFTER BINGE DRINKING

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ABSTRACT

The well-documented relationship between alcohol use and affective distress can be destructive, in many cases leading to negative physiological, social, and legal consequences. Binge drinking, defined as a pattern of drinking that brings blood alcohol concentration levels to 0.08 g/dL, typically reached after drinking more than 4 (for women) or 5 (for men) standard drinks in under two hours, is an increasingly popular activity, particularly among young people, and rates of binge drinking spike around the same time lifelong patterns of alcohol abuse are being established. Given the prominence of negative affect and associated constructs (i.e., repetitive negative thought, intolerance of uncertainty, anxiety sensitivity, self-efficacy) in models of alcohol use, anxiety, and mood disorders, the present study examines the predictors and consequences of negative affect and associated constructs the day after binge drinking.

Our primary aims were: (a) to determine the prevalence of negative affect the day after binge drinking in a large, undergraduate sample, and (b) to examine differences in negative affect, post-event processing, and negative perceived self-efficacy between individuals on days following binge drinking as compared to days following abstinence and to assess whether neuroticism moderated these differences. Secondary aims included examining predictors of situational avoidance, changes in alcohol use and negative affect, and psychological factors associated with neuroticism and increases in negative affect (i.e., alcohol-induced memory losses and intolerance of uncertainty, physical hangover symptoms and anxiety sensitivity). We hypothesized that types of negative affect (e.g., anxiety, depression, guilt) would be reported by 5% to 25% of the sample and that

individuals in the binge group would report higher levels of state negative affect, post-event processing, and negative perceived self-efficacy in academic, social, and coping domains than individuals in the abstinence group. Further, we predicted that higher levels of neuroticism would be associated with higher levels of the outcome variables. Neuroticism was expected to moderate the main effect of group such that neuroticism would have a greater effect in the binge group than in the abstinence group.

To these ends, the study was conducted in two parts: first, prevalence of negative affect the day after binge drinking was assessed in a large, undergraduate sample (N = 808). Then, a subsample (n = 139) was recruited to participate in a longitudinal, quasi-experimental examination in which participants were assessed at three time points: baseline, the day following either a night of binge drinking or a night of abstinence, and two weeks following their second assessment. In line with hypotheses, types of negative affect ranged in prevlance from 22.8% of the sample (Apathy) to 1.0% of the sample (Suicidal thoughts). In addition, negative affect, post-event processing, and negative perceived self-efficacy in academic, social, and coping domains were higher on days following binge drinking compared to days following abstinence. Of note, neuroticism did not moderate any of these relationships. Additional results and implications are discussed.

This dissertation is dedicated to

my wife, Meredith,

for her boundless love and acceptance,

and

my grandmother, Ethel,

for teaching me to bake pie.

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CHAPTER 1

INTRODUCTION

A high rate of comorbidity between alcohol use disorder (AUD) and anxiety and mood disorders has been demonstrated in clinical and epidemiological samples (e.g., Burns & Teesson, 2002; Chambless, Cherney, Caputo, & Rheinstein, 1987; Grant et al., 2004; Kessler, Chiu, Demler, Merikangas, & Walters, 2005; Kessler et al., 1997; Regier et al., 1990; Swendsen et al., 1998), and considerable evidence suggests the relationship is particularly pernicious. Comorbidity among AUD and anxiety and mood disorders is associated with tremendous personal and societal cost; "dual diagnosis" cases demonstrate more severe symptoms, higher risk of suicide, and greater overall disability (Burns & Teesson, 2002; Cho et al., 2002; Grant, Hasin, & Dawson, 1996; Hirschfeld, Hasin, Keller, Endicott, & Wunder, 1990; Waller, Lyons, & Costantini-Ferrando, 1999). Further, comorbid cases are more likely to use treatment services and to use more of them (Burns & Teesson, 2002), in part due to the lack of durable treatment effects (Bruce et al., 2005; Buckner, Timpano, Zvolensky, Sachs-Ericsson, & Schmidt, 2008; Driessen et al., 2001; Kushner et al., 2005; Schellekens, de Jong, Buitelaar, & Verkes, 2015).

Many contemporary models of AUD and anxiety and mood disorders suggest that individuals use alcohol to avoid and/or cope with aversive stimuli. Khantzian's (1997) self-medication hypothesis, for example, posits that individuals consume alcohol to cope with existing affective distress (e.g., "I drink to forget"). Similarly, some psychodynamic models interpret addiction as an attempt to quiet and/or rebel against an overactive and oppressive superego (e.g., the criticizing, judging self; Wurmser, 1987). In addition, the withdrawal-relief model suggests that vicious cycles of substance use are maintained by

the onset of aversive withdrawal symptoms that are only relieved by further substance use (Newlin & Pretorius, 1990; Span & Earleywine, 1999). Though several causal and shared etiological pathways between AUD and anxiety and mood disorders have been proposed (see Lehman, Myers, & Corty, 1989, for a review), the preponderance of epidemiological evidence suggests a bidirectional, interpenetrating relationship (Falk, Yi, & Hilton, 2008; Swendsen et al., 1998). Although many of these theories have received empirical support, our understanding of the development and maintenance of AUD comorbid with anxiety and mood disorders remains modest at best.

Alcohol consumption is a common practice in the United States, with 70.7% of adults reporting at least some alcohol use in the past year and 56.4% reporting use in the past month (Substance Abuse and Mental Health Services Administration, 2014). Though most adults tend to engage in light to moderate alcohol use, *binge drinking* (i.e., drinking to a blood alcohol concentration of 0.08 gram percent or above, which typically corresponds to consuming five or more standard drinks for men, or four or more drinks for women, over a 2-hour period; National Institute of Alcohol Abuse and Alcoholism [NIAAA], 2004) is becoming more prevalent, particularly among youth (Courtney & Polich, 2009; Lange et al., 2002; Naimi et al., 2003; Wechsler & Nelson, 2001). One national study of over 200,000 adults in the United States found that, between 1993 and 2001, the average number of binge-drinking episodes per person per year increased from 9.8 to 15.3 for individuals aged 18-20 and from 14.1 to 18.0 for individuals aged 21-25 (Naimi et al., 2003).

Though we often associate binge drinking with negative physical repercussions (e.g., headache, nausea, dehydration, and other symptoms typically associated with

alcohol hangover), some evidence suggests that heavy consumption of alcohol over a short period of time also leads to a host of psychological consequences, including greater levels of negative affect (e.g., anxiety, depression, guilt) (Graham et al., 2011; Muraven, Collins, Morsheimer, Shiffman, & Paty, 2005; Smith & Barnes, 1983). Experimental studies have demonstrated fairly consistently that anxiety is greater on the days after alcohol consumption compared to the days after abstinence (e.g., Collins & Chiles, 1980; McKinney & Coyle, 2004, 2007; Streufert et al., 1995), and a few studies have found higher scores on measures of affective distress (Howland et al., 2010; McKinney & Coyle, 2006). Despite these preliminary findings and the well-documented high rate of comorbidity between AUD and anxiety and mood disorders (e.g., Kessler et al., 2005), only one study has examined psychological symptoms experienced the day after alcohol use as potential contributors to subsequent alcohol use or negative affect. Muraven et al. (2005) found that heightened distress regarding one's quantity of alcohol consumption the night before predicted higher levels of alcohol consumption and shorter time to next drink the subsequent two days. Though this study limited its examination of negative affect to that associated with the quantity of one's alcohol consumption, it provides some evidence that distress following heavy drinking may impact future behavior.

Epidemiological studies suggest that higher levels of negative affect may not occur the day after binge drinking for all individuals. In studies of alcohol hangover, prevalence estimates of anxiety range from 7.4% (Penning et al., 2012) to 18.0% (Smith & Barnes, 1983), and prevalence estimates of depressed mood hover around 20% (18.9%, Penning et al., 2012; 20%, Smith & Barnes, 1983). One possible explanation is that individuals experience affective distress following binge drinking only if they are

predisposed to affective distress more generally. *Neuroticism* refers to the relatively stable tendency to respond to challenges (e.g., threat, frustration, loss) with negative emotions (e.g., Costa & McCrae, 1987). Neuroticism is strongly associated with mood, anxiety, and substance use disorders (see Malouff, Thorsteinsson, & Schutte, 2005, for a meta-analytic review) and higher levels of comorbidity among these disorders (Khan, Jacobson, Gardner, Prescott & Kendler, 2005; Weinstock & Whisman, 2006). Further, considerable evidence suggests that individuals high in neuroticism are more likely than individuals low in neuroticism to develop anxiety and mood disorders following stressful life events (e.g., Fanous, Gardner, Prescott, Cancro, & Kendler, 2002; Hutchinson & Williams, 2007; Ormel & Wohlfarth, 1991). Thus, it may be that neuroticism moderates the relationship between binge drinking and negative affect. Moreover, if this is the case, constructs and facets of psychopathology associated with neuroticism may also be relevant. A number of these are reviewed in the following sections.

Post-event processing

The first sober moments following an evening of drunken behavior may be an important period for processing the prior night's events. Considering that alcohol reduces inhibitory control (e.g., Fillmore & Vogel-Sprott, 2000) and anxiety (e.g., Moberg & Curtin, 2009), it is unsurprising that most undergraduate students report experiencing regret or embarrassment regarding things they have done while intoxicated (Kahler, Strong, & Read, 2005; Verster et al., 2009). Fjær (2012) conducted an exploratory qualitative study of social behaviors among Norwegian college students the morning after drinking and described this phenomenon as *binge angst* (Norwegian: *fylleangst*). Participants reported that binge angst is primarily concerned with fear that one has done

something that might elicit negative evaluation from peers. Further, participants reported that binge angst was far more undesirable than the physical aspects of hangover. In an extension of his original study, Fjær (2015) cites the report of one 18-year-old participant:

> Many people can get a hangover without being embarrassed about what they did the day before. But the binge angst is, like, you have to think about what you did the day before. So I would say it's more of a psychological hangover, more mental, where you go through everything in your head and get embarrassed. I remember once I woke up with a terrible, terrible binge angst. I was about to cry. Everything I had done seemed like the world's most embarrassing and [I thought] "My God, why did I say that?" I had met my friend's ex-boyfriend [and] told him he was a real idiot. I thought that now he'll go after me for it and write on Facebook that I'm a jerk. (p. 303)

Notably, this bears a striking resemblance to *post-event processing*, that is, the prolonged, repeated, and often negative reflection and mental reconstruction of one's behavior following a social situation. Though originally investigated as a mechanism maintaining social anxiety disorder (see Brozovich & Heimberg, 2008, for a review), post-event processing has been demonstrated to occur across the anxiety disorders (Laposa, Collimore, & Rector, 2014) and is similar to the types of repetitive negative thought known to occur in other anxiety and mood disorders (i.e., worry, rumination) (McEvoy, Mahoney, & Moulds, 2010). Studies have demonstrated that post-event processing is positively associated with alcohol use (Battista & Kocovski, 2010; Battista,

Pencer, & Stewart, 2014), but some evidence suggests that this may be true for women only (Battista et al., 2014), potentially helping to explain observed gender differences in alcohol use disorder (e.g., Brady & Randall, 1999). Higher levels of post-event processing the day after binge drinking may exacerbate existing affective distress, worsening symptoms for individuals experiencing anxiety or mood disorders and potentially contributing to development of these disorders for at-risk individuals. Further, individuals may cope with this distress by increasing alcohol consumption, which, in turn, may intensify patterns of problematic alcohol use.

Alcohol blackout and intolerance of uncertainty

Complicating the picture even further, alcohol blackouts (i.e., periods in which the individual is unable to form new long-term memories while maintaining the ability to perform other tasks, such as talking or walking; Lee, Roh, & Kim, 2009) may also contribute to higher levels of negative affect (see Lee et al., 2009, for a review of alcohol blackouts). Alcohol blackouts can occur *en bloc,* during which an individual experiences complete amnesia, or in a fragmentary manner, in which memories are sparse or intermittent (Hartzler & Fromme, 2003). In a study of 772 undergraduates, 51% of individuals who had ever consumed alcohol reported experiencing at least one lifetime blackout, 40% reported experiencing at least one blackout within the previous year, and 9.4% of individuals who consumed alcohol in the preceding two weeks reported experiencing blackout during that time (White, Jamieson-Drake, & Swartzwelder, 2002). Despite the frequency and severity of alcohol blackout, few studies have examined its psychological consequences, though some evidence suggests it is associated with emotional distress regarding one's behaviors while amnesic (Buelow & Koeppel, 1995).

Although blackout may be an upsetting experience for anyone, it may be particularly distressing for individuals high in *intolerance of uncertainty* (IU; a dispositional fear of the unknown; Carleton, 2012). IU has been shown to be elevated in several of the anxiety disorders and unipolar depression (e.g., Mahoney & McEvoy, 2012), and some evidence suggests that IU mediates the relationship between neuroticism and symptoms of anxiety disorders (McEvoy & Mahoney, 2012). Alcohol blackout offers quintessential uncertainty: a period during which one was awake, active, interacting and intoxicated, but which one cannot remember. Thus, individuals high in IU may experience particularly intense negative affect following blackout.

Alcohol hangover, anxiety sensitivity, misinterpretation of bodily sensations, and emotional reasoning

Alcohol hangover (i.e., a syndrome of unpleasant physiological and psychological effects following the consumption of alcohol and beginning around the time alcohol has been fully metabolized; Wiese, Shlipak, & Browner, 2000) is the most commonly reported negative consequence of drinking (Verster, Van Herwijnen, Olivier, & Kahler, 2009). Most adult drinkers report having at least one lifetime hangover (77%; Harburg, Gunn, Gleiberman, DiFranceisco, & Schork, 1993), around a third (21-35%) report having had a hangover in the past year (Howland et al., 2008; Smith & Barnes, 1983), and 15% report having had a hangover in the past month (Harburg et al., 1993). Hangover is even more frequent among college students: 87% of students report at least one hangover in the past year (Slutske, Piasecki, & Hunt-Carter, 2003) and 25.5% report at least one hangover in the past week (Meilman, Stone, Gaylor, & Turco, 1990). Hangover costs the U.S. an estimated 148 billion dollars per year in absenteeism and poor

job performance (Wiese et al., 2000), and some evidence indicates that greater hangover frequency is associated with increased risk for AUD (Earleywine, 1993; Newlin & Pretorius, 1990). One prospective study suggests that hangover frequency predicts future onset of AUD, even after controlling for intensity and frequency of alcohol consumption and family history (Piasecki, Sher, Slutske, & Jackson, 2005). In another study, men with and without a family history of alcoholism were submitted to an alcohol challenge (McCaul, Turkkan, Svikis, & Bigelow, 1991). Relative to men without a family history, men with a family history of alcoholism reported more intense hangovers and higher levels of alcohol craving. Considering these findings, the occurrence of hangovers may be an important marker of the development of AUD or may even contribute to their development and/or maintenance.

Considering the sometimes severe physical symptoms of alcohol hangover, the day after heavy drinking may also include greater negative affect for individuals high in *anxiety sensitivity*, that is, fear of anxiety-related symptoms arising from beliefs that these symptoms have negative consequences (e.g., heart attacks, mental illness, additional anxiety; Reiss, 1991; Reiss & McNally, 1985). Elevated anxiety sensitivity has been demonstrated across the anxiety disorders (e.g., Taylor, Koch, & McNally, 1992) and substance use disorders (e.g., McNally et al., 1987; Karp, 1989, as cited in Reiss, 1991), and it is associated with the catastrophic misinterpretation of harmless physical symptoms (e.g., Sandin, Sánchez-Arribas, Chorot, & Valiente, 2015). As hangover involves a host of physical symptoms, many of which overlap with symptoms of anxiety (e.g., tachycardia, fatigue, difficulty concentrating), individuals high in anxiety sensitivity may misinterpret hangover symptoms as signs of impending disaster. In addition,

individuals high in neuroticism tend to engage in *emotional reasoning*, that is, they often draw conclusions about situations based on their emotional response (e.g., "I feel anxious, so there must be something wrong") (Arntz, Rauner, & Van den Hout, 1995). Thus, negative affect during hangover may be associated with physical hangover symptoms, particularly for individuals likely to misinterpret them (i.e., individuals high in anxiety sensitivity). If this is the case, one would expect the physical symptoms of hangover to predict negative affect above and beyond the relationship between neuroticism and negative affect and for this relationship to be moderated by anxiety sensitivity.

Negative perceived self-efficacy

Evidence indicating that perceived negative self-efficacy (i.e., the belief that one will not be able to execute behaviors to produce specific outcomes; Bandura, 1977, 1986) increases the day after heavy drinking is fairly robust (Collins & Chiles, 1980; Finnigan et al., 1998, 2005; Howland et al., 2010; Streufert et al., 1995; Verster et al., 2014). Research suggests that, following an evening of heavy alcohol use, individuals tend to believe that they are less able to perform tasks such as managing, driving, or completing tests of achievement, or that they perform more poorly on these tasks. Of note, perceived negative self-efficacy is associated with the development and maintenance of anxiety, depression, and AUD (e.g., Comunian, 1989; Ehrenberg, Cox, & Koopman, 1991; Myers, Brown, & Mott, 1993; Tahmassian & Moghadam, 2011). Accordingly, it is possible that negative perceived self-efficacy the day after heavy drinking may exacerbate anxiety, depression, or substance use by increasing avoidance of everyday activities (e.g., "I can't do this") or reducing attempts to cope productively (e.g., "I can't deal with this"); thus,

examinations of self-efficacy in a post-drinking context should consider self-efficacy in domains relevant to everyday functioning (e.g., for college students, academics and social interactions) and regarding coping with affective distress. However, no study to date has examined predictors or consequences of negative self-efficacy in any domain the day after heavy drinking.

Present Study

Considering the presence of negative affect in models of AUD comorbid with anxiety and mood disorders (e.g., Khantzian, 1997; Span & Earleywine, 1999; Wurmser, 1987) and of negative affect (Brown, Chorpita, & Barlow, 1998; Khantzian, 1997), repetitive negative thought (Laposa et al., 2014), IU (Mahoney & McEvoy, 2012), anxiety sensitivity (McNally et al., 1987; Taylor et al., 1992), and self-efficacy (Comunian, 1989; Ehrenberg et al., 1991; Myers et al., 1993; Tahmassian & Moghadam, 2011) in AUD and anxiety and mood disorders, the present study aimed to examine the predictors and consequences of negative affect and associated constructs the day after binge drinking. The study was conducted in two phases. First, a large undergraduate sample was assessed to determine the prevalence of negative affect the day after binge drinking (Time 0; T0). Second, a smaller sample was recruited from the first, larger sample to participate in a longitudinal, naturalistic, quasi-experimental between-groups study. Participants in the second, smaller sample were assessed at three additional time points: baseline (Time 1; T1), either the day after an evening of binge drinking or the day after an evening of abstinence (Time 2; T2), and follow-up, two weeks after T2 (Time 3; T3).

Primary Aims.

1. To determine the prevalence of negative affect the day after binge drinking in a large, undergraduate sample.
2. To examine whether individuals in the binge drinking and abstinence groups differ on measures of state negative affect, post-event processing, and negative perceived self-efficacy in academic, social, or coping domains, and, if so, whether neuroticism moderates these effects.

Secondary Aims.

1. To examine whether state negative affect, post-event processing, or negative perceived self-efficacy in academic, social, and coping domains the day after binge drinking predict situational avoidance above and beyond physical symptoms of hangover.
2. To examine whether state negative affect, post-event processing, or negative perceived self-efficacy in academic, social, and coping domains the day after binge drinking predict changes in quantity of alcohol consumption over time above and beyond physical symptoms of hangover.
3. To examine whether state negative affect, post-event processing, or negative perceived self-efficacy in academic, social, and coping domains the day after binge drinking predict changes in trait negative affect over time above and beyond physical symptoms of hangover.
4. To examine psychological factors that may be associated with neuroticism and increases in negative affect the day after binge drinking. Specifically, we examined:

a. Whether alcohol-induced memory losses (i.e., blackouts) predict state negative affect or post-event processing the day after binge drinking and whether these relationships are moderated by intolerance of uncertainty.
b. Whether the physical symptoms of hangover predict state negative affect the day after binge drinking above and beyond neuroticism, and whether this relationship is moderated by anxiety sensitivity.

CHAPTER 2

METHOD

Participants

Participants for the cross-sectional portion of the study were 808 undergraduate students at Temple University. A subsample (n = 139) was also recruited to participate in the longitudinal portion of the study. Of these, 82 were randomized to the binge group and 57 were randomized to the abstinence group at the first time point (T1). All subjects were blind to study hypotheses. Most of the planned analyses occurred within the binge group only; therefore, *a priori* power analyses revealed different target sample sizes for each group. Therefore, randomization was planned to occur via a pre-determined randomization chart that was weighted in favor of the binge group (77:39, binge:abstinence). Groups were compared on all T1 variables and no significant differences were found.

Approximately halfway through data collection, it became clear that our randomization sheet was incorrect: rather than weighting in favor of the binge group, it weighted groups equally. For the remainder of data collection, a new randomization sheet with the originally planned weighting was used. Participants before and after the weighting switch occurred were compared on all measures of interest; no significant differences were found.

The majority (130/139; 93.5%) of recruited participants proceeded to complete questionnaires at time 2 (T2), with similar attrition across groups (3/82 binge, 3.65%; 6/57 abstinence, 10.53%). In addition, three participants who completed T2 did not complete time 3 (T3), all of whom were in the binge group. Completers and non-

completers were compared on all measures of interest; no significant differences emerged (all *p*s > .05). Demographic characteristics for both groups are reported in Table 1.

Inclusion criteria required participants to be between 18 and 24 years old, fluent in English, able to use a computer, and to have access to the Internet. Participants' age was restricted in order to remove age as a potential confounding variable. In addition, participants were included only if they had engaged in binge drinking at least once in their lifetime. Given our interest in determining the prevalence of negative affect the day after binge drinking, participants must have engaged in binge drinking at least once in order to respond. For the purpose of the present study, binge drinking was defined as drinking five or more standard drinks over a two-hour period for men, and four or more standard drinks over a two-hour period for women. This definition is in concordance with the approximations of binge drinking set forth by the NIAAA (2004). All procedures were approved by the university's institutional review board and participants were given partial course credit for their involvement in the study.

Participants were recruited via Temple University's online research participation system and with flyers posted at public locations on campus. Recruitment occurred in two phases: first, a cross-sectional sample was recruited to determine the prevalence of negative affect the day after binge drinking (T0). Participants were included in the first phase only if they report having engaged in binge drinking at least once in their lifetime. Participants were offered partial course credit for their participation in this portion of the study. Second, participants in the cross-sectional sample who reported at least occasional binge drinking (≥ one time a month) were offered further course credit or a $20 gift card

Table 1
Sample Demographics

Characteristic	Cross-sectional Sample $N = 808$	Longitudinal Subsample $n = 139$
Age (*M, SD*)	20.00 (1.60)	20.24 (1.88)
Female (%)	70.8	74.1
Race (%)		
Caucasian or European-American	65.8	69.8
Black or African-American	14.6	12.9
Asian or Asian-American	10.9	11.5
Native Hawaiian or Other Pacific Islander	0.2	0.0
American Indian or Native Alaskan	0.1	0.0
Other	7.2	5.0
No response	1.1	0.7
Hispanic (%)	8.9	6.5
Marital Status (%)		
Single (never married)	62.5	60.4
In a relationship (not married)	34.8	38.8
Married	1.4	0.7
Divorced	0.5	0.0

to participate in the longitudinal portion of the study (T1-T3). Participants were not excluded on the basis of gender, ethnicity/race, or other demographic variables.

Procedure

Time 0. Participants in the initial sample (T0) provided informed consent and completed self-report questionnaires online via FluidSurveys (fluidsurveys.com) or Sona Systems (temple.sona-systems.com), two Internet-based questionnaire administration programs. Participants were first asked to answer a screening question:

A standard drink is defined as 12 oz. beer, 5 oz. wine, or 1.5 oz. distilled spirits.

If you are male: *Have you ever consumed five or more standard drinks over a two-hour period at least once?*[1]

If you are female: *Have you ever consumed four or more standard drinks over a two-hour period?*

Participants who answered "yes" were recruited into the study and proceeded to the T0 questionnaires. Questionnaires assessed demographic characteristics, whether the participant had engaged in binge drinking at least once in the past month, and symptoms they typically experience days after binge drinking and days on which they experience alcohol hangover. A subset of this sample who reported binge drinking at least once in the past month was invited via email to participate in the longitudinal portion of the study.

Time 1. For the longitudinal portion of the study, participants completed questionnaires at three additional time points. At T1, participants were invited into the

[1] The text "at least once" was included erroneously in the "male" version of this question. As it does not change the meaning of the question, only the correctness of its grammar, we do not believe it caused participant confusion.

laboratory and asked to complete a series of questionnaires assessing alcohol consumption over the preceding two weeks, anxiety sensitivity, IU, negative affect over the preceding two weeks, neuroticism, and perceived self-efficacy in academic, social, and coping domains. Next, using the measure of alcohol consumption over the preceding two weeks as a guide and in collaboration with the experimenter, participants identified the next three evenings during which they were likely to engage in binge drinking. Participants were then randomized to binge and abstinence groups using a computer-generated list. The subsequent assessment (T2) occurred the day following one of the identified nights.

Time 2. The second assessment in the longitudinal portion of the study (T2) utilized a *naturalistic* design, that is, participants were assessed following either a night of abstinence or a normal night's drinking in a location and with the company of their choosing. Though naturalistic studies are fraught with uncontrollable/uncontrolled variables (e.g., sleep, other drug use, cigarette smoking), they offer an ecologically valid binge drinking experience, complete with participant knowledge that they have some responsibility for their behavior and any eventual discomfort and/or distress. Use of a naturalistic design allowed us to examine the consequences of binge drinking in a context in which participants were truly invested. Considering our interest in negative affect, it was important that participants were invested in the outcomes of their behavior.

Participants in the binge group were asked to engage in their normal behavior on their next heavy drinking night. Participants in the abstinence group were asked to abstain from drinking on what otherwise would have been their next heavy drinking night. The day before T2 was to occur, participants received an automated reminder text message.

Then, on the identified morning at 10 a.m., links to questionnaires were sent via email to participants. Participants in the binge group were asked to proceed to the questionnaires only if they engaged in binge drinking the night prior (i.e., i.e., they consumed five or more standard drinks for men, or four or more drinks for women, over a 2-hour period). Participants in the abinstence group were asked to proceed to questionnaires only if they remained abstinent the night prior. Participants who did not complete questionnaires on their first identified night were rescheduled for the next day following an evening that they identified as being likely to binge drink at T1. More than half of participants (57.55%) completed questionnaires on their first identified night, 25.90% on their second, and 10.07% on their third. A small percentage of participants did not complete questionnaires following any identified night (6.47%). Average number of days between T1 and T2 was 4.94 (*SD* = 5.56). Participants were alotted four hours (i.e., until 2 p.m.) to complete the questionnaires. Time of questionnaire completion was recorded and examined as a potential covariate. Participants in the binge group were first asked how much alcohol they consumed the night prior. T2 questionnaires assessed state negative affect, state perceived self-efficacy in academic, social, and coping domains, alcohol blackout the night prior, physical symptoms of hangover, post-event processing, and anticipated situational avoidance.

Time 3. Two weeks following T2, participants received a final set of questionnaires via email (T3). The final battery included measures of negative affect since T2, alcohol consumption since T2, and perceived self-efficacy in academic, social, and coping domains.

Measures

Time 0 measures.

Lifetime binge drinking questionnaire (Screener question). Participants were asked whether they had consumed five or more standard drinks for men, or four or more drinks for women, over a 2-hour period at least once in their lifetime.

Past month binge drinking questionnaire. Participants were asked whether they had consumed five or more standard drinks for men, or four or more drinks for women, over a 2-hour period at least once in the past month.

Demographic characteristics. The demographics questionnaire developed for this study assessed basic demographic characteristics, including age, sex, race, ethnicity, and marital status.

Symptoms of hangover. Penning et al. (2012) generated a list of 47 symptoms of hangover drawn from previous literature. Participants were asked to state whether or not they typically experienced each symptom the day after binge drinking. In addition, participants were asked to state whether or not they typically experienced each symptom when they have a hangover. Item frequencies were examined independently and as a composite (i.e., number of individuals reporting each symptom).

Time 1 measures.

Alcohol consumption. The Alcohol Timeline Followback (TLFB) (Sobell & Sobell, 1995) aims to assess the number of standard drinks (i.e., 14 grams of alcohol; the equivalent of 12 oz. beer, 5 oz. wine, or 1.5 oz. distilled spirits) an individual has consumed each day over a specified period of time (for use in the present study, 14 days). For the self-administered version used in this study, the participant is presented with a calendar and the definition of a standard alcoholic beverage, asked to orient themselves to

the notable events of the time period, and directed to write on the calendar the total number of standard drinks that he or she consumed each day. Estimated alcohol use using the TLFB has been shown to be largely consistent with daily diary reports of alcohol use, with slight underreporting on the TLFB (Carney, Tennen, Affleck, Del Boca, & Kranzler, 1998). Two variables were derived: total number of drinks and number of binge days (i.e., days during which male participants consumed more than five and female participants consumed more than four standard drinks).

Anxiety sensitivity. The Anxiety Sensitivity Index - 3 (ASI-3) (Taylor et al., 2007) is a revised version of the original ASI (Peterson & Heilbronner, 1987) developed via factor analysis. It assesses fear of anxiety-related sensations based on the belief that these sensations are dangerous. Participants are asked to rate 18 items (e.g., "It scares me when my heart beats rapidly") on a 5-point Likert-type scale from 0 ("very little") to 4 ("very much"). The ASI-3 has demonstrated good internal consistency (e.g., $\alpha = .92$; Carleton, Collimore, & Asmundson, 2010) and convergent (correlations with corresponding subscales of the original ASI, *r*s = .83 - .99 across six samples), discriminant (correlations with dissimilar subscales of the original ASI, *r*s = .47 - .92 across six samples), and criterion validity (elevated ASI-3 scores in clinical samples of anxiety disorder patients compared to nonclinical controls) (Taylor et al., 2007). Internal consistency in the present sample was good, $\alpha = .89$.

Intolerance of uncertainty. The Intolerance of Uncertainty Scale – 12 item version (IUS-12) (Carleton, Norton, & Asmundson, 2007) is a truncated version of the Intolerance of Uncertainty Scale (IUS; Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994). The original IUS aims to measure emotional, cognitive, and behavioral reactions

to uncertain situations and the experience of feeling uncertain (e.g., "I always want to know what the future has in store for me"). The IUS-12 is highly correlated with the original IUS (r = .94) and demonstrates convergent validity by correlations with related symptom measures (e.g., Beck Anxiety Inventory [Beck, Epstein, Brown, & Steer, 1988], r = .57; Generalized Anxiety Disorder Questionnaire-IV [Newman et al., 2002], r = .61) (Carleton et al., 2007). Items on the IUS-12 are rated on a Likert-type scale ranging from 1 ("Not at all characteristic of me") to 5 ("Entirely characteristic of me"). The IUS-12 has demonstrated good internal consistency in undergraduate (α = .91, Carleton et al., 2007) and clinical samples (α = .91, Laposa, Collimore, Hawley, & Rector, 2015). Internal consistency in the present sample was excellent, α = .91.

Negative affect. Negative affect was assessed using the negative affect subscale (-NA) of the Positive and Negative Affect Schedule (PANAS) (Watson, Clark, & Tellegen, 1988). The PANAS is a 20-item self-report measure assessing positive and negative affect; each subscale is comprised of 10 items derived from a principal components analysis of Zevon and Tellegen's (1982) mood checklist. Participants are presented with the 10 PANAS-NA adjectives (e.g., upset, distressed, guilty, irritable) and asked to respond with regards to how much they felt this way during a specified time period on a 5-point Likert-type scale from 1 ("very slightly") to 5 ("extremely"). The negative affect subscale has demonstrated good internal consistency (α = .85; Watson et al., 1988; Crawford & Henry, 2004). The negative affect subscale is positively correlated with measures of depression, anxiety, and stress, indicating convergent validity (Crawford & Henry, 2004). Participants were oriented to the preceding two weeks. Internal consistency in the present sample was good (α = .87).

Neuroticism. The Eysenck Personality Questionnaire – Neuroticism subscale (EPQ-N) (Eysenck & Eysenck, 1975) is a widely used measure of neuroticism and correlates highly with measures of overlapping constructs (e.g., trait anxiety, $r = .73$; Watson & Clark, 1984). The EPQ-N has 24 items (e.g., "Do you suddenly feel shy when you want to talk to an attractive stranger?") marked "yes" or "no" by participants. Total score is the number of "yes" answers given. Internal consistency of the EPQ-N is good ($\alpha = .69$ - .97; see Caruso, Witkiewitz, Belcourt-Dittloff, & Gottlieb, 2001). Internal consistency in the present sample was good, $\alpha = .84$.

Perceived academic and social self-efficacy. Academic and social self-efficacy was assessed using the College Self-Efficacy Inventory (CSEI) (Solberg, O'Brien, Villarreal, Kennel, & Davis, 1993), a 20-item self-report measure assessing participants' beliefs in their ability to complete college-related tasks in three domains: academics (-A), social interactions (-SI), and roommate-related situations (the latter subscale was not used in the current study). Participants are asked to rate how confident they are in their ability to complete the tasks on a 10-point Likert-type scale from 0 ("Not at all confident") to 9 ("Extremely confident"). Scores are determined by averaging the items in each domain. Both the CSEI-A and CSEI-SI demonstrate good internal consistency (αs = .88; Solberg et al., 1993). Further, using a principal components analysis, each subscale has been related to other indexes of adjustment (e.g., Brief Symptom Inventory; Derogatis & Melisaratos, 1983) and discriminated from non-adjustment constructs (e.g., eight items from the Acculturation Rating Scale for Mexican-Americans; Cuellar, Harris, & Jasso, 1980) (Solberg et al., 1993). Internal consistency in the present sample was good for each subscale (Academic, $\alpha = .89$; Social, $\alpha = .89$).

Perceived coping self-efficacy. The Coping Self-Efficacy Scale (CSE) (Chesney, Neilands, Chambers, Taylor, & Folkman, 2006) is a 26-item measure of one's confidence in performing coping behaviors when faced with difficult circumstances. The CSE has three subscales: problem-focused coping (e.g., "Break an upsetting problem down into smaller parts"; α = .91), stopping unpleasant emotions or thoughts (e.g., "Take your mind off unpleasant thoughts"; α = .91), and getting support from friends and family (e.g., "Get friends to help you with the things you need"; α = .80). Internal consistency for the total score is excellent (α = .95). Items are rated on an 11-point Likert-type scale from 0 ("Cannot do at all") through 5 ("Moderately certain can do") to 10 ("Certain can do"). Each subscale negatively correlates with measures of stress and anxiety controlling for the other two subscales (e.g., State-Trait Anxiety Inventory [STAI], partial *r*s .15 - .26, Spielberger, Gorsuch, & Lushene, 1970) and positively with measures of relevant coping styles (Chesney et al., 2006), suggesting concurrent and convergent validity. Repeated measurement over three months suggests sufficient test-retest reliability (problem focused coping, *r* = .65; stopping unpleasant emotions or thoughts, *r* = .68; getting support, *r* = .52). For the purpose of the present study, the total CSE score was used. Internal consistency in the present sample was excellent, α = .96.

Time 2 measures.

Negative affect. Negative affect at T2 was also assessed with the PANAS-NA; however, at T2, participants were oriented to the present moment. Internal consistency in the present sample was good, α = .79.

Perceived academic and social self-efficacy. A version of the CSEI developed for this study and orienting participants to the present moment was used to assess one's

perceptions of in-the-moment academic and social self-efficacy at T2. Internal consistency in the present sample was excellent for each subscale (Academic, α = .96; Social, α = .95).

Perceived coping self-efficacy. A version of the CSE developed for this study and orienting participants to the present moment was used to assess one's perceptions of in-the-moment coping self-efficacy at T2. Internal consistency in the present sample was excellent, α = .98.

Alcohol blackout. Alcohol blackout was assessed using a revised version of the *Blackout drinking* subscale (-BD-R) from the Young Adult Alcohol Consequences Questionnaire (YAACQ; Read, Kahler, Strong, & Colder, 2006). The original *Blackout drinking* subscale is comprised of seven items rated dichotomously (yes = 1, no = 0) and summed. Given our interest in alcohol blackout specifically, three items not referring to blackout (i.e., items referring to hangover, passing out, and post-drinking nausea) were removed; the remaining four items were reworded to refer to the previous night. The original *Blackout drinking* subscale has demonstrated good internal consistency (α = .86) and has been shown to be elevated in binge drinkers compared to non-binge drinkers (Read, Beattie, Chamberlain, & Merrill, 2008). Internal consistency of the modified scale in the present sample was poor, α = .59.

Physical symptoms of hangover. The Alcohol Hangover Severity Scale (AHSS) (Penning et al., 2013) is a 12-item measure of physical hangover symptom severity. Symptoms (e.g., heart pounding, thirst) are rated on a 10-point Likert-type scale. The AHSS has demonstrated good internal consistency (α = .85) and concurrent validity (correlation with another measure of hangover symptoms, *r* = .92). Additionally, the

AHSS has demonstrated elevated scores the morning after alcohol consumption compared to mornings after abstinence. Internal consistency in the present sample was excellent, α = .93.

Previous night's alcohol consumption. Participants were presented with the criteria for a standard alcoholic drink and asked to estimate the number of standard drinks they consumed the night before.

Post-event processing. The Post-Event Processing Questionnaire (PEP-Q; Rachman, Grüter-Andrew, & Shafran, 2000) is a 13-item measure assessing thoughts, behaviors, and emotions related to post-event processing. Items (e.g., "Did you ever wish that you could turn the clock back and re-do it—do it again, but do it better?") are rated on a 100-point visual analogue scale. The PEP-Q has demonstrated high internal consistency (α = .85) and is significantly correlated with social anxiety (*r* = .40) (Rachman et al., 2000). For the purposes of the current study, items were reworded to orient participants to their present experience of the previous night (e.g., "Do you wish that you could turn the clock back and re-do it—do it again, but do it better?"). Internal consistency in the present sample was good, α = .85.

Situational avoidance. The Cognitive-Behavioral Avoidance Scale (CBAS; Ottenbreit & Dobson, 2004) is a self-report measure that assesses cognitive and behavioral avoidance in social and non-social contexts. Items are rated on a 5-point Likert-type scale from 1 ("Not at all true for me") to 5 ("Extremely true for me"). In the present study, situational avoidance was assessed using versions of the *Behavioral – social* (-BS) and *Behavioral – non-social* (-BN) subscales in which items were reworded to refer to the current day (e.g., "I avoid attending social activities" reworded to "Today, I

will avoid attending social activities"). The CBAS-BS subscale is comprised of eight items and the CBAS-BN of six items; both subscales have demonstrated good internal consistency (CBAS-BS, α = .86; CBAS-BN, α = .75). The CBAS-BS and -BN subscales correlate with other avoidance measures (e.g., Coping Responses Inventory; Moos, 1988, as cited in Ottenbreit & Dobson, 2004), suggesting convergent validity. Internal consistency in the present sample was excellent for the summed subscales (α = .90).

Time 3 measures.

Negative affect. Participants completed the PANAS-NA in respect to the period of time that has elapsed since T2. Internal consistency in the present sample was good, α = .87.

Alcohol consumption. The TLFB was used to assess alcohol consumption since T2.

Perceived academic and social self-efficacy. The original CSEI was used to assess perceived academic and social self-efficacy at T3. Internal consistency at this time point was excellent for each subscale (Academic, α = .95; Social, α = .93).

Perceived coping self-efficacy. The original CSE was used to assess perceived coping self-efficacy at T3. Internal consistency at this time point was also excellent, α = .98).

CHAPTER 3

RESULTS

First, all data were screened for confirmation that they met the necessary assumptions for analysis using hierarchical regression. Specifically, data were tested to ensure multivariate normality, homoscedasticity, and absence of multicollinearity. Six variables (i.e., TLFB number of drinks and number of binges at both T1 and T3, number of drinks at T2, and time of questionnaire completion at T2) failed to meet the assumption of normality due to a natural limit of zero; thus, corrective transformations were performed using the formula $Y' = (Y+1)^{-0.5}$. Following transformation, all variables were normally distributed. Transformed variables were used in all subsequent analyses. We planned to handle multicollinearity that did not resolve following corrective transformations by excluding one or more of the collinear variables from analyses; however, no collinearity issues emerged among variables included in any given analysis. Analyses were conducted using all available cases; the sample varied some from analysis to analysis. No items were left blank if response to a questionnaire was initiated. Bivariate correlations and descriptive statistics for the primary variables of interest (non-transformed) in the longitudinal subsample are shown in Table 2.

Using linear regression, we examined the relationships between gender and all outcome variables, and time of questionnaire completion at T2 and all outcome variables. Gender is important to consider as a covariate given evidence suggesting gender differences in neuroticism (e.g., Costa, Terracciano, & McCrae, 2001) and alcohol consumption (e.g., Wilsnack, Vogeltanz, Wilsnack, & Harris, 2000). Similarly, time of questionnaire completion is important to examine as a covariate considering evidence

Table 2

Bivariate Correlations and Descriptive Statistics for Primary Variables of Interest — Longitudinal Subsample, Both Groups

Variables	*M* (*SD*)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Time 1																								
1. ASI-3	18.93 (12.35)		.677**	.656**	.065	.014	.641**	-.440**	-.330**	-.373**	.156	.532**	.106	.158	.385**	-.311**	-.248**	-.353**	.001	-.013	.547**	-.300**	-.214*	-.272**
2. IUS-12	29.15 (9.19)			.531**	-.080	-.087	.514**	-.420**	-.126	-.338**	.138	.548**	.124	.171	.403**	-.393**	-.237**	-.436**	-.027	.004	.547**	-.375**	-.166	-.351**
3. EPQ-N	11.34 (5.21)				.033	.005	.708**	-.583**	-.354**	-.409**	.128	.472**	.068	.097	.308**	-.414**	-.153	-.255**	.003	.016	.538**	-.471**	-.276**	-.304**
4. TLFB Drinks	34.54 (25.45)					.804**	.001	-.090	.104	.133	.076	-.093	.075	-.022	-.060	.127	.112	.138	.567**	.503**	-.081	.099	.080	.133
5. TLFB Binges	2.96 (2.45)						-.015	-.030	.016	.055	.032	-.098	.089	-.057	-.080	.131	.125	.109	.672**	.712**	-.011	.044	.029	.056
6. PANAS-NA	20.97 (7.23)							-.564**	-.342**	-.359**	.226**	.497**	.094	.179*	.404**	-.362**	-.168	-.232**	0.027	0.03	.657**	-.451**	-.287**	-.254**
7. CSE	164.79 (48.42)								.430**	.596**	-.026	-.348**	.107	.012	-.182*	.612**	.276**	.460**	-.084	-.065	-.340**	.791**	.430**	.607**
8. CSEI-A	51.98 (11.59)									.502**	-.146	-.143	-.048	-.110	-.324**	.429**	.458**	.342**	-.052	-.060	-.187*	.426**	.673**	.408**
9. CSEI-SI	55.73 (16.72)										-.038	-.270**	.140	-.083	-.166	.552**	.350**	.698**	-.047	-.081	-.200*	.574**	.429**	.827**
Time 2																								
10. PEP-Q	25.52 (18.11)											.291**	.546**	.698**	.533**	-.305**	-.357**	-.254**	.169	.135	.349**	-.126	-.194*	-.083
11. CBAS	26.58 (9.72)												.157	.274**	.502**	-.491**	.338**	-.421**	-.121	-.091	.506**	-.366**	-.258**	-.331**
12. YAACQ-BD-R	0.38 (0.75)													.630**	.394**	-.054	-.108	.003	.197*	.161	.218*	.100	.099	.177*
13. AHSS	40.49 (26.18)														.516**	-.307**	-.465**	-.312**	.151	.091	.253**	-.023	-.107	-.028
14. PANAS-NA	12.82 (3.75)															-.454**	-.405**	-.348**	.048	.077	.530**	.277**	-.335**	-.221*
15. CSE	174.62 (55.88)																.663**	.773**	-.019	-.004	-.402**	.740**	.555**	.665**
16. CSEI-A	45.33 (17.68)																	.751**	-.002	.010	-.282**	.440**	.588**	.431**
17. CSEI-SI	51.55 (19.87)																		.000	-.027	-.343**	.605**	.477**	.769**
Time 3																								
18. TLFB Drinks	32.91 (17.15)																			.907**	.044	-.076	-.058	-.031
19. TLFB Binges	2.76 (2.28)																				.040	-.068	-.062	-.060
20. PANAS-NA	17.15 (6.37)																					-.453**	-.324**	-.296**
21. CSE	170.13 (57.13)																						.661**	.758**
22. CSEI-A	51.39 (13.90)																							.646**
23. CSEI-SI	57.17 (17.65)																							

Note. ASI-3 = Anxiety Sensitivity Index - 3; IUS-12 = Intolerance of Uncertainty Scale - 12 item; EPQ-N = Eysenck Personality Questionnaire – Neuroticism subscale; TLFB = Alcohol Timeline Followback; PANAS-NA = Positive and Negative Affect Schedule - Negative affect subscale; CSE = Coping Self-Efficacy Scale; CSEI-A = College Self-Efficacy Inventory - Academic subscale; CSEI-SI = College Self-Efficacy Inventory - Social Interaction subscale; PEP-Q = Post-Event Processing Questionnaire; CBAS = Cognitive-Behavioral Avoidance Scale; YAACQ-BD-R = Young Adult Alcohol Consequences Questionnaire - Blackout Drinking subscale; AHSS = Alcohol Hangover Severity Scale.

*$p < .05$, **$p < .01$

suggesting some repercussions of binge drinking (e.g., hangover) wane over the course of the day (e.g., McKinney & Coyle, 2004). Gender was not associated with any outcome variables and was therefore not included in analyses as a covariate. Time of questionnaire completion was associated with PEP-Q (T2) (R^2 = .036, F[1, 128] = 4.738, p = .031) and CSEI-A (T2) (R^2 = .047, F[1, 128] = 6.304, p = .013) scores, to the extent that as time elapsed, PEP-Q scores increased (i.e., more post-event processing) and CSEI-A scores decreased (i.e., less belief in one's ability to complete academic tasks). Thus, time of questionnaire completion was included in all analyses using PEP-Q (T2) or CSEI-A (T2) as the outcome variable.

In each analysis, collinearity statistics (i.e., Tolerance and VIF) were examined and determined to be within accepted limits (Tolerance > .10; VIF < 10). In addition, unstandardized residuals were plotted against the dependent variable in each regression, revealing that the assumption of homoscedasticity was met.

Primary aim #1: To determine the prevalence of negative affect the day after binge drinking in a large, undergraduate sample.

Hypothesis. Considering some evidence suggesting that anxiety occurs in hangover for between 7.4% (Penning et al., 2012) and 18.0% (Smith & Barnes, 1983) of individuals and estimates of depressed mood in hangover hover around 20% (18.9%, Penning et al., 2012; 20%, Smith & Barnes, 1983), it was hypothesized that types of negative affect (e.g., anxiety, depression, guilt) would be reported by 5% to 25% of the sample.

Results. Frequency of negative affect symptoms from the checklist of hangover symptoms checklist administered at T1 and percent of the sample endorsing each symptom were computed and are displayed in Table 3. Affective symptoms ranged in prevalence from 22.8% of the sample (Apathy) to 1.0% of the sample (Suicidal thoughts). More than half (56.1%) of the sample endorsed no affective symptoms, 16.5% reported one, 8.6% reported two, 8.6% reported three, 3.6% reported four, and 6.4% reported five or more symptoms. Exploratory correlational analysis of number of affective symptoms and neuroticism revealed a positive relationship, $r = .452$, $p < .001$.

Primary aim #2: To examine whether individuals in the binge and abstinence groups differ on measures of state negative affect, post-event processing, or negative perceived self-efficacy in academic, social, or coping domains, and, if so, whether neuroticism moderates these effects.

Hypotheses. Individuals in the binge group would report higher levels of state negative affect, post-event processing, and negative perceived self-efficacy in academic, social, and coping domains than individuals in the abstinence group. Further, higher levels of neuroticism would be associated with higher levels of the outcome variables. Neuroticism was expected to moderate the main effect of group such that neuroticism would have a greater effect in the binge group than in the abstinence group.

Results. Demographic characteristics and descriptive statistics for study variables for each group are displayed in Table 4. To determine whether individuals in the binge and abstinence groups differed on measures of state negative affect, post-event processing, and negative perceived self-efficacy in academic, social, and coping domains, five hierarchical regressions were conducted with the PANAS-NA (T2), PEP-Q (T2),

Table 3

Frequency of Symptoms Experienced after Binge Drinking (N = 808)

Symptom	*n*	%	Symptom	*n*	%
Fatigue (being tired)	623	77.1	Balance problems	94	11.6
Thirst	591	73.1	**Depression**	**82**	**10.1**
Sleepiness	498	61.6	Sweating	80	9.9
Headache	451	55.8	Photo-sensitivity	77	9.5
Dry mouth	381	47.2	Disorientation	75	9.3
Drowsiness	347	42.9	Audio-sensitivity	75.0	9.3
Nausea	324	40.1	Restlessness	71	8.8
Weakness	263	32.5	Shivering	55	6.8
Concentration problems	231	28.6	Heart pounding	52	6.4
Reduced alertness	220	27.2	Hot/cold flashes	46	5.7
Stomach pain	219	27.1	Increased reaction time	45	5.6
Reduced appetite	213	26.4	Vertigo	44	5.4
Apathy	**184**	**22.8**	Tremor	37	4.6
Regret	**174**	**21.5**	**Anger**	**36**	**4.5**
Memory problems	169	20.9	Impulsivity	29	3.6
Dizziness	165	20.4	Loss of taste	26	3.2
Vomiting	150	18.6	Gastritis	20	2.5
Gastrointestinal complaints	137	17.0	**Blunted affect**	**18**	**2.2**
Agitation	**126**	**15.6**	Palpitations	16	2.0
Guilt	**115**	**14.2**	Respiratory problems	13	1.6
Confusion	113	14.0	**Suicidal thoughts**	**8**	**1.0**
Anxiety	**111**	**13.7**	Tinnitus	6	0.7
Clumsiness	99	12.3	Nystagmus	2	0.2
Muscle pain	95	11.8			

Note. Symptoms of psychological distress are presented in bold print.

Table 4

Group Demographics and Descriptive Statistics for Study Variables

	Binge	Abstinence
Demographics		
Age (*M, SD*)	20.22 (1.87)	20.27 (1.89)
Female (%)	72.0	77.2
Race (%)		
Caucasian or European-American	67.1	73.7
Black or African-American	15.9	8.8
Asian or Asian-American	11.0	12.3
Native Hawaiian or Other Pacific Islander	0.0	0.0
American Indian or Native Alaskan	0.0	0.0
Other	4.9	5.3
No response	1.2	0.0
Hispanic (%)	4.9	8.8
Marital Status (%)		
Single (never married)	64.6	54.4
In a relationship (not married)	34.1	45.6
Married	1.2	0.0
Divorced	0.0	0.0
Study Variables (*M, SD*)		
Time 1		
ASI-3	17.82 (12.31)	20.53 (12.32)
IUS-12	28.40 (9.09)	30.23 (9.31)
EPQ-N	10.62 (5.12)	12.37 (5.20)
TLFB Drinks	33.95 (18.13)	33.47 (35.39)
TLFB Binges	2.89 (2.39)	3.05 (2.55)
PANAS-NA	20.44 (6.92)	21.74 (7.65)
CSE	171.85 (44.70)	154.63 (52.06)
CSEI-A	51.96 (11.72)	52.00 (11.51)
CSEI-SI	56.85 (15.48)	54.12 (18.39)
Time 2		
PEP-Q	33.26 (17.92)	13.53 (10.18)
CBAS	26.99 (10.01)	25.94 (9.32)
YAACQ-BD-R	0.62 (0.88)	0.00 (0.00)
AHSS	54.15 (24.78)	19.34 (7.72)
PANAS-NA	13.46 (4.23)	11.82 (2.61)
CSE	169.82 (56.49)	182.04 (54.64)
CSEI-A	39.77 (18.66)	53.94 (11.79)
CSEI-SI	48.68 (20.37)	56.00 (18.40)
Time 3		
TLFB Drinks	33.81 (18.74)	31.59 (14.58)
TLFB Binges	2.76 (2.39)	2.75 (2.12)
PANAS-NA	17.51 (7.12)	16.61 (5.08)
CSE	171.67 (54.22)	167.82 (61.69)
CSEI-A	50.57 (14.21)	52.61 (13.48)
CSEI-SI	57.75 (16.77)	56.31 (19.01)

Note. ASI-3 = Anxiety Sensitivity Index - 3; IUS-12 = Intolerance of Uncertainty Scale - 12 item; EPQ-N = Eysenck Personality Questionnaire – Neuroticism subscale; TLFB = Alcohol Timeline Followback; PANAS-NA = Positive and Negative Affect Schedule - Negative affect subscale; CSE = Coping Self-Efficacy Scale; CSEI-A = College Self-Efficacy Inventory - Academic subscale; CSEI-SI = College Self-Efficacy Inventory - Social Interaction subscale; PEP-Q = Post-Event Processing Questionnaire; CBAS = Cognitive-Behavioral Avoidance Scale; YAACQ-BD-R = Young Adult Alcohol Consequences Questionnaire - Blackout Drinking subscale; AHSS = Alcohol Hangover Severity Scale.

CSEI-A (T2), CSEI-SI (T2), and CSE (T2) as outcome variables. In addition, neuroticism was examined as a moderator by including its interaction with group (binge, abstinence) in the final step of each regression. In all moderation analyses, non-dichotomous variables were grand-mean-centered. Time of questionnaire completion was included as a covariate in step 1 in the analyses predicting PEP-Q (T2) and CSEI-A (T2).

Outcome: Negative affect (PANAS-NA, T2). The initial model including group and EPQ-N as predictors accounted for a significant amount of variance, $R^2 = .164$, $F(2, 127) = 12.429$, $p < .001$. Main effects for group ($\beta = .265$, $t[127] = 3.228$, $p = .002$) and EPQ-N ($\beta = .348$, $t[127] = 4.240$, $p < .001$) were both significant. Membership in the binge group and higher levels of neuroticism were associated with greater negative affect. When introduced to the model, the interaction term did not account for a significant amount of additional variance, $\Delta R^2 = .001$, $\Delta F(1, 126) = 0.196$, $p = .659$. With the addition of the interaction term, main effects for group ($\beta = .263$, $t[126] = 3.182$, $p = .002$) and EPQ-N ($\beta = .305$, $t[126] = 2.391$, $p = .018$) remained significant.

Outcome: Post-event processing (PEP-Q, T2). Time of questionnaire completion was included as a covariate in step 1, $R^2 = .036$, $F(1,128) = 4.738$, $p = .031$. Including group and EPQ-N in step 2 accounted for a significant portion of additional variance, $\Delta R^2 = .307$, $\Delta F(2, 126) = 29.427$, $p < .001$. Main effects for group ($\beta = .552$, $t[126] = 7.509$, $p < .001$) and EPQ-N ($\beta = .202$, $t[126] = 2.748$, $p = .007$) were both significant. Membership in the binge group and higher levels of neuroticism were associated with greater post-event processing. When introduced to the model, the interaction term did not account for a significant amount of additional variance, $\Delta R^2 = .006$, $\Delta F(1, 125) = 1.160$, $p = .284$. With the addition of the interaction term, the main effect for group remained

significant (β = .547, t[125] = 7.423, p < .001), whereas the main effect of EPQ-N did not (β = .108, t[125] = 0.956, p = .341).

In order to clarify existing findings suggesting gender differences in PEP following alcohol use, an additional hierarchical linear regression was conducted predicting PEP-Q. Step 1 was identical to the above, including time of questionnaire completion as a covariate. In step 2, group (binge, abstinence) and gender (male, female) were added, contributing significantly to the model, ΔR^2 = .268, ΔF(2, 126) = 24.219, p < .001. In step 2, the main effect of group was significant (β = .521, t[126] = 6.957, p < .001) but the main effect of gender was not (β = -.011, t[126] = -0.153, p = .879). The group-by-gender interaction was added in step 3 and did not account for additional variance, ΔR^2 = .000, ΔF(1, 125) = 0.004, p = .951. With the addition of the interaction term, the main effect for group remained significant (β = .523, t[125] = 6.140, p < .001) and the main effect for gender remained non-significant (β = -.005, t[125] = -0.043, p = .966).

Outcome: Academic self-efficacy (CSEI-A, T2). Time of questionnaire completion was included as a covariate in step 1, R^2 = .047, F[1, 128] = 6.304, p = .013. Step 2 included group and EPQ-N, accounting for a significant portion of additional variance, ΔR^2 = .178, ΔF(2, 126) = 14.472, p < .001. Main effects for group (β = -.407, t[126] = -5.091, p < .001) and EPQ-N (β = -.201, t[126] = 2.527, p = .013) were both significant. Membership in the binge group and higher levels of neuroticism were associated with lesser self-efficacy in academic situations. When introduced to the model, the interaction term did not account for a significant amount of additional variance, ΔR^2 = .002, ΔF(1, 125) = 0.320, p = .573. With the addition of the interaction term, the main

effect for group remained significant (β = -.403, t[125] = -5.027, p < .001), whereas the main effect of EPQ-N did not (β = -.148, t[125] = -1.198, p = .233).

Outcome: Social interaction self-efficacy (CSEI-SI, T2). The preliminary model including group and EPQ-N as predictors accounted for a significant amount of variance, R^2 = .114, F(2, 127) = 8.167, p < .001. Main effects for group (β = -.224, t[127] = -2.647, p = .009) and EPQ-N (β = -.289, t[127] = -3.416, p = .001) were both significant. Membership in the binge group and higher levels of neuroticism were associated with lesser self-efficacy in social situations. When introduced to the model, the interaction term did not account for a significant amount of additional variance, ΔR^2 = .001, ΔF(1, 126) = 0.131, p = .718. With the addition of the interaction term, the main effects of group (β = -.226, t[126] = -2.656, p = .009) and EPQ-N (β = -.325, t[126] = -2.474, p = .015) remained significant.

Outcome: Coping self-efficacy (CSE, T2). The first model including group and EPQ-N as predictors accounted for a significant amount of variance, R^2 = .201, F(2, 127) = 15.964, p < .001. Main effects for group (β = -.173, t[127] = -2.156, p = .033) and EPQ-N (β = -.440, t[127] = -5.487, p < .001) were both significant. Membership in the binge group and higher levels of neuroticism were associated with lesser self-efficacy regarding coping. When introduced to the model, the interaction term did not account for a significant amount of additional variance, ΔR^2 = .000, ΔF(1, 126) = 0.004, p = .953. With the addition of the interaction term, the main effects of group (β = -.173, t[126] = -2.147, p = .034) and EPQ-N (β = -.446, t[126] = -3.574, p < .001) remained significant.

Secondary aim #1: To examine whether state negative affect, post-event processing, or negative perceived self-efficacy in academic, social, and coping domains the day

after binge drinking predict situational avoidance above and beyond physical symptoms of hangover.

Hypotheses. State negative affect, post-event processing, and negative perceived self-efficacy in academic, social, and coping domains the day after binge drinking would each predict situational avoidance above and beyond the physical symptoms of hangover.

Results. To determine whether state negative affect, post-event processing, or negative perceived self-efficacy in academic, social, and coping domains the day after binge drinking predict situational avoidance above and beyond physical symptoms of hangover, three hierarchical regressions were conducted within the binge group only using the CBAS as the outcome measure. In each set of regressions, the AHSS (T2) was entered in step 1. In step two, either the PANAS-NA (T2), PEP-Q (T2), or CSEI-A (T2), CSEI-SI (T2), and CSE (T2) were entered. Step 1 was identical in each set of regressions: AHSS predicted CBAS scores, $R^2 = .146$, $F(1, 77) = 13.188$, $p = .001$, such that greater severity of hangover symptoms was associated with higher levels of situational avoidance.

Predictor: Negative affect (PANAS-NA, T2). The addition of PANAS-NA (T2) accounted for a significant increase in variance, $\Delta R^2 = .173$, $\Delta F(1, 76) = 19.270$, $p < .001$, and PANAS-NA significantly predicted CBAS, $\beta = .499$, $t(76) = 4.390$, $p < .001$. Higher levels of negative affect were associated with greater situational avoidance.

Predictor: Post-event processing (PEP-Q, T2). The addition of PEP-Q (T2) did not account for a significant increase in variance, $\Delta R^2 = .036$, $\Delta F(1, 76) = 3.359$, $p = .071$. Higher levels of post-event processing were not associated with greater situational avoidance.

Predictor: Academic, social interaction, and coping self-efficacy (CSEI-A, CSEI-SI, and CSE; T2). The addition of the three self-efficacy variables (T2) accounted for a significant increase in variance, $\Delta R^2 = .166$, $\Delta F(3, 74) = 5.962$, $p = .001$. Neither CSEI subscale predicted CBAS scores (Academic: $\beta = -.041$, $t[74] = 0.233$, $p = .817$; Social Interaction: $\beta = -.094$, $t[74] = -0.472$, $p = .638$), whereas the CSE did, $\beta = -.398$, $t[74] = -2.52$, $p = .014$. Lower levels of coping self-efficacy were associated with greater situational avoidance.

To determine whether coping self-efficacy and negative affect each accounted for some portion of variance in behavioral avoidance, a *post hoc* hierarchical linear regression predicting the CBAS from the CSE (T2) and PANAS-NA (T2) and controlling for the AHSS was conducted. In the final model ($\Delta R^2 = .252$, $\Delta F[2, 75] = 15.701$, $p < .001$), both PANAS-NA (T2; $\beta = .378$, $t[75] = 3.310$, $p = .001$) and CSE (T2; $\beta = -.326$, $t[75] = -3.143$, $p = .002$) significantly predicted the CBAS, whereas AHSS (T2) did not, $\beta = .043$, $t(75) = 0.395$, $p = .694$. Higher levels of negative affect and lower levels of coping self-efficacy were associated with greater situational avoidance.

Secondary Aim #2: To examine whether state negative affect, post-event processing, or negative perceived self-efficacy in academic, social, and coping domains the day after binge drinking predict changes in quantity of alcohol consumption over time above and beyond physical symptoms of hangover.

Hypotheses. State negative affect, post-event processing, and negative perceived self-efficacy in academic, social, and coping domains the day after binge drinking would predict increases in alcohol consumption.

Results. To examine whether state negative affect, post-event processing, and negative perceived self-efficacy in academic, social, and coping domains the day after binge drinking predict changes in quantity of alcohol consumption over time above and beyond physical symptoms of hangover, six hierarchical linear regressions were be conducted within the binge group only. Alcohol consumption – total quantity (T3) – was the outcome variable for three regressions and alcohol consumption – number of binge days (T3) – was the outcome variable for the remaining three regressions. In each, the corresponding T1 alcohol consumption variable (e.g., when predicting T3 total quantity, T1 total quantity was used) and the AHSS was entered in step 1. In step 2, either the PANAS-NA (T2), PEP-Q (T2), or the self-efficacy questionnaires (i.e., the CSEI-A [T2], CSEI-SI [T2], or CSE [T2]) were entered.

Outcome: Alcohol consumption — total quantity (T3). Step 1 was identical in all three regression sets, with the overall model significantly predicting total quantity of alcohol consumption at T3, $R^2 = .592$, $F(2, 72) = 52.333$, $p < .001$. Total alcohol consumption at T1 significantly predicted total alcohol consumption at T3, $\beta = .748$, $t(72) = 9.896$, $p < .001$; AHSS at T2 did not, $\beta = -.129$, $t(74) = -1.702$, $p = .093$.

Predictor: Negative affect (PANAS-NA, T2). The addition of PANAS-NA to the model did not account for a significant increase in variance, $\Delta R^2 = .001$, $\Delta F(1, 71) = 0.230$, $p = .633$.

Predictor: Post-event processing (PEP-Q, T2). The addition of PEP-Q to the model did not account for a significant increase in variance, $\Delta R^2 = .001$, $\Delta F(1, 71) = 0.216$, $p = .643$.

Predictor: Academic, social interaction, and coping self-efficacy (CSEI-A, CSEI-SI, and CSE, T2). The addition of the three self-efficacy variables to the model did not account for a significant increase in variance, $\Delta R^2 = .022$, $\Delta F(3, 69) = 1.310$, $p = .278$.

Outcome: Alcohol consumption — number of binge days (T3). Step 1 was identical in all three regression sets, with the overall model significantly predicting number of binges at T3, $R^2 = .388$, $F(2, 73) = 23.143$, $p < .001$. Number of binges at T1 significantly predicted number of binges at T3, $\beta = .580$, $t(73) = 6.324$, $p < .001$, as did AHSS at T2, $\beta = -.200$, $t(74) = -2.178$, $p = .033$.

Predictor: Negative affect (PANAS-NA, T2). The addition of PANAS-NA to the model did not account for a significant increase in variance, $\Delta R^2 = .016$, $\Delta F(1, 72) = 1.932$, $p = .169$.

Predictor: Post-event processing (PEP-Q, T2). The addition of PEP-Q to the model did not account for a significant increase in variance, $\Delta R^2 = .002$, $\Delta F(1, 72) = 0.265$, $p = .643$.

Predictor: Academic, social interaction, and coping self-efficacy (CSEI-A, CSEI-SI, and CSE, T2). The addition of the three self-efficacy variables to the model did not account for a significant increase in variance, $\Delta R^2 = .023$, $\Delta F(3, 670) = 0.897$, $p = .447$.

Secondary Aim #3: To examine whether state negative affect, post-event processing, or negative perceived self-efficacy in academic, social, and coping domains the day after binge drinking predict changes in trait negative affect over time above and beyond physical symptoms of hangover.

Hypotheses. State negative affect, post-event processing, and negative perceived self-efficacy in academic, social, and coping domains the day after binge drinking would

predict increases in trait negative affect above and beyond physical symptoms of hangover.

Results. To examine whether state negative affect, post-event processing, and negative perceived self-efficacy in academic, social, and coping domains the day after binge drinking predict changes in trait negative affect over time above and beyond physical symptoms of hangover, three hierarchical linear regressions were conducted within the binge group only using trait negative affect (T3) as the outcome variable. T1 trait negative affect and the AHSS were entered in step 1, and either the PANAS-NA (T2), PEP-Q (T2), or the self-efficacy questionnaires (i.e., the CSEI-A [T2], CSEI-SI [T2], or CSE [T2]) were entered in step 2.

Step 1 was identical in all three regressions. The model significantly predicted PANAS-NA (T3), $R^2 = .540$, $F(2, 73) = 42.881$, $p < .001$. PANAS-NA (T1) significantly predicted PANAS-NA (T3), $\beta = .682$, $t(73) = 8.236$, $p < .001$, whereas AHSS (T2) did not, $\beta = .141$, $t(73) = 1.701$, $p = .093$.

Predictor: Negative affect (PANAS-NA, T2). The addition of PANAS-NA (T2) accounted for a small but significant increase in variance, $\Delta R^2 = .032$, $\beta = .232$, $\Delta F(1, 72) = 5.312$, $p = .024$.

Predictor: Post-event processing (PEP-Q, T2). The addition of PEP-Q did not account for a significant increase in variance, $\Delta R^2 = .019$, $\Delta F(1, 72) = 3.037$, $p = .086$.

Predictor: Academic, social interaction, and coping self-efficacy (CSEI-A, CSEI-SI, and CSE, T2). The addition of the three self-efficacy variables did not account for a significant increase in variance, $\Delta R^2 = .032$, $\Delta F(3, 70) = 1.758$, $p = .163$.

Secondary Aim #4a: To examine whether alcohol-induced memory losses (i.e., blackouts) predict state negative affect or post-event processing the day after binge drinking and whether these relationships are moderated by intolerance of uncertainty.

Hypotheses. Alcohol-induced memory loss would positively predict negative affect and post-event processing the day after binge drinking and intolerance of uncertainty would moderate these relationships such that individuals high in intolerance of uncertainty would experience greater negative affect and post-event processing than individuals low in intolerance of uncertainty.

Results. To examine whether alcohol-induced memory losses (i.e., blackouts) predict state negative affect or post-event processing the day after binge drinking and whether these relationships are moderated by intolerance of uncertainty, moderation analyses were conducted using hierarchical linear regression for each outcome variable (i.e., PANAS-NA [T2] and PEP-Q [T2]). Non-dichotomous variables were mean-centered. When predicting PEP-Q, time of questionnaire completion was entered as a covariate in the first step. Next, the YAACQ-BD-R and the IUS-12 were entered, and finally, the product of the YAACQ-BD-R and the IUS-12 (i.e., the interaction variable) was entered.

Outcome: Negative affect (PANAS-NA, T2). The initial model including IUS-12 and YAACQ-BD-R as predictors accounted for a significant amount of variance, $R^2 = .421$, $F(2, 76) = 27.613$, $p < .001$. Main effects for IUS-12 ($\beta = .536$, $t[76] = 5.992$, $p < .001$) and YAACQ-BD-R ($\beta = .266$, $t[127] = 2.968$, $p = .004$) were both significant. Higher levels of intolerance of uncertainty and more severe blackout were associated

with greater negative affect. When introduced to the model, the interaction term did not account for a significant amount of additional variance, $\Delta R^2 = .019$, $\Delta F(1, 75) = 2.611$, $p = .110$. With the addition of the interaction term, main effects of IUS-12 ($\beta = .531$, $t[75] = 5.995$, $p < .001$) and YAACQ-BD-R ($\beta = .217$, $t[75] = 2.318$, $p = .023$) remained significant.

Outcome: Post-event processing (PEP-Q, T2). The model including IUS-12 and YAACQ-BD-R as predictors accounted for a significant amount of variance, $R^2 = .284$, $F(3, 75) = 9.923$, $p < .001$. Main effects for IUS-12 ($\beta = .212$, $t[75] = 2.115$, $p = .038$) and YAACQ-BD-R ($\beta = .406$, $t[75] = 4.036$, $p < .001$) were both significant. Higher levels of intolerance of uncertainty and more severe blackout were associated with greater post-event processing. When introduced to the model, the interaction term did not account for a significant amount of additional variance, $\Delta R^2 = .001$, $\Delta F(1, 74) = 0.093$, $p = .761$. With the addition of the interaction term, main effects of IUS-12 ($\beta = .211$, $t[74] = 2.091$, $p = .040$) and YAACQ-BD-R ($\beta = .396$, $t[74] = 3.697$, $p < .001$) remained significant.

Secondary Aim #4b: To examine whether the physical symptoms of hangover predict state negative affect the day after binge drinking above and beyond neuroticism, and whether this relationship is moderated by anxiety sensitivity.

Hypothesis. The physical symptoms of hangover would predict state negative affect above and beyond neuroticism, and anxiety sensitivity would moderate the relationship such that physical symptoms of hangover would predict state negative affect for individuals high in anxiety sensitivity but not for individuals low in anxiety sensitivity.

Results. To examine whether the physical symptoms of hangover predict state negative affect the day after binge drinking above and beyond neuroticism, and whether this relationship is moderated by anxiety sensitivity, hierarchical linear regression was used to conduct a moderation analysis in which the PANAS-NA (T2) was the outcome variable. Non-dichotomous variables were mean centered. The EPQ-N (T1) was entered in step 1, followed by the AHSS (T2) in step 2 and the ASI-3 (T1) in step 3. Lastly, the product of the AHSS and the ASI-3 (i.e., the interaction variable) was entered in the final step.

In step 1, neuroticism significantly predicted state negative affect the day after binge drinking, $R^2 = .107$, $F(1, 77) = 9.186$, $p = .003$. In step 2, the addition of the AHSS (T2) accounted for a significant increase in variance, $\Delta R^2 = .226$, $\Delta F(1, 76) = 25.686$, $p < .001$. In step 3, the addition of the ASI-3 accounted for a significant increase in variance, $\Delta R^2 = .075$, $\Delta F(1, 75) = 9.530$, $p = .003$. In step 3, both the AHSS (T2) and ASI-3 significantly predicted PANAS-NA (T2), AHSS: $\beta = .430$, $t(75) = 4.455$, $p < .001$; ASI-3: $\beta = .378$, $t(75) = 3.087$, $p = .003$. Greater hangover severity and higher levels of anxiety sensitivity were associated with greater negative affect.

The addition of the interaction variable in step 3 contributed significantly to the model, $\Delta R^2 = .042$, $\beta = .230$, $\Delta F(1, 74) = 5.586$, $p = .021$. In order to determine regions of significance, Hayes' MODPROBE macro was used to employ the Johnson-Neyman technique (Johnson & Neyman, 1936, as cited in Hayes & Matthes, 2009), revealing that the relationship between AHSS (T2) and PANAS-NA (T2) was only significant when ASI-3 was above 8.858 (See Figure 1 for visualization of the effect). Johnson-Neyman analysis also revealed that the effect increased in tandem with ASI-3 scores: at ASI-3 =

8.858, β = .042, 95% CI [.000, .083]; at ASI-3 = 56.842, β = .172, 95% CI [.083, .260]. At low levels of anxiety sensitivity, there was not a significant relationship between hangover severity and negative affect. At higher levels of anxiety sensitivity, however, greater severity of hangover symptoms was associated with higher levels of negative affect. Of note, the CIs of these effects overlap less than 50%, suggesting a statistically significant difference (Cumming, 2009).

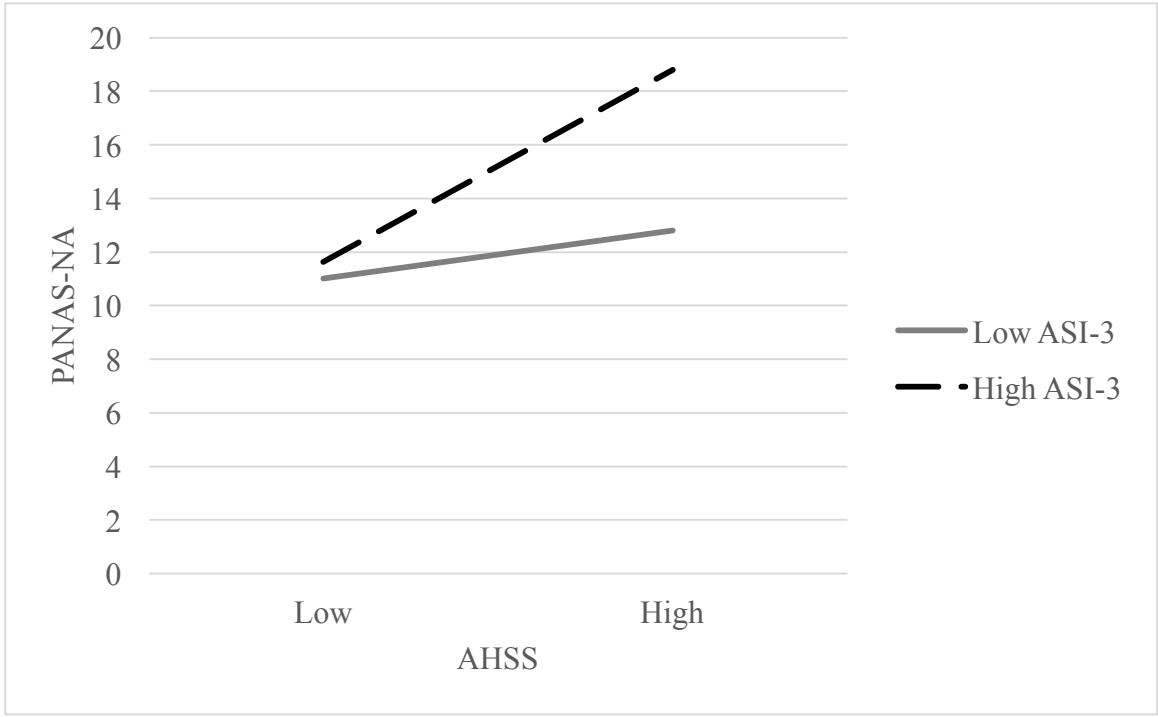

Figure 1. Moderation of relationship between Alcohol Hangover Severity Scale (AHSS) and Positive and Negative Affect Schedule - Negative affect subscale (PANAS-NA) by Anxiety Sensitivity Index – 3 (ASI-3). Low and high are defined as the 10th and 90th percentile of each variable and are used only for the purpose of visualization of the effect. When ASI-3 is low, there is not a significant relationship between AHSS and PANAS-NA scores. As ASI-3 increases, however, higher AHSS scores are associated with higher PANAS-NA scores.

CHAPTER 4

DISCUSSION

The results of the present study suggest that the effects of binge drinking are both physical and psychological and are not limited to acute periods of intoxication. For at least some people, the days after binge drinking are marked by unpleasant emotion, repetitive negative thought regarding the events of the night prior, and the belief that one is less able to perform in multiple domains. In contrast to our hypotheses, the effect of binge drinking on negative affect, post-event processing, and self-efficacy was not moderated by neuroticism, suggesting that one's tendency to experience negative affect more generally does not affect one's risk for experiencing negative affect and related constructs the day after binge drinking, although neuroticism does exert its own unique effect. Our findings also show that elevated negative affect and reduced coping self-efficacy are associated with behavioral avoidance above and beyond the physical symptoms of hangover and that each of these constructs accounts for unique variance in behavioral avoidance, providing some support for our hypothesis that the psychological effects of binge drinking may have behavioral repercussions. We did not find the same effect for post-event processing or self-efficacy in social and academic domains. It may be that negative affect and coping self-efficacy are more central to affective distress than PEP or social and academic self-efficacy, which may account for this pattern of findings.

Contrary to our hypotheses, negative affect, post-event processing, and self-efficacy in academic, social, and coping domains the morning after binge drinking did not predict changes in overall alcohol use or number of binges over the course of the study. The best predictor for T3 alcohol use was consistently T1 alcohol use.

Interestingly, hangover symptoms at T2 did not predict changes in total number of drinks, but did predict changes in number of binges: the more physical hangover symptoms experienced at T2, the fewer binges reported at T3. Further, in line with our hypotheses, negative affect the morning after binge drinking predicted changes in negative affect over time; however, post-event processing and self-efficacy in academic, social, and coping domains the morning after binge drinking did not. Although this may indicate that negative affect experienced the day after binge drinking leads to increased negative affect two weeks later, results must be interpreted with caution. Negative affect is a relatively stable trait; analyses may be capturing the existing fluctuation in negative affect over time. Or, it may be that our revised version of the PANAS did not adequately assess *state* versus *trait* negative affect. Nevertheless, given our finding regarding higher levels of negative affect days after binge drinking compared to days after abstinence, we may be seeing a true effect.

We also found that that alcohol-related memory losses (i.e., blackouts) were associated with next-day negative affect and post-event processing. Individuals who cannot remember what they did the night prior might not feel great about it and may spend time attempting to mentally digest what could have happened. We had hypothesized that these effects would be particularly salient for individuals high in intolerance of uncertainty; however, this hypothesis was not supported. Intolerance of uncertainty predicted negative affect and post-event processing, but no interaction between intolerance of uncertainty and alcohol-related memory losses emerged. One possible explanation for this finding could be that our measure of blackout (YAACQ-BD-R) was revised for use in this study and is fairly untested. Internal consistency in our

sample was poor (α = .59), suggesting that measurement was less than satisfactory. Items assessed common experiences associated with alcohol blackout (e.g., not remembering stretches of the night prior, waking up in an unexpected place) dichotomously; however, individual experiences of blackout — and subsequently, self-report — are likely to be inconsistent given the memory-interfering nature of the phenomenon. Internal consistency may improve with additional items or Likert-type scoring.

Findings also indicate that physical hangover symptoms are associated with negative affect and that the relationship becomes more pronounced at higher levels of anxiety sensitivity. The effect first becomes significant at a fairly low level of anxiety sensitivity (ASI-3 = 8.858), well within the normal range delineated by Allan and colleages (2014). However, as ASI-3 scores increase, so does the effect, suggesting that physical symptoms are more strongly associated with negative affect as anxiety sensitivity increases.

In line with the extant literature, the present study indicates that negative affect is a common experience in the days following binge drinking. Negative affect symptoms most reported in our sample were apathy (22.8%), regret (21.5%), agitation (15.6%), and guilt (14.2%). The prevalence of anxiety the day after binge drinking in our sample (13.7%) was within the range of estimates from previous studies (7.4% in Penning et al., 2012, to 18% in Smith & Barnes, 1983). Conversely, the prevalence of depression the day after binge drinking in our sample (10.1%) was somewhat lower than existing research would suggest (18.9%, Penning et al., 2012; 20% Smith & Barnes, 1983)[2]. In

[2] Penning and colleages and Smith and Barnes assessed their participants on symptoms *during hangover*, whereas we focused primarily on symptoms *the day after binge*

addition, although the primacy of these symptoms was largely the same in Penning et al.'s study (2012; Apathy: 74.0%, Regret: 27.1%, Agitation: 49.5%, Guilt: 25.2%), with the addition of blunted affect (29.9%), the prevalence rates are markedly different. Demographic and cultural differences may account for these discrepancies: Penning and colleages conducted their study with students in the Netherlands in the past decade, and Smith and Barnes examined hangover symptoms in adults (>18) living in western New York state in the 1970s. Some evidence suggest that binge drinking is far more prevalent among students in the Netherlands than in the U.S. (Swedish Council for Information on Alcohol and Other Drugs, 2004), which may affect symptom prevalence. Although Smith and Barnes examined individuals in the U.S., their study occurred in a different era. Further, they do not report demographics, leaving us to wonder whether the sample is similar to our own. Given evidence that binge drinking has become increasingly popular in recent years (Naimi et al., 2003) and that binge drinking is more normative among youth (Courtney & Polich, 2009; Lange et al., 2002; Naimi et al., 2003; Wechsler & Nelson, 2001), it may be that heavy episodic drinking and the ensuing hangover were less accepted in Smith and Barnes' sample than in the present study, potentially resulting in relatively higher levels of negative affect.

Our findings also support extant research indicating that post-event processing increases following events during which alcohol is consumed in large quantities (Battista & Kocovski, 2010; Battista et al., 2014). Notably, our study deepens our understanding of this phenomenon by identifying alcohol blackout as a notable contributor to post-event

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drinking. Although these circumstances frequently co-occur, they are not identical. Thus, we also assessed participants' symptoms during hangover. Symptom rates were largely consistent with rates the day after binge drinking. Data are available on request.

processing. Existing research suggests that alcohol blackout leads to negative affect the day after binge drinking (Buelow & Koeppel, 1995; Lee et al., 2009); however, no study to date has examined the relationship between alcohol blackout and cognitive factors that are associated with negative affect (e.g., post-event processing).

The present study also supports existing research indicating negative self-efficacy increases days following heavy alcohol consumption (Collins & Chiles, 1980; Finnigan et al., 1998, 2005; Howland et al., 2010; Streufert et al., 1995; Verster et al., 2014). Of note, our study is the first of its kind to examine coping self-efficacy in the context of the aftermath of binge drinking, finding that individuals are less likely to believe they are able to cope on days following binge drinking compared to days following abstinence. Considered in the context of Khantzian's (1997) self-medication hypothesis, belief that one is less able to cope may lead to increased alcohol use to compensate for one's inability to cope otherwise.

In contrast to the findings of Battista and colleages (2014), we did not find an effect of gender on post-event processing following binge drinking. Of note, Battista et al. used an experimental design in which participants were given alcohol in an attempt to reach a blood alcohol content of 0.07% (average BAC = 0.057%). This is below the cutoff that the National Institute of Alcohol Abuse and Alcoholism define as binge drinking (i.e., 0.08%, approximately four drinks in two hours for women or five drinks in two hours for men; NIAAA, 2004). In our sample, participants reported that they consumed an average of 6.97 drinks (6.90 for women, 6.70 for men) on the identified night. Depending on the length of time over which participants consumed alcohol, this may have resulted in a blood alcohol content level much higher than the level achieved in

the Battista et al. (2014) study. Further, it may be that women achieved higher BACs than men. Participants in our study were able to regulate their own alcohol consumption, and given that mean drink intake was relatively comparable across genders and that women tend to be smaller in stature and more sensitive to the effects of alcohol than men, it may be that any gender effects were confounded by different degrees of intoxication.

Several implications of our findings are worthy of discussion. First, recognition that binge drinking has both physiological and psychological consequences may help inform public health efforts aimed toward reducing dangerous alcohol use. Informing at-risk populations – namely individuals in late adolescence and early adulthood – of the psychological effects of binge drinking will allow individuals to make informed decisions about their alcohol intake and perhaps recognize the dynamic relationship between alcohol use and affective distress in their own lives before it becomes an uncontrollable problem.

In addition, our finding that neuroticism is associated with negative affect, post-event processing, and self-efficacy adds support to the well-documented relationships between these and related constructs. Importantly, that neuroticism did not moderate the effect of binge drinking on negative affect, post-event processing, or self-efficacy suggests that some other factor may contribute to the tendency to experience negative affect the day after binge drinking. Two areas of inquiry come to mind: social anxiety and attitudes regarding alcohol use. Although social anxiety is associated with neuroticism, it is a distinct construct; given the often social nature of binge drinking, particularly among undergraduate students, social anxiety may play an important role in predicting negative affect and associated constructs the day after binge drinking. Attitudes regarding alcohol

use may be another important line of investigation. In line with findings from Muraven et al. (2005), some negative affect experienced the day after binge drinking may be in connection with judgment of the quantity of alcohol consumed the night before. Future research should examine additional moderators of negative affect and associated constructs the day following binge drinking.

Of note, we did not see changes in drinking behavior in association with negative affect or associated constructs following binge drinking. This may reflect a lack of a true effect or may indicate that effects are smaller than we estimated. If the former is true, it may be that the psychological and behavioral effects of binge drinking are limited to the short term (i.e., the next day) or that the long-term repercussions were not captured by assessment of alcohol intake and negative affect. If the latter is true, our analyses may have been underpowered. Further investigation with larger sample sizes and more frequent measurement is warranted to clarify these effects.

The present study aimed to capture the real-world experience of binge drinking by using a quasi-experimental design in which participants were encouraged to engage in their typical drinking behaviors. This design allowed for the inclusion of factors that are impossible to recreate in the laboratory, namely the investment of an individual in their own life. Assessing participants following binge drinking in context better captures real-world alcohol quantity and social dynamics. And, by not removing participants from their world in order to evaluate them, we are able to see the real-life repercussions of their self-directed behaviors. In addition, by using remote assessment in the participants' own spaces, we were more likely to capture genuine reactions. Given the commonly bed-ridden nature of the morning after the night before, this is particularly relevant when

examining binge drinking. Further, our two-stage design (i.e., large, cross-sectional and smaller longitudinal) allowed for an efficient examination of prevalence while offering the ability to evaluate the repercussions of binge drinking over time.

Several limitations must be noted. First, though the quasi-experimental nature of our design allowed for semi-naturalistic examination, it also resulted in reduced experimental control. The range of experience in any given "night out" can be great, and thus, our results must be interpreted knowing that confounding factors may be at play. In addition, the present sample was limited to college students. Although this population is relevant to the examination of binge drinking, it may also obscure effects of problematic binge drinking given that most individuals who binge drink in college are unlikely to develop alcohol use disorder. Further, this study relied solely on self-report assessments. Although this made data collection more resource-efficient, it also may lead to problems with reporting bias. Given that alcohol use may pull at feelings of shame and or guilt for some individuals, social desirability may be at play. Lastly, our study design at T2 did not differentiate between participants who did not complete questionnaires because they failed to act in accordance with their group (i.e., individuals in the abstinence group who did not abstain from drinking; individuals in the alcohol group who did not binge) and participants who did not complete questionnaires for other reasons. This information would have permitted a better understanding of participant binge behavior.

The present study demonstrates that binge drinking has considerable psychological consequences, in addition to its well-established physiological effects, and that these consequences affect next-day behavior. In addition, alcohol-induced memory loss has a considerable effect on post-event processing, a construct particularly relevant

for individuals with anxiety disorders. And, individuals high in anxiety sensitivity may misinterpret hangover symptoms as signs that something is terribly wrong. Given the often destructive relationship between alcohol use and affective distress, continued investigation into the interplay between binge drinking and psychological constructs is merited.

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