

## Major Article

# Predictors of At-Risk Intoxication in a University Field Setting: Social Anxiety, Demographics, and Intentions

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**Abstract. Objective:** The determinants of alcohol consumption among university students were investigated in a downtown field setting with blood alcohol content (BAC) as the dependent variable. **Participants:** In total, 521 participants completed a brief survey and had their BAC assessed during April 2013. **Methods:** Between 10:00 PM and 2:00 AM, teams of researchers recruited passersby at 3 heavy-drinking locations near a university campus. Before the BAC assessment, participants completed a questionnaire regarding their drinking intentions, drinking group, and social anxiety. **Results:** The average BAC of drinking students was 0.107 g/dL, which was 0.033 g/dL higher than their intended BAC. Males and members of a Greek-life organization consumed significantly more alcohol than their demographic counterparts. A significant positive curvilinear relationship was observed between social anxiety and BAC. **Conclusions:** University students achieve high levels of intoxication, often exceeding their intended BAC. Social anxiety may be an informative predictor of alcohol consumption in this setting.

**Keywords:** alcohol, blood alcohol content, drinking, field methodologies, intended intoxication, social anxiety

Mitigating alcohol-related harm remains one of the greatest challenges to institutions of higher education. It is estimated 1,825 college and university students lose their lives annually as a result of alcohol consumption.<sup>1</sup> Moreover, an estimated 600,000

injuries, 700,000 aggressive conflicts, and 90,000 sexual assaults result from college drinking each year.<sup>2</sup>

Not only is alcohol use and abuse one of the leading causes of morbidity and mortality among youth worldwide,<sup>3</sup> its deleterious effects are uniquely felt on college and university campuses. College students drink significantly more alcohol than their non-college-attending peers.<sup>4-6</sup> Furthermore, college students are more likely than their non-college-attending peers to drive under the influence of alcohol (28.9% vs 21.6%, respectively).<sup>1,7,8</sup>

In order to address this critical problem, research of the underlying mechanisms of alcohol abuse among college students and more valid measurement strategies are imperative. The current research investigated the role of social anxiety as a risk factor for excessive alcohol consumption. Additionally, actual blood alcohol content (BAC) was assessed in a naturalistic field setting, thereby advancing the traditional self-report approach.

## Social Anxiety

Anxiety disorders are the most pervasive class of mental disorders, with social anxiety being one of the most common subtypes.<sup>9,10</sup> This degree of prevalence holds true among the college-student population.<sup>9</sup> Not only is social anxiety disabling in itself, but it also serves as a risk factor for subsequent issues involving substance use.<sup>11</sup> Indeed, socially anxious college students engage more frequently in alcohol consumption and more often have a diagnosis of alcohol abuse or dependence than their nonanxious peers.<sup>12-14</sup>

College students regularly encounter a variety of social situations (eg, meeting new roommates, working on

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## METHODS

### Participants and Setting

During 4 nights of data collection in April 2013, participants ( $N = 521$ ) completed a brief survey and a BAC assessment. Individuals participated at 1 of 3 research tables between the hours of 10:00 PM and 2:00 AM. Two tables were located near downtown bars adjacent to a large public university in the southeastern United States, and 1 table was positioned on campus near a late-night dining facility. These tables were chosen because they captured a broad range of pedestrians passing downtown bars and the only central late-night hangout on campus.

The majority of participants were male (71.0%); 50.9% were seniors, followed by freshmen (19.7%), juniors (9.7%), and sophomores and graduate students (8% each), with the remainder representing alumni. Nearly one-third (31.5%) were members of a Greek-life organization. Participants were asked about their current educational status, including if they were currently undergraduate students at the university and at what year.

### Apparatus

Participants' BACs were assessed using handheld Lifeloc FC-20 breath alcohol testers (Lifeloc Technologies, Wheat Ridge, Colorado). These breathalyzer units are accurate to  $\pm 0.005$  g/dL. Two breath alcohol testers were present at each location, and all were calibrated prior to data collection. The research assistants (RAs) administering the BAC tests alternated the use of the breath alcohol testers to counteract alcohol saturation.

### Measures and Questionnaires

#### Social Interaction Anxiety Scale (SIAS)

The SIAS ( $\alpha = .94$ )<sup>34</sup> assesses fears of general social interaction, the central concerns of which "include fears of being inarticulate, boring, sounding stupid, not knowing what to say or how to respond within social interactions, and of being ignored."<sup>34(p457)</sup> A representative item on the SIAS is "I have difficulty making eye-contact with others." The scale consists of 20 items rated on a Likert scale ranging from 0 (*not at all characteristic or true*) to 4 (*extremely characteristic or true*).

#### Drink-Refusal Self-efficacy

Students who are more socially at ease are better able to resist offerings of alcohol by peers.<sup>35</sup> To examine this phenomenon, the survey incorporated 3 questions regarding drink-refusal self-efficacy (DRSE). The questions were derived from Jang et al's modified version ( $\alpha = .90$ ) of Perry and Grant's 1988 DRSE scale.<sup>36</sup> One of the questions read, "How sure are you that you could turn down an alcoholic beverage from a friend?" The other 2 DRSE questions

assignments with classmates, attending large parties, etc) that could prompt feelings of social anxiety and motivate alcohol consumption.<sup>15</sup> Yet, little is known about the relationship between social anxiety and level of intoxication in a naturalistic social setting. Additionally, this relationship is often viewed linearly, albeit a curvilinear relationship seems logical because individuals with social anxieties on the extreme ends of the spectrum would have unique motivations and activators for drinking. For example, individuals who are extremely socially anxious use alcohol as a "social lubricant" to lower their anxiety. This stems from the alcohol myopia theory, which suggests that alcohol may serve to reduce anxiety by decreasing the attention an individual is able to allocate to inhibitory cues.<sup>16</sup> After all, social anxiety likely produces inhibitory cues such as rejection or public humiliation.<sup>17</sup> People with high social anxiety may believe and act on the idea that the more alcohol they consume, the greater the suppression of these inhibitory cues and consequent reduction of anxiety.<sup>18</sup>

Individuals with minimal social anxiety may have higher BACs because they do not fear the consequences of intoxication, such as impaired judgment, that lead to potential embarrassment. For this reason, they may not feel the need to limit their alcohol consumption. Thus, the exploration of a curvilinear relationship is warranted. Understanding the nature of the relationship can inform the development of prevention efforts targeting social anxiety and alcohol abuse.

### Drinking Intentions

Many interventions to prevent alcohol abuse among college/university students rely on reducing the amount of alcohol students intend to drink. Yet, only limited research exists on how closely drinking intentions mirror actual drinking behavior.<sup>19</sup> Research on relations between drinking intentions and behaviors is needed because drinking intentions have been linked to self-perceptions of impairment<sup>20,21</sup> and one's perceived ability to operate a motor vehicle while intoxicated.<sup>22</sup>

### Beyond Self-report

The vast majority of research on alcohol consumption has relied exclusively on self-reports of drinking.<sup>23–26</sup> Yet, a plethora of studies indicate that self-reports of alcohol consumption are particularly prone to error due to (a) misunderstanding the definition of a "standard drink,"<sup>27,28</sup> (b) ignorance of standard drink volumes,<sup>29,30</sup> (c) poor recall while intoxicated,<sup>31,32</sup> and (d) environmental factors that influence self-monitoring of alcohol consumption.<sup>33</sup>

Thus, the current study investigated alcohol consumption using BAC testing in a field setting in order to explore relationships between student's social anxiety, demographics, drinking intentions, and BAC.

replaced the word “friend” with “stranger” and “significant other,” respectively. Responses to these questions were given with a 5-point Likert scale from 1 (*could not say no*) to 5 (*could say no*).

### Drinking-Group Characteristics

A number of studies have highlighted the influence of drinking-group characteristics on an individual’s level of intoxication from alcohol.<sup>35,37,38</sup> In order to examine this effect and control for unique features of the drinking group when exploring the relationship between social anxiety and BAC, 3 questions were asked regarding one’s comfort, familiarity, and anxiety with one’s drinking group (eg, “How comfortable are you with the people in your drinking group”). These items were scored on a 5-point Likert scale.

### Intended BAC

The intended BAC was determined by asking participants “How intoxicated did you plan on getting tonight?” Participants were then shown a scale of BACs ranging from 0.000 to 0.299 g/dL, with corresponding labels (eg “slightly impaired,” “ready to pass out”), reflecting how intoxicated the average person would feel at specific BAC levels. Participants were able to refer to the scale when indicating which BAC they planned on reaching prior to beginning their alcohol consumption that evening.

### Procedure

Each of the 3 research teams consisted of 2 recruiters/surveyors and 1 breathalyzer administrator. Additionally, 1 project leader was assigned to each table to ensure a consistent protocol was followed and to aid in maintaining an effective research environment. All RAs were required to complete institutional review board training from the host university, attend a 2-hour training session on the project at the beginning of the semester, and attend a 1-hour training session prior to each shift of data collection. All research activities were approved by the Virginia Tech Institutional Review Board (IRB).

All passersby were recruited to participate, irrespective of demographics or perceived intoxication. When participants indicated that they were interested in hearing more about the study, they were provided with an information sheet and given an opportunity to ask any questions regarding the study. Participants were specifically informed that the data were collected anonymously and confidentially and that they were free to withdraw at any time without penalty. Anyone who agreed to participate—approximately 60% of passersby—had to confirm that s/he was 18 years or older (in order to provide consent) and refrain from eating, drinking, chewing gum, or smoking for the duration of the assessment.

An RA read all surveys aloud to participants and recorded their responses. After completing the survey, the participant was asked to swish his/her mouth out with water to remove any residual alcohol. The recruiter RA then marked a psi on the participant’s hand with a sharpie to prevent a participant from returning multiple times in a night. The BAC of the participant was then assessed. The BAC reading was recorded on the survey and shown to the participant in a one-to-one private conversation. Individuals with a BAC greater than or equal to 0.05 g/dL were encouraged not to drive.

## Data Analysis

### Drinking-Group Categories

Participants were assigned to drinking-group categories based on their responses to the question “How many people are in your drinking group tonight?” Assignments were based on the number of people in the group besides the participant, so participants drinking alone were assigned to Category 0, those drinking with 1 other person to Category 1, with 2 others to Category 2, and so forth, up to Category 6. Persons drinking with 7–9 people were assigned to Category 7, with 10–14 people to Category 8, and with 15 or more to Category 9.

### Drinking Intentions

The discrepancy between intended BAC and actual BAC was assessed by calculating the difference between each participant’s observed BAC via the breath alcohol tester and the participant’s self-reported intended BAC. This number was averaged across participants to demonstrate if participants as a whole tended to go beyond or remain under their intended BAC. The absolute value of this difference was also calculated for each participant and averaged across the sample to determine the magnitude of the difference between intended and achieved BAC.

### Social Anxiety

In order to create higher-order terms for social anxiety, the raw social anxiety scores were first mean centered. Mean centering was used to reduce nonessential multicollinearity while adding to the interpretability of social anxiety regression coefficients.<sup>39</sup> A second-order term was created for social anxiety by squaring the mean-centered social anxiety scores. The squared term was used as a predictor in the regression model to evaluate the curvilinear relationship between social anxiety and BAC. The mean-centered lower-order term was also used as a predictor in the regression model.

### Analytic Framework

All analyses were conducted using SAS 9.3 (SAS Institute, Cary, North Carolina). Descriptive statistics were used to assess overall levels of intoxication. For dichotic

comparisons (eg, sex), *t* tests were used. One-way analyses of variance (ANOVAs) were applied to assess class differences. Tukey's post hoc procedure was used to maintain the type I error rate while accounting for necessary power. A polynomial regression was performed to examine social anxiety, group size, DRSE, comfort, familiarity, and anxiousness around one's drinking group as predictors of BAC. All predictors were entered simultaneously into a single model. Again, the second-order social anxiety term was used to evaluate the curvilinear relationship between social anxiety and BAC in the polynomial regression framework.<sup>39</sup>

## RESULTS

### Levels of Student Alcohol Intoxication

The mean BAC of those participants who consumed alcohol was 0.107 g/dL (*SD* = .047). Several significant differences in level of intoxication were found based on participant demographics. Specifically, male participants who consumed alcohol had significantly higher BACs (0.111 g/dL) than female consumers of alcohol (0.099 g/dL;  $t[421] = -2.27, p = .02$ ). Additionally, members of a Greek-life organization who consumed alcohol had significantly higher BACs (0.117 g/dL) than non-Greek students (0.103 g/dL;  $t[424] = -2.95, p < .01$ ). Significant differences in BAC were also observed based on year in college,  $F(5, 395) = 4.98, p < .01$ . Table 1 depicts the results of Tukey's post hoc testing for year in school, showing seniors had significantly higher BACs than freshmen and graduate students. Table 1 also depicts average BACs as a function of demographic group.

### Intended Blood Alcohol Content

Among those participants who consumed alcohol, the mean intended BAC was 0.074 g/dL, 0.033 g/dL lower than the average observed BAC. The average absolute difference between intended and actual BAC was 0.060 g/dL. As indicated in Table 1, there were no differences based on sex, Greek-life membership, or year in school in either intended BAC or intended–observed difference in BAC.

### Group Category Distribution

The largest group category was Category 7 (17.0%), followed by Categories 2 (13.5%), 3 and 5 (13.1% each), 4 (11.8%), 6 (11.4%), 9 (6.7%), 1 (6.2%), 0 (3.9%), and 8 (3.5%).

### Social Anxiety and Level of Intoxication

Cronbach's alpha for the SIAS was .91, indicating excellent reliability. Table 1 presents the results of *t* tests and an ANOVA on the relationship between participant characteristics and social anxiety. Students not involved in Greek life reported greater social anxiety than did those affiliated with Greek-life organizations. Freshmen reported greater social anxiety than did juniors. There were no differences in social anxiety as a function of sex.

The overall regression model of social anxiety squared, social anxiety, group size, DRSE, comfort, familiarity, and anxiousness around one's drinking group on the dependent variable of BAC was statistically significant,  $F(9, 496) = 12.54, p < .01; R^2 = .188$ . Several predictors reached significance: the squared social anxiety score, familiarity with

**TABLE 1. Study Descriptive Statistics as a Function of Sex, Greek-Life Status, and Class Status**

Demographic group	BAC (g/dL)		Mean intended BAC*	Mean BAC – Mean intended BAC *	SIAS score
	<i>M</i> *	<i>SD</i> *			
Sex*					
Female	.099 <sub>a</sub>	.046	.066 <sub>a</sub>	.059 <sub>a</sub>	23.70 <sub>a</sub>
Male	.111 <sub>b</sub>	.046	.077 <sub>a</sub>	.060 <sub>a</sub>	23.31 <sub>a</sub>
Greek status*					
Greek	.117 <sub>a</sub>	.043	.080 <sub>a</sub>	.063 <sub>a</sub>	21.60 <sub>a</sub>
Non-Greek	.103 <sub>b</sub>	.048	.071 <sub>a</sub>	.059 <sub>a</sub>	24.07 <sub>b</sub>
Class status					
Freshman	.090 <sub>ac</sub>	.043	.061 <sub>a</sub>	.051 <sub>a</sub>	24.81 <sub>a</sub>
Sophomore	.102 <sub>abc</sub>	.048	.093 <sub>a</sub>	.046 <sub>a</sub>	23.98 <sub>ab</sub>
Junior	.114 <sub>abc</sub>	.042	.086 <sub>a</sub>	.075 <sub>a</sub>	19.40 <sub>b</sub>
Senior	.117 <sub>b</sub>	.045	.078 <sub>a</sub>	.065 <sub>a</sub>	23.06 <sub>ab</sub>
Grad Student	.091 <sub>ac</sub>	.053	.055 <sub>a</sub>	.054 <sub>a</sub>	24.89 <sub>ab</sub>
Alumni	.105 <sub>abc</sub>	.051	.092 <sub>a</sub>	.039 <sub>a</sub>	23.00 <sub>ab</sub>
Total	.107	.047	.074	.060	23.39

Note. BAC = blood alcohol content; SIAS = Social Interaction Anxiety Scale. Different subscripts denote the groups are significantly different ( $ps < .05$ ).

\*Only includes individuals consuming alcohol.

**TABLE 2. Summary of Multiple Regression Analysis for Blood Alcohol Content (*N* = 496)**

Variable	Correlation with BAC	Correlation with social anxiety	<i>B</i>	95% CI	$\beta$	<i>p</i>
(Constant)	—	—	0.058	0.008, 0.109		.02
Social anxiety <sup>2</sup>	-.03	—	$2.28 \times 10^{-5}$	$1.5 \times 10^{-6}$ , $4.4 \times 10^{-5}$	0.098	.04
Social anxiety	-.04	—	$-3.19 \times 10^{-4}$	$-7.3 \times 10^{-4}$ , $9.3 \times 10^{-5}$	-0.075	.13
Comfort	.05	-.18	$6.27 \times 10^{-4}$	-0.008, 0.010	0.007	.89
Familiarity	.11	-.10	0.009	0.003, 0.016	0.126	.01
Anxiousness	-.01	.20	$-7.38 \times 10^{-4}$	-0.006, 0.005	-0.011	.79
Drink refusal–Friend	-.28	-.15	-0.005	-0.010, -0.0006	-0.140	.03
Drink refusal–Stranger	-.25	-.13	-0.005	-0.010, -0.0003	-0.105	.04
Drink refusal–Significant other	-.25	-.12	-0.003	-0.007, 0.001	-0.075	.17
Group size	.14	-.07	0.007	0.005, 0.009	0.294	<.01

Note.  $R^2 = .1884$ ; BAC = blood alcohol content; CI = confidence interval.

one's drinking group, DRSE for friends and strangers, and group size ( $ps < .05$ ). The former indicates a significant positive curvilinear relationship between social anxiety and BAC such that those with lower and higher SIAS scores had relatively higher BACs. Full regression results including specific regression coefficients are given in Table 2.

### COMMENT

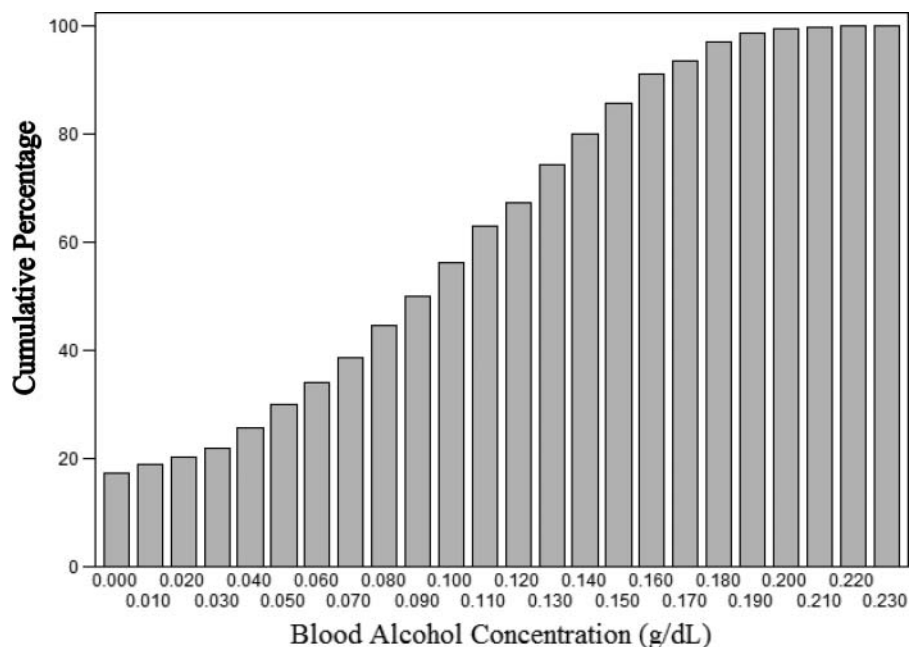
#### Alcohol Consumption and Demographics-Driven Differences in BAC

The levels of alcohol intoxication, assessed in a late-night university field setting, demonstrated the average student

was highly intoxicated (ie, average BAC = 0.107 g/dL). Furthermore, as depicted in Figure 1, many students were drinking well beyond this average BAC.

Demographic differences in the consumption of alcohol are constantly evolving. This is particularly true for sex differences in alcohol consumption among university students. Whereas these sex differences are more pronounced in high school, they are markedly less in college.<sup>40–43</sup> Additionally, recent research suggests that male and female college students are both drinking at higher levels, but the drinking rate of females is growing faster than that among males.<sup>41,44</sup>

These sex differences were reflected in the current sample. Males reached significantly higher BACs than females,



**FIGURE 1.** Cumulative percentage of participants as a function of BAC.

which is consistent with the majority of research.<sup>45–54</sup> Yet, the difference between BACs was only 0.012 g/dL, indicating that the BAC differences were slight. Interestingly, previous research conducted at this particular university mirror the national trends. Specifically, previous research in this setting from about a decade ago found (a) significantly lower mean BACs across both males and females, and (b) a sex difference in BAC that was nearly 3 times larger than the difference observed in the current study.<sup>55</sup>

A similarly slight, but statistically significant BAC difference was observed based on membership in a Greek-life organization (ie, a 0.014 g/dL difference). This significant difference is consistent with a host of research on alcohol consumption among members of a Greek-life organization.<sup>56–60</sup> As found by Glindemann and Geller,<sup>61</sup> differences in alcohol consumption based on Greek-life status are often due to the likelihood of consuming alcohol in a high-risk drinking context (eg, fraternity parties) rather than consistent demographic differences within a similar drinking setting. Thus, it is not entirely surprising larger differences as a function of Greek-life membership were not observed in the field setting of the current study.

### Drinking Intentions

Several worrisome findings emerged from the vast discrepancy between BAC intentions and actual BAC. Not only were the observed BACs surprisingly far from intended BAC ( $\Delta 0.060$  g/dL), but also the participants had a tendency to reach BACs far in excess of their intended BAC. Similar discrepancies were observed across year in school, sex, and Greek-life status. This suggests that environmental influences may cause college students to consume greater quantities of alcohol than initially intended.

### Social Anxiety and BAC

The mean SIAS score in this study (ie, 23.39) was greater than typical means for both undergraduate and community scores on SIAS, which are 19.0 and 18.8, respectively.<sup>34</sup> This may indicate that students who drink in this context are more prone to social anxiety. As noted in Table 1, nonmembers of a Greek-life organization had significantly higher scores on the SIAS than members of a Greek-life organization.

To our knowledge, this is the first study to demonstrate the hypothesized curvilinear relationship between social anxiety and alcohol consumption. The significant positive curvilinear relationship indicated that individuals on the lower and higher ends of social anxiety had higher BACs than those individuals scoring in the middle of the range.

It should also be noted the regression covariates of familiarity with one's drinking group, group size, and DRSE (both for friends and strangers) also reached statistical significance. The largest effect size was observed for size of

the drinking group, indicating that individuals with larger drinking groups tended to also have higher BACs.

It is interesting that familiarity with one's drinking group was statistically significant, but not one's comfort or anxiety with one's drinking group. It is possible that some of the comfort and anxiousness variance is explained by scores on the SIAS, thus attenuating these regression coefficients. Similarly, it is curious that DRSE was significant for friends and strangers, but not for significant others. We hypothesize that this finding was due to the nature of this particular social-drinking context. Whereas friends and strangers may have a larger influence on alcohol consumption in a downtown bar setting, this relationship would likely be reversed in other settings (eg, an intimate versus social-drinking setting).

### Limitations

The main limitation is that the direction of causality cannot be determined. Because social anxiety and alcohol consumption were measured at the same time, temporal precedence cannot be established. Although it is natural to think of the study results in terms of social anxiety producing differences in alcohol consumption, it is also plausible that level of intoxication is changing people's perceptions of anxiety. However, if this were the case, it would be anticipated that the mean SIAS scores of this sample would be significantly lower than college sample and community averages because presumably alcohol would reduce the mean level of social anxiety of the sample. On the contrary, this sample had a higher mean SIAS score than the average college sample.<sup>34</sup>

An additional limitation is the representativeness of the sample. Although it is evident students at this particular rural, large, public university might not be representative of all college and university students, it is also possible that this particular sample is also different from the larger university population. In particular, students with relatively high anxiety may feel less comfortable volunteering to participate in this research. However, the mean SIAS scores did not indicate a range restriction in social anxiety. Upperclassmen and males were also overrepresented in this sample compared with the demographics of the university as a whole. In order to examine a potential selection bias for sex, researchers did counts of males and females as they passed by the table. This indicated that males were also overrepresented in this drinking setting. For IRB reasons, participants were not asked their age (ie, legality to consume alcohol). Research was conducted at a predominantly white, non-Hispanic university, and race information was also not collected.

It is also possible that individuals who are more intoxicated may be more likely to participate in the research. Although this is impossible to preclude, the data are also not indicative of a BAC selection bias. As indicated in Figure 1, BACs in the sample very closely approximated a normal distribution. Furthermore, nearly 20% of the participants were completely sober at their time of

participation. The refusal rate was approximately 40%, which may also indicate a selection bias. However, time was the most common reason for not participating and many indicated that they would “come back later.”

## Conclusions

The mean levels of intoxication observed in this setting are indicative of an at-risk university drinking culture. These high levels of intoxication were observed across sex, Greek-life membership, and year in school. Yet, this research also shed light on potential areas for prevention intervention.

The large discrepancy between intended and observed BAC reflects one obvious target for intervention. Specifically, future research should focus on the nature of this discrepancy to determine if it is due to the powerful influence of the drinking environment or a lack of awareness of one's current level of intoxication. This particular finding also demonstrates the unique insight provided by the use of breathalyzers in a naturalistic, community setting. Many prevention intervention programs focus on consciously reducing a student's intended alcohol consumption. However, results indicate that this might not be sufficient because many students are unaware of their actual intoxication and only a weak relationship was observed between drinking intentions and BAC. BAC education should also accompany these types of intervention efforts.

Finally, a significant curvilinear relationship was observed between social anxiety and BAC. Thus, not only was social anxiety found to be a significant predictor of university-student alcohol consumption, the nature of this relationship was curvilinear. Health professionals dealing with drinking for coping motives or social anxiety should consider this unique relationship. For example, student consumers of alcohol with both high and low levels of social anxiety may reach higher BACs. Future studies examining this relationship should consider the curvilinear nature of this relationship in their data analysis and interpretation.

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## CONFLICT OF INTEREST DISCLOSURE

The authors have no conflicts of interest to report. The authors confirm that the research presented in this article met the ethical guidelines, including adherence to the legal requirements, of the United States and received approval from the Virginia Tech Institutional Review Board.

## NOTE

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## REFERENCES

1. Hingson RW, Zha W, Weitzman ER. Magnitude of and trends in alcohol-related mortality and morbidity among U.S. college students ages 18–24: 1998–2005. *J Stud Alcohol Drugs*. 2009;16:12–20.
2. Hingson R, Heeren T, Winter M, Wechsler H. Magnitude of alcohol-related mortality and morbidity among U.S. college students ages 18–24: changes from 1998 to 2001. *Annu Rev Public Health*. 2005;26:259–279.
3. World Health Organization. Alcohol and injuries: emergency department studies in an international perspective. Available at: [http://www.who.int/substance\\_abuse/publications/alcohol/en/](http://www.who.int/substance_abuse/publications/alcohol/en/). Published 2009. Accessed September 9, 2013.
4. Merline A, Jagger J, Schulenberg JE. Adolescent risk factors for adult alcohol use and abuse: stability and change of predictive value across early and middle adulthood. *Addiction*. 2008;103:84–99.
5. Stone AL, Becker LG, Huber AM, Catalano RF. Review of risk and protective factors of substance use and problem use in emerging adulthood. *Addict Behav*. 2012;37:747–775. doi: 10.1016/j.addbeh.2012.02.014.
6. White HR, McMorris BJ, Catalano RF, Fleming CB, Haggerty KP, Abbott RD. Increases in alcohol and marijuana use during the transition out of high school into emerging adulthood: the effects of leaving home, going to college, and high school protective factors. *J Stud Alcohol*. 2006;67:810–822.
7. Slutske WS. Alcohol use disorders among U.S. college students and their non-college-attending peers. *Arch Gen Psychiatry*. 2005;62:321–327.
8. Slutske WS, Hunter-Carter EE, Nabors-Oberg RE, et al. Do college students drink more than their non-college-attending peers? Evidence from a population-based longitudinal female twin study. *J Abnorm Psychol*. 2004;113:530–540. doi: 10.1037/0021-843X.113.4.530.
9. Schry AR, Roberson-Nay R, White SW. Measuring social anxiety in college students: a comprehensive evaluation of the psychometric properties of the SPAI-23. *Psychol Assess*. 2012;24:846–854. doi: 10.1037/a0027398.
10. Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry*. 2005;62:593–602. doi: 10.1001/archpsyc.62.6.593.
11. Buckner J, Schmidt N, Lang A, Small J, Schlauch R, Lewinsohn P. Specificity of social anxiety disorder as a risk factor for alcohol and cannabis dependence. *J Psychiatr Res*. 2008;42:230–239.
12. Kushner MG, Sher KJ. Comorbidity of alcohol and anxiety disorders among college students: effects of gender and family history on alcoholism. *Addict Behav*. 1993;18:543–552.
13. Gilles DM, Turk CL, Fresco DM. Social anxiety, alcohol expectancies, and self-efficacy as predictors of heavy drinking in college students. *Addict Behav*. 2006;31:388–398.
14. Buckner JD, Schmidt NB, Eggleston AM. Social anxiety and problematic alcohol consumption: the mediating role of drinking motives and situations. *Behav Ther*. 2006;37:381–391.
15. Ham L, Zamboanga B, Olthuis J, Casner H, Bui N. No fear, just relax and play: social anxiety, alcohol expectancies, and drinking games among college students. *J Am Coll Health*. 2010;58:473–479.
16. Steele CM, Josephs RA. Alcohol myopia: its prized and dangerous effects. *Am Psychol*. 1990;45:921–933.

17. Monahan J, Lannutti P. Alcohol as social lubricant. *Hum Commun Res.* 2000;26:175–202.
18. Lewis MA, Hove MC, Whiteside U, et al. Fitting in and feeling fine: conformity and coping motives as mediators of the relationship between social anxiety and problematic drinking. *Psychol Addict Behav.* 2008;22:58–67.
19. Glindemann KE, Geller ES, Ludwig TD. Behavioral intentions and blood alcohol concentration: a relationship for prevention intervention. *J Alcohol Drug Educ.* 1996;41:60–72.
20. Filmore MT, Roach EL, Rice JT. Does caffeine counteract alcohol-induced impairment? The ironic effects of expectancy. *J Stud Alcohol.* 2002;63:745–755.
21. Williams JG. Experience with alcohol and ability to discriminate legal intoxication status: a field study. *Addict Behav.* 1991;16:355–362.
22. Smith RC, Geller ES, Schry AR. Relationships among intentions, alcohol consumption, and intoxication: a field study. Paper presented at the 118th Annual Convention of the American Psychological Association; San Diego, CA; August 2010.
23. Clapp JD, Min JW, Trim RS, et al. Predictors of error in estimates of blood alcohol concentration: a replication. *J Stud Alcohol Drugs.* 2009;70:683–688.
24. Gruenewald PJ, Nephew T. Drinking in California: theoretical and empirical analyses of alcohol consumption patterns. *Addiction.* 1994;89:707–723.
25. Wechsler H, Lee JE, Kuo M, Seibring M, Nelson TF, Lee, H. Trends in college binge drinking during a period of increased prevention efforts: findings from 4 Harvard School of Public Health College Alcohol Study surveys: 1993–2001. *J Am Coll Health.* 2002;50:203–217.
26. Ham LS, Hope DA. Incorporating social anxiety into a model of college problematic drinking. *Addict Behav.* 2005;30:127–150.
27. Kerr WC, Stockwell T. Understanding standard drinks and drinking guidelines. *Drug Alcohol Rev.* 2012;31:200–205. doi: 10.1111/j.1465-3362.2011.00374.x.
28. Lemmens PH. The alcohol content of self-report and “standard” drinks. *Addiction.* 1994;89:593–601.
29. White HR, Kraus C, Flom J, et al. College students lack knowledge of standard drink volumes: implications for definitions of risky drinking based on survey data. *Alcohol Clin Exp Res.* 2005;29:631–638.
30. White AM, Kraus CL, McCracken LA, Swartzwelder HS. Do college students drink more than they think? Use of a free-pour paradigm to assess how college students define standard drinks. *Alcohol Clin Exp Res.* 2003;24:1751–1756.
31. Babor T, Steinberg K, Anton R, Del Boca F. Talk is cheap: measuring drinking outcomes in clinical trials. *J Stud Alcohol.* 2000;61:55–63.
32. Hustad J, Carey K. Using calculations to estimate blood alcohol concentrations for naturally occurring drinking episodes: a validity study. *J Stud Alcohol.* 2005;66:130–138.
33. Clapp JD, Min JW, Shillington A, Reed M, Lange J, Holmes M. Environmental and individual predictors of error in field estimates of blood alcohol concentration: a multilevel analysis. *J Stud Alcohol.* 2006;67:620–627.
34. Mattick RP, Clarke JC. Development and validation of measures of social phobia scrutiny fear and social interaction anxiety. *Behav Res Ther.* 1998;36:455–470.
35. Borsari B, Carey KB. Peer influences on college drinking: a review of the research. *J Subst Abuse Treat.* 2001;13:391–424.
36. Jang SA, Cho N, Yoo J. Understanding the antecedents of Korean high school students’ drinking refusal self-efficacy: parental influence, peer influence, and behavior. *Glob J Health Sci.* 2012;4:10–21.
37. Miller BA, Byrnes HF, Branner A, Johnson M, Voas R. Group influences on individuals’ drinking and other drug use at clubs. *J Stud Alcohol Drugs.* 2013;74:280–287.
38. Lange JE, Devos-Comby L, Moore RS, Daniel J, Homer K. Collegiate natural drinking groups: characteristics, structure, and processes. *Addict Res Theory.* 2011;19:312–322.
39. Cohen J, Cohen P, West SG, Aiken LS. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences.* 3rd ed. Mahwah, NJ: Lawrence Erlbaum Associates; 2003.
40. Clapp JD, Min JW, Shillington A, Reed M, Croff JK. Person and environment predictors of blood alcohol concentrations: a multi-level study of college parties. *Alcohol Clin Exp Res.* 2008;32:100–107.
41. Gruzca RA, Norberg KE, Bierut LJ. Binge drinking among youths and young adults in the United States: 1979–2006. *J Am Acad Child Adolesc Psychiatry.* 2009;48:692–702.
42. Keyes KM, Li G, Hasin DS. Birth cohort effects and gender differences in alcohol epidemiology: a review and synthesis. *Alcohol Clin Exp Res.* 2011;35:2101–2112.
43. Keyes KM, Martins, SS, Blanco, C, Hasin, DS. Telescoping and gender differences in alcohol dependence: new evidence from two national surveys. *Am J Psychiatry.* 2010;167:969–976.
44. The National Center on Addiction and Substance Abuse (CASA) at Columbia University. *Wasting the Best and Brightest: Substance Abuse at America’s Colleges and Universities.* New York, NY: The National Center on Addiction and Substance Abuse (CASA) at Columbia University; 2007.
45. Geller ES, Altomari MG, Russ NW, Harwood MK. Exploring the drinking/driving behaviors and attitudes of college students. *Higher Education Abstracts;* 1985. Resources in Education No. ED252756.
46. Geller ES, Clarke SW, Kalsher MJ. Knowing when to say when: a simple assessment of alcohol impairment. *J Appl Behav Anal.* 1991;24:65–72.
47. Geller ES, Lehman, GR. Drinking-driving intervention strategies: a person-situation-behavior framework. In: Laurence M, Snortum J, Zimring F, eds. *The Social Control of Drinking and Driving.* Chicago, IL: University of Chicago Press; 1988:279–320.
48. O’Malley M, Johnston L. Epidemiology of alcohol and other drug use among American college students. *J Stud Alcohol.* 2002;14:23–39.
49. Presley CS, Meilman PW, Lyster R. *Alcohol and Other Drugs on American College Campuses: Use, Consequences, and Perceptions of the Campus Environment, Volume I: 1989–1991.* Carbondale, IL: Core Institute, Southern Illinois University; 1993.
50. Tremblay PF, Graham K, Wells S, Harris R, Pullford R, Roberts SE. When do first-year college students drink most during the academic year? An Internet-based study of daily and weekly drinking. *J Am Coll Health.* 2010;58:401–411.
51. Vaisman-Tzachor R, Lai J. The effects of college tenure, gender, and social involvement on alcohol drinking and alcoholism in college students. *Ann Am Psychother Assoc.* 2008;11:18–24.
52. Johnston LD, O’Malley PM, Bachman JG, Schulenberg JE. *Monitoring the Future National Survey Results on Drug Use, 1975–2009. Volume I: Secondary School Students.* Bethesda, MD: National Institute on Drug Abuse; 2010.
53. Nolen-Hoeksema S. Gender differences in risk factors and consequences of alcohol use and problems. *Clin Psychol Rev.* 2004;24:981–1010.
54. Glindemann KE, Wiegand DM, Geller ES. Celebratory drinking and intoxication: a contextual influence on alcohol consumption. *Environ Behav.* 2007;39:352–366. doi: 10.1177/001391650290949.
55. Timmerman MA, Geller ES, Glindemann KE, Fournier AK. Do designated drivers of college students stay sober? *J Saf Res.* 2003;34:127–133.



56. Cashin JR, Presley CA, Meilman PW. Alcohol use in the Greek system: follow the leader? *J Stud Alcohol*. 1998;59:63–70.
57. Scott-Sheldon, LAJ, Carey KB, Carey MP. Health behavior and college students: does Greek affiliation matter? *Ann Behav Med*. 2008;31:61–70.
58. Wechsler H, Kuh M, Lee H, Davenport AE. Fraternities, sororities, and binge drinking: results from a national study of American colleges. *NASPA J*. 1996;33:401–411.
59. Wechsler H, Kuh G, Davenport AE. Fraternities, sororities and binge drinking: results from a national study of American colleges. *NASPA J*. 2009;46:395–416.
60. Park A, Sher, KJ Krull JL. Risky drinking in college changes as fraternity/sorority affiliation changes: a person–environment perspective. *Psychol Addict Behav*. 2008;22:219–229.
61. Glindemann KE, Geller ES. A systematic assessment of intoxication at university parties: effects of the environmental context. *Environ Behav*. 2003;35:655–664. doi: 10.1177/0013916503254751.

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