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Effect of Anticipatory Stress on Placebo Alcohol Consumption in a Bar-Laboratory

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Abstract

Background—Only one laboratory study has examined the relation between stress and alcohol use in an ecologically valid drinking context. In that prior study, drinking was measured *after* the stressful situation.

Objective—To examine the effect of an *anticipatory* stressor, and trait social anxiety on “alcohol” consumption in a bar-laboratory.

Methods—College students ages 18 and older ($N=127$) in same-sex groups of two or three participants took part in a study that ostensibly examined alcohol's effect on language fluency. Using a between-subjects design, participants were randomly assigned to a stress or control condition. Participants in the stress condition anticipated giving a stressful speech for the fluency procedure, whereas those in the control group anticipated a non-stressful activity. Before the alleged fluency task, groups could order and consume mixed drinks *ad-lib* in a bar laboratory. No beverages actually contained alcohol, but we used a validated procedure to ensure that participants included in these analyses were deceived. Primary analyses were performed with a Hierarchical Linear Model due to a substantial group/modeling effect.

Results—Counter to expectations, participants in the *control* group consumed more placebo alcohol than those in the stress condition. This main effect was moderated by past 3-months drinks per week, such that the effect was attenuated (or reversed) among heavy drinkers. No main or interaction effects were observed for trait social anxiety.

Conclusions—Some stressors (i.e. those invoking performance anxiety) may *decrease* consumption. People with higher levels of alcohol involvement might be especially motivated to drink for tension reduction purposes.

Keywords

alcohol; bar-laboratory; stress; anxiety

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Introduction

The relationship between stress and alcohol use is complex. On the one hand, experimental studies have found mixed support for the hypothesis that alcohol alleviates tension (1-3) On the other hand, Alcohol Use Disorders and Anxiety Disorders are comorbid (4). Furthermore, whether or not it is accurate, the *belief* that alcohol decreases stress is widely held, and dates back at least to the Ancient Greeks (5).

To investigate if people are motivated to drink alcohol after a stressful situation, several studies with non-clinical samples have been conducted. These examine whether experimentally induced stress causes greater *ad-lib* drinking, compared to a no-stress control group, among adults above the legal drinking age. This often entails inducing stress (or not), and then having participants complete an ostensibly unrelated taste-test while alone. In the taste-test procedure, participants are given a variety of alcoholic drinks to try. They are told to complete a rating form, which requires rating the beverages (typically wine) on up to 64 different characteristics (6-7). The idea behind this approach is that if people randomly assigned to receive a stressor consume more alcohol during the taste-test than those in a no-stress control group, the stressor is associated with increased drinking. Using the taste-test procedure, researchers have found full or partial support for increases in alcohol consumption when receiving negative feedback on an intelligence test (8), talking to an annoying confederate (9), after preparing an embarrassing speech (10), and being judged on attractiveness by members of the opposite sex (7). Other work has shown that being ostracized (11) or preparing a self-disclosing speech (12) does not cause an increase in alcohol consumed during a taste-test.

However, although widely used in laboratory research, the “taste test paradigm” is a poor reflection of alcohol consumption in the real-world, where drinking is much less rigid. To circumvent this issue, researchers have recently begun using a “bar-laboratory” which is designed to mimic a real-world bar or pub. Consuming alcohol in this context corresponds to the reality that drinking often takes place during down time (13), and that people have the option of refusing drinks (14-15). Crucially, research in bar-laboratories typically entails drinking in *groups*, whereas the taste-test paradigm involves consuming alcohol alone. To our knowledge, only one study has examined the impact of stress on alcohol use in a bar-lab.

Larsen and colleagues (16) assigned 106 college men at a university in the Netherlands to a stress or no-stress condition. Participants in the stress group gave a 6-minute speech to a stoic research assistant arguing they would be qualified for a desirable job, and students in the no-stress group completed a puzzle. Next, the men entered a laboratory bar and were allowed to drink real alcohol *ad-lib* for 30 minutes with a confederate who consumed either three alcoholic or three non-alcoholic drinks. There was a strong effect of modeling, but the stress manipulation had no impact on alcohol use. However, as noted by the authors, this study measured alcohol consumption *after* a stressor. It is possible that results would differ if participants were instead *anticipating* a stressful event. An additional limitation of the study is that participants were men only.

Present Study

The goal of the present study is to extend the findings related to stress-induced drinking of Larsen et al. (16) in the following ways: 1) Analyze the impact of anticipatory stress, 2) examine potential moderators, and 3) include a more generalizable participant pool (i.e. men and women). Although the findings are mixed, research generally shows that stress increases alcohol use; as such, we hypothesized that people who anticipate giving a self-disclosing speech will drink more than those in a control condition. Second, we predicted an interaction between stress and trait social anxiety such that the stressor's impact on alcohol use would be especially strong for participants with elevated trait anxiety. This is consistent with other laboratory research showing that trait anxious people are especially prone to drink heavily when exposed to a stressful situation (7, 17). Finally, we examined whether baseline alcohol use would also moderate the relation between stress and consumption, although no a priori hypothesis was established.

Data reported in the current study were part of a broader investigation to examine: 1) a new procedure for credibly administering placebo alcohol to underage drinkers (18), and 2) the effect of anticipatory stress on *ad-lib* drinking. The current paper focuses on the second aim. Regarding the first aim, we established that 89.1% of participants were successfully deceived with respect to placebo alcohol, and deception rates did not vary by age (18-20 versus 21+) or alcohol involvement (18). The high degree of placebo believability supports the internal validity of the study discussed here.

Method

Participants & Recruitment

Participants completed a consent form at the beginning of the laboratory session, although they were kept naïve to certain elements of the study (placebo alcohol, experiment aim, fluency procedure). All policies and procedures were approved by the Institutional Review Board at BLINDED.

Participants were recruited from lower level psychology courses at a mid-sized New England university for a study that allegedly examines the effect of alcohol use on verbal fluency. During our recruitment procedure, participants were told “You will be given the opportunity to drink alcohol prior to completing a language task.” Participants were eligible if they: were 18 years or older, consumed alcohol in the past three months, did not think they were pregnant, and never attended alcohol/drug treatment. Although our prior study (18) reported on participants who were both deceived and non-deceived with respect to placebo alcohol, here we only focus on the $n=127$ who were successfully deceived (see “placebo administration” subsection below). Participants were predominantly female (65.4%), aged 18 (54.6%), White/Caucasian (83.5%), and drank moderately (average weekly drinks=10.59, $SD=7.58$). See Table 1 for more information regarding demographics, as well as comparisons between participants in the stress and control group.

Procedure

Participants were run in same-sex groups of 2 or 3 between 4:15 and 8:35 on Sunday through Wednesday evening. Upon arriving at the laboratory, these groups were joined by one same-sex confederate, and each individual was led to an isolated room and completed the Demographics, DDQ, SIAS-6, and SPS-6 questionnaires. Random assignment to conditions occurred at the group level, such that participants within each group were either all assigned to the stress condition or all assigned to the control condition. However, instructions were given to each participant while isolated from their group members.

Based on a procedure used by Sher and colleagues (19), participants in the stress condition were told

For the fluency procedure, which will happen after the alcohol portion of the study, you will be asked to do the following: A man/woman (opposite sex) will enter a room with you and the other participants. You are to speak to him/her about how you would impress someone on a date. You should make as favorable an impression as possible, such that he/she, as well as the other participants, will think you are fun and engaging on dates. He/she is instructed not to talk back. It is important that the speech last five minutes. It will be video-recorded and used for training clinical psychology students. Afterwards, you will be asked a few questions about how difficult the task was. You can take a moment to prepare and gather your thoughts and I'll be back in a minute.

These instructions were given very deliberately with extensive eye contact. Participants were also provided with scrap paper that they could use to brainstorm their speech. Those in the control group were told:

For the fluency procedure, which will happen after the alcohol portion of the study, you will return here and read a poem. Afterwards, you will be asked a few questions about how difficult the task was.

After receiving their instructions, participants were left alone for approximately one minute to encourage rumination, after which they completed the STAI short form as a manipulation check.

Next, the groups were led to a nearby bar-laboratory, and were provided with a menu of non-alcoholic or allegedly alcoholic drinks. This room was furnished with tables, chairs, a bar, a mirror, liquor signs and glasses that are similar to a real-world pub. A standardized play-list of popular music was also played from speakers placed on the bar. "Alcoholic" drinks entailed one type of liquor and one type of juice or soda. Participants were allowed to order and consume as many of these beverages as desired from a bartender (who was always a female undergraduate RA), and could drink *ad-lib* during a 20 minute drinking period. In each session, the confederate drank 1.5 supposedly alcoholic drinks, and paced his/her sips evenly. The bartender subtly recorded the amount of alcohol consumed by each participant. This was facilitated by having all beverages contain exactly 9 oz (or 266 mL). If a participant did not finish a drink, the quantity of any remaining liquid was measured with a graduated cylinder after the session ended.

While in the bar-laboratory, participants watched a 17-minute portion of *Happy Gilmore* and responded to the movie rating questionnaire. They were free to consume and order drinks during this time. Participants were told this task was to help researchers develop materials for a different study. In actuality, it was largely designed to discourage participants in the stress condition from discussing anxiety-reducing tactics, which would undermine our manipulation. At the conclusion of the 20 minute drinking period, participants were debriefed and left the study.

Materials

Demographics—Participants indicated their age, gender, and race.

Daily alcohol drinking questionnaire (DDQ)—This measure queries the typical number of standard drinks on each day of the week within the past three months (20). From this, we derived the number of weekly drinks.

Social Interaction Anxiety (SIAS-6) and Social Phobia Scale (SPS-6)—Six-item short forms of the SIAS and SPS (21) were given as a measure of trait social anxiety. These measures are on a five-point Likert scale, have been psychometrically validated, and are highly correlated with the full scales from which they were derived (22). Coefficient alpha was .835 in our sample. Scores can range from 0.0 to 4.0 and are computed as the mean of all items.

Spielberger State-Trait Anxiety Inventory (STAI) Short Form—This consists of six items from the 20-question STAI state form (23-24), as a measure of *state* anxiety. The state STAI survey is a commonly used measure of anxiety. We observed an alpha of .746.

Movie Rating Questionnaire—Participants indicated the extent to which the film clip was “interesting,” “engaging,” “funny,” and “realistic” on a scale from 1 (“not at all”) to 5 (“extremely”). They were also asked: “What is the best and worst part of the clip?”

Placebo Administration

As mentioned above, one aim of this broader experiment was to design a procedure for credibly administering placebo alcohol to underage drinkers. As such, no participant consumed real alcohol. Instead, a number of tactics were employed to increase deception: 1) The confederate made two carefully scripted statements (i.e. “I’m definitely feeling this – good to be a lightweight sometimes”). 2) The bar-laboratory was sprayed with potent liquor prior to each session. 3) All allegedly alcoholic drinks were also sprayed and 2mL of liquor (1 mL of tequila and 1 mL of rum extract) were floated on top of these beverages.

Specifically, drinks were prepared as follows: In plain view of participants, the bartender poured 1.5 oz. of flattened tonic water from real liquor bottles into a shot glass, which she then transferred to a drinking glass. Next, the bartender added 7.5. oz. of juice or soda to the drinking glass. Then, she turned around while holding the drinks. With her back facing the participants, the bartender added a lime wedge to each beverage and subtly floated the 2mL mixture of real liquor.

To determine whether participants who drank the placebo alcoholic beverages believed they were consuming real alcohol, we administered a lengthy one-on-one funnel debrief. Based on this semi-structured conversation, a Research Assistant coded the degree of deception on a 9-pt scale from 1.0 (“No suspicion surrounding the placebo alcohol”) to 5.0 (“Strongly suspected that alcohol was fake”) in increments of 0.5. Anything higher than 3.0 (“Moderate suspicion the alcohol was weaker than usual”) was considered “non-deceived.” This criterion has been validated, and is described at greater length in an earlier report (18). Participants who did not believe it was real alcohol ($n=15$) were excluded from all analyses reported herein.

Statistical Methods

First, we ran a manipulation check using an independent t -test to ensure that participants in the stress condition were higher on the STAI short form than participants in the control condition. Next, we examined the assumptions underlying our analytic approaches and conducted a principal components analysis on our social anxiety measure. To test our primary hypotheses, we used an HLM because participants were nested within groups, so the assumption of independence is violated, especially since there is a strong modeling effect of alcohol consumption (25). An HLM framework accounts for that nesting effect. The model was run using the PROC GLIMMIX command in SAS v. 9.4. All other analyses were performed with SPSS v. 22.

Results

Manipulation Check

Regarding our manipulation, participants in the stress condition scored significantly higher on the STAI short form ($M=12.22$, $SD=2.60$) than participants in the control condition ($M=9.63$, $SD=2.81$), $t(125)=5.37$, $p<.001$, $d=0.96$

Hypothesis Testing

Preliminary analyses—Since data were analyzed with a Hierarchical Linear Model (HLM) we checked for normality, linearity, and homoscedasticity on the outcome (laboratory alcohol use), as violations of these assumptions can result in bias estimates (26). Alcohol consumption was normally distributed (skewness=-0.18, kurtosis=0.28), and visual inspection of a scatter-plot verified linearity. Results from a Levine's test demonstrated that variance was not different in the stress and control condition, suggesting homoscedasticity.

We performed a Parallel Analysis (27) for our Principle Components Analysis using software provided by Patil and colleagues (28) with the SIAS and SPS items. A one-factor solution best fit the data, so trait social anxiety was calculated as a mean of all 12 items across the 6-item SPS and 6-item SIAS questionnaires.

Main Results—For the HLM analyses, experimental condition (stress v. control), trait social anxiety ($M=0.54$, $SD=.49$), and past three-month drinks per week ($M=10.59$, $SD=7.58$) were entered as main effects. Condition X Trait Social Anxiety, and Condition X

Weekly Drinks were entered as interactions. The dependent variable was laboratory alcohol consumption.

The intra-class correlation (ICC) in this model was .43¹, which suggests a very strong nesting effect, such that individuals within groups drank similar amounts. As shown in Table 2, results from the HLM revealed a main effect for condition ($p=.049$) and a main effect for weekly drinking ($p>.001$). Regarding the main effect of condition, laboratory alcohol consumption was significantly higher in the control ($M=456$ oz, $SD=154$ oz.) than the stress ($M=419$ oz, $SD=177$ oz.) group, in contrast to our hypothesis. Regarding the main effect of weekly drinking, heavier weekly drinking was significantly associated with greater laboratory consumption. No main effect was observed for trait social anxiety nor was the hypothesized Condition X Trait Social Anxiety interaction observed. Of interest, we observed a significant Condition X Weekly Drinks interaction, $t(71) = 2.15$, $p=.035$. As depicted in Figure 1, probes of this interaction revealed that the main effect was most pronounced among the light drinkers.

Discussion

The current study was designed to assess the influence of acute anticipatory stress on *ad-lib* drinking. Although the manipulation was successful, and produced scores on the STAI short form similar to other stressors widely used in laboratory research (e.g. TSST; 29), participants in the stress group drank *less* alcohol than those in the control group. Neither trait social anxiety, nor the Condition X Trait Social Anxiety interaction was significant, although there may have been a floor effect on this measure ($M=.54$). Of particular interest was the Condition x Weekly Drinks interaction, which revealed that the main effect (more consumption in the control condition v. stress condition) was attenuated with heavy drinkers, and reversed at 17 drinks per week (18.3% of the current sample). We also observed a very strong modeling effect, where the alcohol consumption of a participant was heavily influenced by how much his/her group was drinking. In fact, the impact of modeling was stronger than any of our independent variables (other than the main effect of weekly drinks), and this is not surprising given results from several prior studies (i.e. 15, 25, 30). This suggests that social influences may play a more prominent role on alcohol consumption than acute stress, despite observing a significant main and interaction effect of our manipulation.

In the one prior study most similar to our experiment, participants in the stress condition gave an anxiety provoking speech on why they would be competitive for a job. Male college students assigned to this condition did not drink more in a bar-laboratory after their speech than those in a control group (16). In designing our experiment, we chose to focus on *anticipatory* stress – that is, consuming alcohol while expecting a stressful event in the near future. Larsen and colleagues suggested that such a manipulation might encourage participants to “withhold their consumption” (p. 482), presumably due to concerns about performance decrements while intoxicated.

¹The ICC in the control condition was .47. The ICC in the stress condition was .34. One explanation for this difference is that participants in the latter group were preoccupied with thinking about the impending speech, and therefore less attentive to how much their group members were drinking.

However, we thought that the opposite would occur, with more consumption in the stress condition. We based this hypothesis on prior studies showing elevated consumption among participants expecting a stressful event (7, 17) or no difference between participants expecting a stressful versus non-stressful task (11-12). The studies showing no effect had a small sample size, and we are not aware of any experiment on a non-clinical sample that observed decreased consumption among participants exposed to anticipatory stress.

In spite of this, it was indeed the case (as Larsen and colleagues [16] predicted) that participants assigned to the stress group consumed *less* alcohol than those assigned to the control group. This finding, in conjunction with the work discussed above, suggests that drinking to relieve tension is not entirely robust and may be impacted by contextual or personal factors. The stressor used here was the anticipation of making an uncomfortable speech. It could be that a different type of stressor (namely, one that does not have a performance element) would yield different results (32). Although the interaction between weekly drinks and condition was not hypothesized, it is consistent with prior literature. In an early review of the Tension Reduction Hypothesis, Sher and Levenson (3) discuss some studies that suggest people with greater alcohol involvement have more pronounced anxiolytic effects from drinking. If heavy drinkers experience greater psychological rewards from alcohol consumption, they may become conditioned to consume alcohol as means of coping with stressful situations. This explanation would fit the interaction effect found in the present experiment, and may help explain the comorbidity between AUDs and Anxiety Disorders (4). Clinicians who work with this group may wish to emphasize alternative (non-drinking) approaches of relieving anxiety as a means of treating both conditions.

Strengths, Limitations, and Future Directions

One strength of the current study is that we achieved high ecological validity without compromising internal validity. The taste-test paradigm commonly used in early alcohol administration work does not reflect alcohol consumption in the real world. By having participants in groups of 2-3 (or 3-4, including the confederate) drink their beverage of choice *ad-lib* in a bar setting, the current study mirrored alcohol consumption outside of the laboratory while maintaining experimental control. Additionally, although using placebo alcohol does raise some questions (see below), one advantage of this approach is that we could include college students under the legal drinking age. In fact, to our knowledge, the current study is the first attempt to examine a psychosocial predictor of “alcohol” consumption in a laboratory setting among participants who cannot legally drink.

Although our study included only placebo alcoholic beverages by design, it is possible that results would have differed if participants consumed real alcohol instead. A recent study found that college students consumed more alcoholic beverages after completing a Trier Social Stress Task, but this trend was not observed when given placebo (told alcohol/received non-alcohol) or non-alcoholic (told non-alcohol/received non-alcohol) beverages (33). Whereas future research could compare the effect of anticipatory stress between real and placebo *ad-lib* alcohol consumption (as Magrys and Olmstead [33] did with post-stress anxiety), we think it is unlikely results would differ since we took many precautions to ensure that participants were adequately deceived (18). Such an experiment would also

necessitate a sample above the drinking age, and a unique feature of the present study is that we included participants predominantly under the legal drinking age (21 for the U.S.A., where data were collected). Another limitation is that, by only using 1.5 oz. of alleged liquor per 9 oz. glass, some participants may have been motivated to drink for relief of tension, but assumed they would not derive an anxiolytic effect from the alcohol we were serving. Although the 1:5 ratio of alcohol to mixer used here is typical for laboratory studies (34), many participants during the debriefing session stated that they usually make significantly stronger beverages. Additionally, it is possible that viewing a movie (especially a comedy) during the drinking period may have had a stress-reducing effect for participants in both conditions. However, our manipulation check still revealed that participants receiving the stressor were substantially more anxious than those in the control condition ($d \approx 1.0$). A final limitation is that this experiment may have been under-powered due to the very strong modeling effect. This was likely influenced, in part, by the inclusion of a confederate.

Future studies could examine whether anticipatory stress reduces alcohol consumption in a naturalistic setting when the stressor more selectively targets social anxiety. For example, it would be useful to consider an experiment where participants assigned to the stress condition anticipate interacting with others in an awkward, social setting. In that circumstance, it may be the case anxiety would increase alcohol use because there is no performance (e.g. speech) element. Such an approach may mirror real-world decisions, where college students often have the option of pre-gaming (or pre-loading) before a social event (35). Also, additional research could lengthen the duration of *ad-lib* drinking or prepare beverages with a higher real or imagined alcohol content.

Summary

In the present study, anticipatory stress suppressed placebo alcohol use among predominantly underage college students in a naturalistic setting. However, we observed a significant interaction such that this effect was attenuated or reversed among heavier drinking participants. These findings suggest that drinking to relieve tension is a complex process that may be moderated by individual characteristics.

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Figure 1. Condition X Weekly Drinks Interaction Probe. The x-axis refers to the average number of drinks consumed within the past three months, as reported prior to the laboratory procedure. Squares and triangles represent observed values for participants in the control and stress condition, respectively. The gray and black lines represented predicted values for the control and stress condition, respectively.

Table 1
Sample Description

Sample Characteristic	Percent of Sample	
	Control (<i>n</i> =67)	Stress (<i>n</i> =60)
Gender		
Male	26.9	43.3
Female	73.1	56.7
Age		
18	52.4	57.1
19	34.9	25.0
20	6.3	8.9
21+	6.4	9.0
Race		
White/Caucasian	84.5	82.1
Black/African American	1.5	3.6
Asian	4.6	3.6
Multi-racial	3.1	5.4
Other	6.2	5.4
Weekly Drinks (<i>M</i> =10.59, <i>SD</i> =7.58)		
0-5.0	29.2	22.0
5.1-10.0	37.3	27.1
10.1-15.0	17.9	20.3
15.1-20.0	7.5	13.6
20.1+	7.5	16.9
Drinking Days Per Week		
0	7.5	3.4
1	6.0	8.5
2	52.2	33.9
3	25.4	44.1
4	6.0	5.1
5+	3.0	5.1
Lab Alcohol Consumption (<i>M</i> =457mL, <i>SD</i> =166 mL)		
0-266 mL (0-1 drink)	13.4	33.3
227-532 mL (1-2 drinks)	73.1	55.0
533+ mL (more than 2 drinks)	13.4	11.7

Note: Lab alcohol consumption refers to the volume of placebo alcoholic beverage(s) consumed. Chi-squared analyses were run comparing the control and stress groups on gender and race. Race was dichotomized as White/Caucasian v. not White/Caucasian, due to a very low rate of minorities in this sample, consistent with the institution where these data were collected. Race did not significantly differ by condition, $\chi^2(1, N=127)=.572, p>.40$. There was a marginal difference with gender, $\chi^2(1, N=127)=3.79, p=.052$. Independent samples *t*-tests were run to determine whether age, Weekly Drinks, and Drinking Days per Week differed by condition. There were no differences for age $t(117)=-.116, p>.90$ or drinking days per week, $t(124)=-1.63, p>.1$, but there was a marginal difference for weekly drinks, $t(124)=-1.77, p=.079$ such that participants in the stress group consumed more drinks per week than those in the control group.

Table 2

Laboratory Alcohol Consumption as a Function of Experimental Condition, Trait Social Anxiety, and Weekly Drinks.

Variable	<i>t</i> -value
Main Effects	
Condition ^a	-2.02 *
Trait Social Anxiety	1.21
Weekly Drinks	4.06 ***
Interactions	
Condition x Trait Social Anxiety	0.27
Condition x Weekly Drinks	2.15 *

Note: Analyses conducted with Hierarchical Linear Modeling. Intra-class Correlation Coefficient (ICC)=0.43. The quantity of *ad-lib* laboratory consumption was the dependent variable for this model.

*
 $p < .05$, two-tailed

**
 $p < .001$, two-tailed

^aDummy-coded as 0=control, 1=stress