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The Effect of an Alcohol Cue on a Risk Taking Task

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The Effect of an Alcohol Cue on a Risk Taking Task

by

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A thesis submitted in partial fulfillment
of the requirements for the degree of
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Abstract

Laboratory-based tasks of impulsivity and related constructs can be useful in predicting alcohol use. Performance on these tasks is generally assumed to reflect traits that remain stable across situations. However, several studies have indicated that manipulations of state-like variables (e.g., mood or stress) can influence levels of impulsivity demonstrated on the tasks. Furthermore, environmental context (in the form of physical setting, or contextual cues) has a demonstrable effect on tasks relevant to alcohol-related risky behaviors (e.g., ad lib drinking tasks). Importantly, this effect of context on behavior is dependent on the individual's alcohol expectancies. It is unknown, however, whether alcohol-related cues would lead to greater risk taking on a commonly used laboratory-based risk task, and whether this effect would be moderated by alcohol expectancies. These hypotheses were tested in a sample of undergraduate social drinkers. Results indicated that participants who viewed an alcohol prime did not perform significantly more riskily on the Balloon Analogue Risk Task than those who viewed a non-alcohol prime. While mean levels of risk taking were higher following the alcohol prime, the difference did not approach significance; the priming condition-by-expectancy interaction was also not significant.

Risk Taking and Alcohol Contexts

70% of high school seniors have consumed alcohol in their lifetime, with 25% of 12th graders also reporting being intoxicated in the previous 30 days (Johnston, O'Malley, Bachman, & Schulenberg, 2012). Adolescent alcohol use is related to a range of negative outcomes, including risky sexual behavior (e.g., Halpern-Felsher, Millstein, & Ellen, 1996), motor vehicle accidents (Hingson, Zha, & Weitzman, 2009), and accidental death (Hingson et al., 2009) and is also a significant predictor of lifetime alcohol use disorders (Grant & Dawson, 1998). Research suggests that initiation of regular alcohol use before the age of 14 is associated with increases in the risk of future alcohol use disorders (Grant & Dawson, 1998).

Given the negative outcomes associated with drinking, research examining the predictors and mechanisms of problematic drinking are of importance. Research on the antecedents of problematic alcohol use has often focused on trait-like individual difference variables, such as personality traits (e.g., impulsivity). While considering these variables as generalized behavioral tendencies has been useful (in that they have been frequently related in a variety of samples to problematic alcohol use), information about the contexts in which impulsive behavior occurs could provide incremental prediction. This information about context is important because it is well established that alcohol expectancies, which play a role in drinking behavior, become more relevant in certain contexts. In other words, variables that account for context-specific cognitions could provide a further level of explanation. Thus, what follows is a review of the trait-like explanations of impulsivity and their linkages to drinking, and how alcohol expectancies could be integrated with these methods to provide a further level of explanation. Specifically, the

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potential for linking the reward valuation aspect of expectancies with a common laboratory-based risk task will be discussed.

Impulsivity and Sensation Seeking

Self-report measures. A large body of research has examined the role of impulsivity and sensation seeking in engagement in risky behavior. Toward this end, researchers have drawn from personality theory to explain risky behavior as a result of underlying stable behavioral tendencies (e.g., Barratt, 1985; Eysenck et al., 1985; Zuckerman & Kuhlman, 2000). Impulsivity, or the "the tendency to enter into situations, or rapidly respond to cues for potential reward, without much planning or deliberation and without consideration of potential punishment or loss of reward" (Zuckerman, 1994), has a logical theoretical link to substance use. Indeed, strong evidence links impulsivity to a range of problematic behaviors. Impulsivity and related constructs are most frequently measured with questionnaires (e.g., Barratt Impulsiveness Scale—BIS; Eysenck Impulsiveness Scale; Zuckerman-Kuhlman Personality Questionnaire—ZKPQ; Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993).

Laboratory-based behavioral tasks. In addition to self-report assessments of impulsivity and related constructs, a range of behavioral tasks have been developed to measure impulsive behavior in vivo. The assumed advantage of behavioral tasks over self-report measures is that they capture behavioral processes as they occur naturally. While self-report questionnaires might be vulnerable to a respondent's subjective bias (e.g., a highly impulsive individual might be reluctant, or unable, to accurately report impulsive tendencies), behavioral tasks do not rely on an individual's accuracy of self-report. Similar to the self-report measures, these behavioral tasks measure unique aspects of impulsivity. A recent review categorized existing tasks based on the aspects of impulsivity they measure (Cyders & Coskunpinar, 2011).

The categories included tasks that measure pre-potent response inhibition (e.g., Go/No-Go task; Marczinski & Fillmore, 2003), ability to resist distraction from task-irrelevant stimuli (e.g., Eriksen Flanker task; Eriksen and Eriksen, 1974), ability to resist proactive interference (e.g., Tolan & Tehan, 1999), delay discounting (e.g., Kirby, Petry, & Bickel, 1999), and distortions of time judgment (e.g., Dougherty, Mathias, Marsh, & Jagar, 2005). These tasks often (but not always) relate to measures of risky behavior in the real world (i.e., outside the laboratory), but meta-analytic findings suggest there is relatively little overlap between behavioral tasks and self-report measures of impulsivity (Cyders & Coskunpinar, 2011). This is reflective of the uniqueness of the dimensions that fall under the umbrella term of impulsivity. Furthermore, this lack of overlap is consistent with the intended development of laboratory tasks, which are generally thought to measure state-like variables.

Impulsivity and drinking. Despite the lack of congruence between the constructs measured by self-report measures and behavioral tasks of impulsivity, impulsive-related traits have often been implicated as significant correlates of risky alcohol-related behaviors. Impulsivity has been found to prospectively predict alcohol use disorders (AUD; e.g., Sher, Bartholow, & Wood, 2000). Sher et al. (2000) measured personality traits (using the Tridimensional Personality Questionnaire—TPQ—and the Eysenck Personality Questionnaire— EPQ; Cloninger, 1987; Eysenck & Eysenck, 1975) of incoming university freshmen, and found that the Novelty Seeking scale of the TPQ and the Psychoticism scale of the EPQ predicted AUD diagnoses seven years later. Furthermore, Novelty Seeking, as measured in six- to ten year-olds by the TPQ (Cloninger, 1987), predicted early engagement in adolescent substance use (Masse & Tremblay, 1999). Given the role of impulsivity as an antecedent of problematic alcohol use, it is

not surprising, then, that it is also observed as being elevated in AUD samples in comparison to controls (Dawe & Loxton, 2004; Sher et al., 2000).

Using the four-factor framework of impulsive-related traits put forth by Whiteside and Lynam (2001), Smith et al. (2007) examined the utility of discriminating among sensation seeking, lack of planning, lack of persistence, and urgency in predicting risky behaviors. Their findings suggest that urgency and sensation seeking accounted for the most variance in alcohol use, but in distinct ways. Specifically, urgency was related to problems from drinking, while sensation seeking was related to drinking quantity and frequency.

Findings regarding the relationship between behavioral tasks of impulsivity and alcohol use are mixed. Some studies, for instance, have found relationships of impulsive traits with alcohol consumption, while others have only implicated them as a predictor of alcohol problems (e.g., Courtney, Arellano, Barkley-Levenson et al., 2012). In a study utilizing the Go/No-Go task, alcohol dependent individuals demonstrated decreased inhibition by committing commission errors (Kamarajan, Porjesz, Jones et al., 2005). These findings were not replicated in samples of either heavy social drinkers or problem drinkers (Fernie et al., 2010; Courtney et al., 2012). Studies of delay discounting, which identify impulsivity as choosing a smaller, more immediate reward over a larger, more delayed reward, also involve mixed findings. While heavy social drinkers have been found to choose a significantly smaller and sooner reward than lighter drinkers (Vuchinich & Simpson, 1998), other findings suggest that discounting is more relevant in identifying alcohol misuse (Courtney et al., 2012; MacKillop, Amlung, Few, Ray, Sweet, & Munafo, 2011).

Given how questionnaires of impulsive-related traits appear to measure distinct, but related, constructs (Cyders & Coskunpinar, 2011), it is perhaps not surprising that different

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laboratory tasks of impulsivity relate to unique aspects of risky behavior. Different tasks likely measure unique processes. For instance, the Go/No-Go Task (Marczinski & Fillmore, 2003) captures pre-potent response inhibition, but does not involve aspects of reward valuation. Reward valuation, which has an obvious conceptual linkage to risky behavior, is an inherent aspect of the delay discounting task, in which participants must choose between rewards of different values. While choosing a smaller, sooner reward over a larger, more delayed reward is an important correlate of problem drinking (MacKillop et al., 2011), these choices do not involve "risk" in the sense that one's decision might result in a negative outcome. This element of risk is incorporated into the Balloon Analogue Risk Task (BART; Lejuez et al., 2002), which was developed to capture risk taking in a laboratory setting.

Balloon Analogue Risk Task (BART)

Another behavioral task designed to measure impulsivity is the Balloon Analog Risk Task (BART; Lejuez et al., 2002), in which participants "pump" a computerized balloon to earn rewards. Rewards are earned with each pump, but, with each successive pump, there is an increased likelihood of the balloon exploding, costing the participant all of her earnings on that balloon. Thus, the BART is theorized to index risk taking, such that engaging in a behavior (pumping the balloon) offers the potential for reward, but also the possibility for loss (Lejuez et al., 2002). As a construct, risk taking (as measured by the BART) overlaps with other known risk factors for problematic behavior, including sensation seeking and self-report measures of impulsivity (Gabriel & Williamson, 2010; Lejuez et al., 2002; Lejuez, Aklin, Bornovalova, & Moolchan, 2005). The BART also has good discriminant validity, in that the number of pumps has been found to explain unique variance in the occurrence of real-world risk behaviors, such as

tobacco use and alcohol use (Aklin, Lejuez, Zvolensky, Kahler, & Gwadz, 2005; Fernie et al., 2010; Lejuez et al., 2002; Lejuez et al., 2005).

The BART and real-world risk taking. Several studies indicate that BART performance is related to involvement in risk-related behaviors. In the initial study, the predictive utility of the BART was demonstrated in a community sample of young adults. As anticipated, the adjusted mean number of pumps (AMP) correlated with self-report measures of impulsivity and sensation seeking, as well as self-report measures of engagement in real-world risk behaviors. The results also supported the discriminant validity as BART scores explained significant unique variance in the occurrence of real-world risk behaviors above that explained by a composite of personality measures of impulsivity and sensation seeking (Lejuez et al., 2002).

Subsequent investigations extended the initial findings to a community sample of high school-aged adolescents (Lejuez, Aklin, Zvolensky, & Pedulla, 2003) and smoking status among inner-city adolescents (Lejuez et al., 2005). In a sample of college undergraduates, BART performance accounted for unique variance in quantity of alcohol use in the week prior to testing, as measured using the Timeline Follow Back Questionnaire (Fernie et al., 2010).

Risk taking and development. Evidence from some studies using the BART suggests that findings should be considered in light of the developmental context of the sample. In a study comparing BART performance of young adults (average age of 19) to older adults (average age of 76), analyses indicated that the young adults pumped more often than older adults, but only on earlier balloons (Rolison, Hanoch, & Wood, 2012). Statistical modeling suggested that the young adults took risks in early trials, while the older adults were more risk averse in these early trials. After the early trials, however, the performance was similar between the groups. This suggested

that while older adults were risk averse, and waited to make risky decisions off of experience, younger adults made their decisions without prior knowledge (Rolison et al., 2012). When placed in the larger context of human development, and in the even broader context of evolution, this finding makes sense: young adults need to take risks to effectively operate in a social environment. If adolescents based every decision on prior experience, they would be "stuck," in a sense.

In a community sample of adult problem drinkers (mean ages of 28.5 and 30.6 for females and males, respectively), Ashenhurst et al. (2011) found that those with more AUD symptoms pumped less than those with fewer AUD symptoms. While contrary to what would be expected given that those with increased real-world riskiness performed more conservatively, the authors noted that age and IQ mediated this relationship. Specifically, older individuals tended to be more conservative than younger individuals (Ashenhurst et al., 2011). An additional study also found a negative relationship between BART performance and alcohol problems, but this, too, was in a community adult sample (mean age of 30; Courtney et al., 2012). Findings suggest that risk taking, as measured by BART performance, might be a function of development.

The BART and context. Various contextual factors also affect BART performance, as reflected by several findings in which state-like variables affect the number of pumps. Noting that risky decisions are often made under stressful situations, Lighthall et al. (2009) investigated BART performance following a stress induction. The results indicated that males were riskier with increased stress, while females were more risk averse. A separate study detected significant effects of sleep deprivation on risk taking, such that sleep deprivation decreased risk taking in females, but not in males (Acheson, Richards, & de Wit, 2007). In a study examining the role of positive urgency in risk taking, the number of balloon explosions following a positive mood

prime was significantly predicted by positive urgency (Cyders et al., 2010). The BART is amenable to manipulations of state-like variables that affect risk taking.

In summary, the BART is an effective laboratory task that accounts for some of the variation in real-world risk behaviors. While describing an individual's level of risk taking in a behavioral task is useful (e.g., as a measure for identifying those at risk for future risky behaviors—a population in which questionnaires that inquire about behavior that has yet to happen might be of little use; Andrew & Cronin, 1997; Greene et al., 2000; Lejuez et al., 2002), it cannot explain why they take risks. To further understand the cognitive mechanisms involved in BART performance, some researchers have utilized statistical modeling to examine individual differences in risky decision making (e.g., Rolison et al., 2012; Wallsten, Pleskac, & Lejuez, 2005). Their findings indicated that risk takers (both in the real-world and on the BART) tended to be less responsive to losses and gains, while also inflating the value of gains (Wallsten et al., 2005). While this illustrates the role of reward valuation in risk taking, its utility is in describing the cognitive mechanisms that lead to risk taking. The BART, as constructed, is effective at measuring risk taking, but it is not designed to explain why risky behavior occurs. To better model how, and why, some individuals engage in risk taking, the BART could be integrated with existing theories that account for more proximal causes of risk-related behavior. Specifically, given the role of reward valuation in the BART, examining reward-related alcohol cognitions could be of value. The expectations that individuals have about the positive and rewarding effects of alcohol are important components of drinking behavior, and by incorporating a contextual frame of alcohol into the BART, the relationship between risk taking and individuals' pre-existing expectancies can be more closely examined.

Alcohol Expectancies

Alcohol expectancy theory holds that the anticipated effects of alcohol guide drinking related behavior. Expectancy theory is based on the notion that organisms must anticipate outcomes in order to appropriately interact with their environment. This fundamental concept can be observed even in rudimentary behaviors, such as food-seeking behavior in animals. In order to survive, an animal must recognize events or cues in its surroundings that signal either the potential for danger or the potential for reward. Prior to acting on these signals, however, an animal must first learn which signals are meaningful. Through associative learning, the animal learns which cues or contexts signal the availability of a reward, and it learns which actions are necessary to obtain that reward. These relationships between contextual cues and rewards, and the necessary actions to obtain these rewards, are stored in memory systems that subserve emotional, motivational, cognitive, and perceptual pathways (Goldman, 2002).

Expectancy questionnaires and drinking. Early research on alcohol expectancies focused on the development of psychometrically validated questionnaires that asked individuals whether they expect to experience certain effects after drinking alcohol (e.g., Brown, Goldman, Inn, & Anderson, 1980). These efforts followed earlier research that demonstrated the cognitive, rather than strictly pharmacological, determinants of alcohol behavior (e.g., Rohsenow & Marlatt, 1981). Thus, Brown et al. (1980) created the Alcohol Expectancy Questionnaire (AEQ), a single measure that encompassed a wide range of alcohol expectancies. As individuals' expectancies would presumably vary based (at least partly) on their direct experiences with alcohol, the authors accurately predicted that expectancies could be related to consumption patterns (Brown et al., 1980). In a community sample of adults, heavier drinkers tended to have higher expectancies of aggression and sexual enhancement, while lighter drinkers generally had expectancies about the positive effects of alcohol (Brown et al., 1980). In a study using a

different measure (Alcohol Expectancy Multiaxial Assessment; AEMax; Goldman & Darkes, 2004), college undergraduates' positive social and sexual expectancies accounted for significant variance in drinking measured one year later (Goldman & Darkes, 2004).

Expectancy operation. While expectancies have been shown to uniquely predict drinking patterns, experimental studies have demonstrated the cognitive operation of expectancies, and their influence on subsequent drinking. Specifically, context, in the form of semantic, visual, or environmental cues, activates expectancies (i.e., the "templates" that guide cognition and behavior based on relationships between actions and expected outcomes). These contexts lead to measurable influences on cognition and behavior.

Studies have used implicit priming to demonstrate alcohol expectancy operation. Implicit priming has been utilized, as it is thought to mimic cognitive processes as they occur in natural contexts, in which stimuli influence cognitions outside of conscious awareness. Current conceptualizations of expectancy theory hold that alcohol-related cues activate relevant concepts in memory. To test this, Reich et al. (2005) presented two groups of participants with a word list consisting of grocery items and alcohol expectancy words. By presenting one group with a list beginning with the word "milk," and the second group with a list beginning with the word "beer," the authors predicted that recall of the lists would be dependent on the semantic set activated. Indeed, participants in the "milk" condition recalled significantly more grocery items than alcohol expectancy words (Reich et al., 2005). Participants in the "beer" condition, particularly those with heavy drinking histories (and, hence, a presumably larger and more strongly associated memory network of expectancies), recalled more alcohol expectancy words than grocery words.

Additional evidence supports the influence of context on alcohol cognitions. In a study utilizing the false memory paradigm, undergraduates with heavy, light, and no drinking histories studied word lists of alcohol expectancy words (Reich, Goldman, & Noll, 2004). The implicit effect of context was tested by comparing false memory for expectancy words in a laboratory bar context and a neutral context. The findings indicated that, among heavy drinkers, more false alcohol expectancy words were recalled in the bar context than in the neutral context (Reich et al., 2004). Among lighter drinkers, the number of falsely recalled expectancy words did not differ between contexts. As noted by the authors, these findings are consistent with alcohol expectancy theory, in which context (in this instance, environmental) activates context-specific templates in memory to guide cognition.

Effects of experimental manipulation of expectancies on ad libitum drinking. Activation of alcohol expectancy concepts through implicit priming has been shown to influence amount of drinking in laboratory settings (e.g., Roehrich & Goldman, 1995; Stein, Goldman, & Del Boca, 2000). To validate the effects of increased drinking as due to expectancy processes (rather than affective responses), the amount of drinking following an expectancy prime was compared to the amount of drinking following an affective prime (Stein et al., 2000). Participants who were presented with positive expectancy words drank significantly more than those who were presented with either neutral expectancy words or positive-mood-inducing music (Stein et al., 2000). While affect contributes to drinking behavior, these findings indicate that, in a laboratory bar setting, anticipatory processes influence drinking behavior.

Effects of expectancy manipulation on non-consumptive behavior. The effects of priming with alcohol-related stimuli are not limited to alcohol consumption alone. Freeman and colleagues (2010) exposed participants to alcohol or neutral images, and found that participants

who viewed the alcohol images exhibited more social disinhibition than those who viewed neutral images. This finding is consistent with alcohol expectancy theory, in which alcohol-related context activates representations of alcohol in memory, leading to behavior consistent with one's expectancies. Similarly, in individuals with high aggression expectancies, exposure to semantic alcohol cues (but not neutral cues) resulted in aggressive behavior toward the experimenter (Friedman, McCarthy, Bartholow, & Hicks, 2007). Together, these findings suggest that expectancies are fundamental and automatic anticipatory processes that direct behavioral output.

Alcohol expectancies and risk taking. The relationship between alcohol expectancies and performance on laboratory-based risk tasks (e.g., the BART) in young adults has not been examined. Recent conceptualizations of the role of alcohol in the social agency of late adolescents consider alcohol as the "perfect chemical facilitator" of risk taking and socializing (Reich & Goldman, 2012). That is, the expected effects of alcohol enable (or make more likely to happen) risky behaviors that would otherwise be inappropriate. For instance, the commonly reported expectancy of reduced inhibitions could make sexual encounters more likely to occur (Reich & Goldman, 2012). Given how expectancies mediate the influence of emotion, motivation, and other systems on alcohol-related cognition and behavior (see Goldman, 2002), it is relevant to consider how alcohol expectancies would relate to risk taking as measured by the BART.

Present Study

While evidence strongly indicates that alcohol expectancies are a central component of the cognitive, affective, and behavioral processes that lead to drinking, it is unclear how expectancies are related to risk taking on the BART. While the BART is unique in that it

incorporates reward valuation and risk taking, it (like many laboratory tasks) lacks the contextual factors that contribute to risky drinking. Theoretical models have been proposed to address the link between impulsivity and drinking, and findings support that this relationship is mediated by positive alcohol expectancies (e.g., the Acquired Preparedness model; Smith & Anderson, 2004). Thus, examining BART performance while incorporating the more proximal, context-sensitive variable of expectancies might be more reflective of risk taking as it occurs naturally, outside of the lab. Previous findings suggest that there are individuals who have a trait-like tendency to engage in risk taking, but incorporating expectancy-related cues into the BART could potentially allow for more meaningful prediction of risky alcohol-related behaviors.

The present study examined the effect of priming with images depicting alcoholic beverages on riskiness as indexed on the BART. Specifically, it was predicted that exposure to visual cues of alcoholic beverages would lead to a greater number of pumps than exposure to visual cues of non-alcoholic beverages. It was also predicted that this effect would be positively related to individuals' expectancies. The decision to compare exposure to alcohol cues versus non-alcohol cues was intended to determine whether expectancies were more related to alcohol cue responses than non-alcohol cue responses.

Method

Design

The present study examined the effect of a visual prime on risk taking (BART performance). The potential moderating role of alcohol expectancies on this effect was also examined. Undergraduate students were randomly assigned to one of two priming conditions. The alcohol primes included images of alcoholic beverages. The non-alcohol primes included images of non-alcoholic beverages (e.g., milk).

Participants

113 undergraduate students (power analyses suggested that, for a regression with 3 predictors, an anticipated effect size of .10, and statistical power of .80, a sample of 112 was required) enrolled in psychology courses at the University of South Florida were recruited through SONA, an online research participant database. Given that alcohol expectancies are linked with social context, and the increased occurrence of risky behavior in college-aged individuals, students between 18 and 25 years old were recruited. Participants must be English speaking, and must consume alcohol at least once a month.

Participants were assigned randomly to one of two visual priming conditions (a non-alcohol images condition and an alcohol images condition). An online-based random number generator was used to assign participants to the conditions.

Measures

Drinking Questionnaire. Data on participants' drinking patterns were gathered with a brief questionnaire. The measure included items on self-identified drinker "class" (possible

responses range from 0 = *abstain from alcohol*, to 7 = *recovering alcoholic*), frequency of

drinking during the past year (possible responses range from 0 = *never*, to 8 = *5 or more times*

per week), type of drink typically consumed (items include *beer*, *wine*, *hard liquor*, and *I don't*

know), quantity per drinking occasion (possible responses range from 0 = *none; I don't drink*, to

9 = *17 or more drinks*), and frequency of intoxication during the past year (possible responses

range from 0 = *never; I don't drink*, to 8 = *5 or more times per week*).

Alcohol Use Disorders Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders,

& Monteiro, 2001). The AUDIT is a 10-item self-report questionnaire intended for use as a brief

screening measure to identify hazardous and harmful levels of alcohol use. Response options

range from 0 to 4, with higher values reflecting a greater frequency of problems due to alcohol

use.

Alcohol Expectancy Questionnaire (**AEQ**; Brown, Christiansen, & Goldman,

1987). The AEQ is a 68-item questionnaire that measures the degree to which individuals report

expecting certain effects from alcohol. The two-point forced-choice responses (yes or no) result

in six subscales, including global positive changes (e.g., "Drinking makes the future seem

brighter"), sexual enhancement (e.g., "After a few drinks, I am more sexually responsive"),

physical and social pleasure (e.g., "Having a few drinks is a nice way to celebrate special

occasions"), increased social assertiveness (e.g., "A few drinks make it easier to talk to people"),

relaxation and tension reduction (e.g., "Alcohol enables me to fall asleep more easily"), arousal

and aggression (e.g., "After a few drinks it is easier to pick a fight). The subscales have internal

reliability estimates between .72 and .92. The AEQ was chosen over other expectancy measures

because of its strong association with drinking. In a sample of college students, the AEQ

accounted for 57% of the variance in concurrent drinking, and it predicted 50% of the variance in

drinking assessed one-year later (Goldman & Darkes, 2004).

Eysenck Impulsiveness Questionnaire – Impulsiveness subscale (EIQ; Eysenck et al.,

1985). The EIQ consists of 17 items inquiring about various aspects of impulsivity. The items

are phrased as questions (e.g., "Do you generally do and say things without stopping to think?").

The forced-choice responses are coded (*yes* = 1 and *no* = 0) such that higher scores reflect higher

levels of impulsivity. Eysenck et al. (1985) reported high levels of reliability (α = .82 - .86).

Zuckerman Sensation Seeking Scale (SSS; Zuckerman, Eysenck, & Eysenck, 1978).

The SSS is a 40-item questionnaire comprised of items inquiring about thrill and adventure

seeking (e.g., "I would like to try parachute jumping), experience seeking (e.g., "1 would like to

take off on a trip with no preplanned or definite routes or timetables"), disinhibition (e.g., "1 like

to have new and exciting experiences and sensations even if they arc a little unconventional or

illegal"), and boredom susceptibility (e.g., "I prefer friends who are excitingly unpredictable").

Response options are in a true-false format. The scale has demonstrated good reliability (α = .83

- .86; Zuckerman et al., 1978). As sensation seeking has been positively associated with riskiness

on the BART in previous studies (e.g., Lejuez et al., 2002), it is important to consider when

determining the relative influence of different variables on BART performance.

Balloon Analogue Risk Task (BART; Lejuez et al., 2002). The BART is a

computerized task in which a participant earns money or points by "inflating" a balloon on a

computer screen. In the present study, participants earned 25 points with each pump. These

points are deposited in a temporary "bank" (in which the amount is not revealed to the

participant). Following each pump, the participants have the option to inflate the balloon further,

but they risk losing all of the money earned on a given balloon if the balloon explodes. The

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participants are not made aware of specific explosion points; rather, they are told that the balloons can explode at any point—from the first pump, up until the balloon fills the entire screen. The participants may also choose to press a button labeled "Press to Collect $$$," in which the amount from the temporary bank is deposited into the permanent bank. Points in the permanent bank are not affected by subsequent balloon explosions. The amount in the permanent bank is displayed beside the balloon, in a box labeled "Total Earned." This amount is updated immediately after the collect button is pressed. A new trial (balloon) appears immediately following either a balloon explosion or collection of money.

The BART contains the following on-screen instructions, which are presented immediately before beginning the task.

Now you're going to see 20 balloons, one after another, on the screen. For each balloon, you will use the mouse to click on the box that will pump up the balloon. Each click on the mouse pumps the balloon up a little more.

BUT remember, balloons pop if you pump them up too much. It is up to you to decide how much to pump up the balloon. Some of these balloons might pop after just one pump. Others might not pop until they fill the whole screen.

You get points for every pump. Each pump earns 25 points. But if a balloon pops, you lose the points you earned on that balloon. To keep the points from a balloon, stop pumping before it pops and click on the box labeled "Collect."

After each time you collect or pop a balloon, a new balloon will appear.

You make 25 points for each pump. You save the points from a balloon when you click "collect." You lose points from a balloon when it pops. There are just 20 balloons. Now, do you have any questions?

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The explosion points are determined prior to each session by random number generation. Specifically, the program generates a random list of 20 numbers, from 1-128, until it arrives on a list with an average value of 64 (Lejuez et al., 2002). This method of determining explosion points is frequently used by other studies (e.g., Bornovalova et al., 2009; Fernie et al., 2010; Lejuez et al., 2002). The decision to use 20 trials (instead of 30, as is commonly used; Bornovalova et al., 2009; Cyders et al., 2010; Fernie et al., 2010; Lejuez et al., 2002) was intended to improve the likelihood that any priming effects would last for the duration of the task. Furthermore, Lejuez and colleagues (2002) noted that the relative level of riskiness remained stable across 30 trials.

The BART produces multiple outcome variables, including the adjusted mean number of pumps (AMP), total number of explosions, and total points earned. The most commonly utilized outcome variable is the AMP. The AMP is computed by averaging the number of pumps on balloons that do not result in explosions. This average is typically preferred to an absolute mean number of pumps, as it avoids restricting variability across participants. For the present study, only the AMP was used in the primary analysis.

Visual primes. Participants were presented with a set of images according to their experimental condition. The images were displayed on a 17-inch computer monitor. In the alcohol condition, 20 images, sampled from the internet, were presented. The images depicted beverages that were overtly alcoholic (e.g., beer or wine).

In the non-alcohol condition, 20 images, sampled from the internet, will be presented. The non-alcohol images depict beverages that are non-alcoholic (e.g., milk).

Craving questionnaire. This measure functioned as a validity check to determine whether viewing the alcohol prime had an observable effect on alcohol-related cognitive

processes. The measure (based on items used in Stasiewicz, Brandon, & Bradizza, 2007) consists of 3 items in which participants rate their desire to drink on a 5-point Likert scale (*completely disagree* = 1; *completely agree* = 5), with higher scores indicating a higher level of craving.

Procedure

    Overview. Participants signed up for timeslots for the study via SONA. Collection of the DQ, AUDIT, AEQ, EIQ, and SSS data took place online, prior to the laboratory visit.

    In the laboratory, participants signed an informed consent document, after which they were given an overview of the testing procedures. Then, they were presented with the primes, followed immediately by the BART. The picture recall test followed the BART. Finally, participants completed the craving questionnaire.

    Specifics. Once in the testing room, the experimenter provided the participant with informed consent documentation, which described the procedures as an attempt to examine the relationship between memory and decision making. To reduce demand characteristics, the actual purpose of the study was not revealed in the consent process. After the participant provided consent, the participant was informed that she would first be asked to view several photos on the computer, which were to be presented individually, one after the other, for approximately 5 seconds apiece. The experimenter then mentioned that the participant would perform a computer task following the picture presentation, and that part of the task would include an opportunity to earn entries into a drawing for one of several gift cards. To increase the likelihood of a priming effect carrying over to the BART, the instructions for the BART were presented prior to the visual primes. For the visual primes, the participant was reminded that she would view a picture, which she should attend to, as questions would be asked about them later in the session. Each photo was presented for 5 seconds.

Following the visual primes, the experimenter briefly reminded the participant that the number of points they earned on the next task would determine how many entries they earn for a drawing of one of several gift cards to a popular shopping website. Specific details about the number of points and number of entries were not provided. The participant then began the BART. After 20 trials, a screen appeared that informed the participant how many points she earned.

The experimenter then presented 10 of the original 20 stimulus pictures. Also included in these pictures were 10 pictures that were not in the original stimulus presentation. These photos depicted beverages similar to those depicted in the original series (for the alcohol condition, alcoholic beverages; for the non-alcohol condition, non-alcoholic beverages). The experimenter Participants responded to each picture by pressing a key.

Analytic Plan

Group equivalency. The primary aim of the present study was to examine whether a visual prime affected risk taking. Prior to drawing any conclusions, however, it was necessary to examine the make-up of the two priming groups to ensure no pre-existing group differences existed on variables potentially related to BART performance. Thus, the two priming groups' data was compared. To determine whether groups differed on when sessions were run, two chi-square analyses were conducted to compare the day of week and time of day of sessions. A chi-square analysis was conducted to determine whether groups differed on ethnicity, and an independent samples t-test was run to compare the mean age of the two groups. A multivariate analysis of variance (MANOVA) was computed to compare the two groups' drinking data (including mean past-year quantity, frequency, frequency of intoxication, AUDIT total score,

and AEQ total score). Separate independent samples *t*-tests were conducted to compare mean EIQ scale scores and SSS total scores.

Effect of alcohol prime on risk taking. To test whether the alcohol prime lead to increased risk taking on the BART, an independent-samples *t* test was conducted to compare the two priming conditions' mean AMP. It was hypothesized that the mean AMP would be higher in the alcohol condition than the non-alcohol condition.

Moderating effects of expectancy on the effect of alcohol prime on risk taking. A secondary aim was to determine whether alcohol expectancies moderate the effect of an alcohol prime on BART performance. A multiple regression analysis was run, with the priming condition, AEQ total score, and the priming condition-by-AEQ interaction term as predictors. It was predicted that there would be a significant group-by-expectancy interaction, such that the relationship between priming condition and risk taking would be strongest for those with higher expectancies.

Relationship between self-report measures of impulsivity and behavioral measure of risk taking. Correlations within each group's data were also examined. As impulsivity and sensation seeking are considered underlying traits that contribute to risk taking, the correlations of both the EIQ and SSS with the BART AMP should be positively related.

Relationship between expectancy and risk taking. Correlations among the AEQ scales (including the AEQ total score), and also with the BART AMP, were examined. Consistent with prior research, we expected positive relationships between the AEQ total score and the BART AMP.

Relationship between drinking and risk taking. The relationship between drinking and BART performance has not always been consistent across studies, despite the obvious theoretical

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relationship between the two. We expected to find a positive relationship between the drinking

variables and risk taking (as measured by the BART).

Results

Premorbid Group Differences

Analyses were run to determine whether groups differed on relevant premorbid characteristics. Descriptive data of demographic, personality, and drinking variables are included in Table 1. Age and gender composition of the groups did not significantly differ. However, ethnic composition was significantly different, χ^2 (4, $N = 110$) $= 13.52$, $p < .01$, such that Hispanic participants were slightly more represented in the non-alcohol condition, while African-Americans were significantly more represented in the alcohol condition. In the absence of group differences in more pertinent variables (e.g., personality variables), the difference in ethnicity composition was not considered a threat to internal validity. No significant differences were observed in personality data, in either the EIQ, $t(104) = -0.71$, $p = .48$, or the SSS, $t(109) = .37$, $p = .71$. Drinking variables (including past-year quantity, frequency, and frequency of intoxication; AUDIT total score; and AEQ total score) were analyzed together using multivariate analysis of variance (MANOVA). Groups did not significantly differ, $F(5, 99) = 1.29$, $p = .27$. Past-year quantity levels were examined separately by gender (Figures 1 and 2). Median quantity per occasion was at binge levels for males and females (5 drinks and 4 drinks, respectively). Distributions of past-year frequency and past-year frequency of intoxication are included in Figures 3 and 4.

Given that risk taking behaviors in college students frequently occur in drinking contexts, it is conceivable that contexts proximal in time (day of the session and time of day of the session) could influence BART performance. Thus, the day of the week and time of day of each

participant were compared between groups. Neither test statistic was significant, indicating that the distribution of day or time of session did not differ between groups.

Prior to examining correlations among personality and drinking data, data was inspected for outliers and missingness. Through visual inspection of the data using boxplots, four participants' (3 in non-alcohol condition) AUDIT data was identified. Two of these responses had Z-scores above 3. The similar 5% trimmed mean and original group mean suggested that these responses had limited impact on the group mean; thus, these values were retained. No other outliers were detected among any of the personality or drinking data.

Correlations among personality and drinking data are presented in Table 2. As expected, several significant positive correlations existed, suggesting that participants attended to the questionnaires.

BART Results

Prior to testing the primary hypothesis, BART AMP was evaluated for normality and outliers. No outliers were detected. Tests of normality were not significant for either condition, indicating that the distributions were normally distributed.

The primary hypothesis was that viewing a series of alcohol images would lead to greater risk taking on the BART than those who viewed non-alcohol images. Although AMP was higher in the alcohol prime condition ($M = 33.76$, $SD = 14.20$) than in the non-alcohol prime condition ($M = 31.54$, $SD = 14.74$), this difference was not significant, $t(111) = -0.82$, $p = .42$, $d = 0.15$ (Table 3). To investigate the possibility that a priming effect existed, but attenuated across trials, AMP over the first 10 trials was compared between groups. Again, AMP was higher in the alcohol condition, but this difference was not significant. Responses on the CQ, intended to serve

as a manipulation check, indicated that participants who viewed the alcohol prime endorsed marginally (but not significantly) higher levels of craving (Table 3).

A secondary hypothesis was that alcohol expectancies would moderate the effect of a prime on risk taking. The interaction term, when entered in a regression equation along with priming condition and AEQ total score, was not significant, $b = -.03$, $t(103) = -0.15$, $p = .88$. Correlations between AEQ scales and the BART are presented in Table 4. Although there was no significant main effect of condition, it is conceivable that the prime had an effect for a subset of participants (e.g., heavier drinkers). That is, if the alcohol images were to promote risk taking, it would be more likely to do so for heavier drinkers. Such a relationship would be demonstrated by stronger correlations among drinking variables and BART outcomes in the alcohol condition compared to the non-alcohol condition. As shown in Table 5, none of the correlations, in either condition, were significant, indicating that alcohol use was not related to risk taking on the BART, regardless of the prime. In a similar vein, a priming effect on BART outcomes could have been masked by the subclinical nature of the sample. To explore this possibility, BART outcomes were compared among those at the highest and lowest ends of the distribution of drinking variables. If a priming effect existed as hypothesized, it would be expected that it would exist among the heaviest drinkers (i.e., a drinking by prime interaction). Thus, BART performance among the highest and lowest quartile groups were compared across conditions. No interactions or patterns were observed.

Given the general tendency for males to be higher than females on risk-related variables, gender was examined as a moderator. A two-way analysis of variance (ANOVA; with condition and gender as factors) was conducted; the main effect of gender approached significance, such that AMP was higher for males ($M = 35.05$, $SD = 14.38$) than for females ($M = 30.18$, $SD =$

14.24), $F(1, 112) = 3.16$, $p = .08$, $\eta_p^2 = .03$. The condition-by-gender interaction was not significant ($p > .05$). Given that the mean difference in AMP between priming conditions was larger (though not significant) for the males than the females, the males' data was further examined. Specifically, correlations between drinking and AMP were examined among males (Table 6) to determine whether the prime affected risk taking for heavier drinkers. Although drinking variables tended to be negatively correlated with AMP for males in the alcohol condition (opposite to what would be expected), none of the correlations were significant.

Table 1

Demographic, Personality, and Drinking Data Across Conditions

	Non-alcohol prime (*n* = 57)	Alcohol prime (*n* = 56)	*p*
Gender, %	49.1% males	51.8% males	.78
Ethnicity, %			
Caucasian	53.6%	46.3%	.45
Hispanic	32.1%	18.5%	.10
African-American	3.6%	20.4%	.01
Asian	3.6%	13.0%	.07
Other	7.1%	1.9%	.18
Age, *M* (*SD*)	19.9 (1.9)	19.4 (1.6)	.11
Personality			
EIQ, *M* (*SD*)	6.6 (4.3)	6.3 (4.2)	.71
SSS, *M* (*SD*)	20.4 (6.0)	21.25 (6.9)	.48
Drinking			
Quantity	4.11 (1.65)	4.49 (1.68)	.20
Frequency	4.89 (1.26)	5.00 (1.16)	.64
Freq. of Intoxication	3.52 (1.79)	3.93 (1.87)	.24
AUDIT Total	8.02 (5.22)	7.59 (4.06)	.63
AEQ Total	32.90 (12.34)	33.78 (15.96)	.75

Note: ** = $p < .01$. EIQ = Eysenck Impulsiveness Questionnaire; SSS = Sensation Seeking Scale; AUDIT = Alcohol Use Disorders Identification Test; AEQ = Alcohol Expectancy Questionnaire.

Table 2

Correlations among Personality and Drinking Variables Across the Sample

	EIQ	SSS	Quantity	Freq.	Freq. of Intox.	AUDIT	AEQ
EIQ	1						
SSS	.29**	1					
Quantity	.14	.18	1				
Freq.	.04	.18	.41**	1			
Freq. of Intox.	.15	.27**	.49**	.60**	1		
AUDIT	.29**	.28**	.52**	.52**	.62**	1	
AEQ	.39**	.30**	.14	.15	.35**	.30**	1

Note: ** = $p < .01$. EIQ = Eysenck Impulsiveness Questionnaire; SSS = Sensation Seeking Scale; AUDIT = Alcohol Use Disorders Identification Test; AEQ = Alcohol Expectancy Questionnaire.

Table 3

BART and CQ Outcomes Between Conditions

	Non-Alcohol Prime	Alcohol Prime	*t*(111)	*p*	Cohen's *d*
BART					
AMP	31.54 (14.74)	33.76 (14.20)	-0.82	.42	0.15
Explosions	5.49 (2.92)	5.89 (2.78)	-0.75	.46	0.14
AMP (Trials 1-10)	30.33 (16.64)	32.71 (17.01)	-0.73	.47	0.14
AMP (Trials 11-20)	32.89 (14.34)	35.13 (13.12)	-0.94	.35	0.16
Total Points Earned	10,456.14 (3256)	11,000.45 (3085)	-0.91	.36	0.17
Craving Questionnaire	4.41 (3.01)	5.26 (3.19)	-1.44	.15	0.27

Note: AMP = Adjusted Mean Number of Pumps.

Table 4

Correlations Among BART and AEQ Scales Within Each Priming Condition

	AMP	Explosions	AMP 1-10	AMP 11-20	Tot	GP	SPP	SA	SE	TR	AA
AMP	1	.93**	.96**	.96**	-.07	-.05	.01	-.08	-.10	-.06	.07
Explosions	.93**	1	.90**	.89**	-.03	.02	.05	.01	-.03	.00	.11
AMP 1-10	.96**	.91**	1	.86**	-.10	-.09	.05	-.01	-.05	.02	.12
AMP 11-20	.95**	.86**	.82**	1	-.03	-.11	-.03	-.15	-.15	-.15	.01
AEQ-Tot	-.13	-.12	-.13	-.10	1	.96**	.75**	.86**	.86**	.87**	.89**
AEQ-GP	-.10	-.07	-.10	-.08	.98**	1	.67**	.79**	.78**	.76**	.81**
AEQ-SPP	-.20	-.19	-.22	-.14	.89**	.84**	1	.65**	.73**	.69**	.60**
AEQ-SA	.00	-.04	-.01	.02	.93**	.88**	.81**	1	.62**	.74**	.70**
AEQ-SE	-.01	-.05	-.09	-.05	.89**	.84**	.86**	.79**	1	.65**	.62**
AEQ-TR	-.23	-.22	-.24	-.20	.90**	.84**	.83**	.80**	.74**	1	.81**
AEQ-AA	-.17	-.20	-.17	-.13	.92**	.86**	.82**	.86**	.78**	.81**	1

Note: Non-alcohol condition correlations are above the diagonal; alcohol condition is below. AMP = Adjusted Mean Number of Pumps; AEQ = Alcohol Expectancy Questionnaire; Tot = Total; GP = Global Positive; SPP = Social and Physical Pleasure; SA = Social Assertion; SE = Sexual Enhancement; TR = Tension Reduction; AA = Aggression and Arousal.

Table 5

Correlations Among BART and Drinking Variables Within Each Priming Condition

	AMP	Explosions	AMP 1-10	AMP 11-20	Quantity	Frequency	Freq. of Intox.	AUDIT	AEQ Total
AMP	1	.93**	.96**	.96**	-.07	-.08	-.10	.06	-.07
Explosions	.93**	1	.90**	.89**	-.03	.01	-.03	.11	.01
AMP 1-10	.96**	.91**	1	.86**	-.10	-.09	-.11	.08	.00
AMP 11-20	.95**	.86**	.82**	1	-.03	-.06	-.08	.05	-.14
Quantity	-.04	.08	.00	-.06	1	.41**	.58**	.44**	.27
Frequency	.02	-.06	-.01	.05	.40**	1	.61**	.54**	.16
Freq. of Intox.	-.13	-.10	-.15	-.09	.39**	.59**	1	.65**	.24
AUDIT	-.07	-.02	-.06	-.07	.66	.51**	.62**	1	.34*
AEQ Total	-.13	-.12	-.13	-.10	.06	.13	.43**	.28*	1

Note: ** = $p < .01$. Non-alcohol condition correlations are above the diagonal; alcohol condition is below. AMP = Adjusted Mean Number of Pumps;
AUDIT = Alcohol Use Disorders Identification Test; AEQ = Alcohol Expectancy Questionnaire.

Table 6

Correlations Among BART and Drinking Variables Among Male Participants

	AMP	Explosions	AMP 1-10	AMP 11-20	Quantity	Frequency	Freq. of Intox.	AUDIT	AEQ Total
AMP	1	.92**	.95**	.95**	-.08	.23	-.13	.17	.21
Explosions	.93**	1	.89**	.87**	-.01	.31	.07	.27	.29
AMP 1-10	.97**	.91**	1	.82**	-.15	.21	-.15	.11	.24
AMP 11-20	.94**	.86**	.83**	1	.00	.22	-.11	.21	.16
Quantity	-.31	-.11	-.23	-.38*	1	.48*	.57**	.41**	.25
Frequency	-.22	-.27	-.23	-.19	.43*	1	.66**	.58**	.34
Freq. of Intox.	-.26	-.22	-.27	-.21	.50**	.64**	1	.63**	.35
AUDIT	-.24	-.19	-.19	-.29	.78**	.58**	.68**	1	.38
AEQ Total	-.24	-.24	-.24	-.18	-.01	.11	.43*	.11	1

Note: ** = $p < .01$. Non-alcohol condition correlations are above the diagonal; alcohol condition is below. AMP = Adjusted Mean Number of Pumps;
AUDIT = Alcohol Use Disorders Identification Test; AEQ = Alcohol Expectancy Questionnaire.
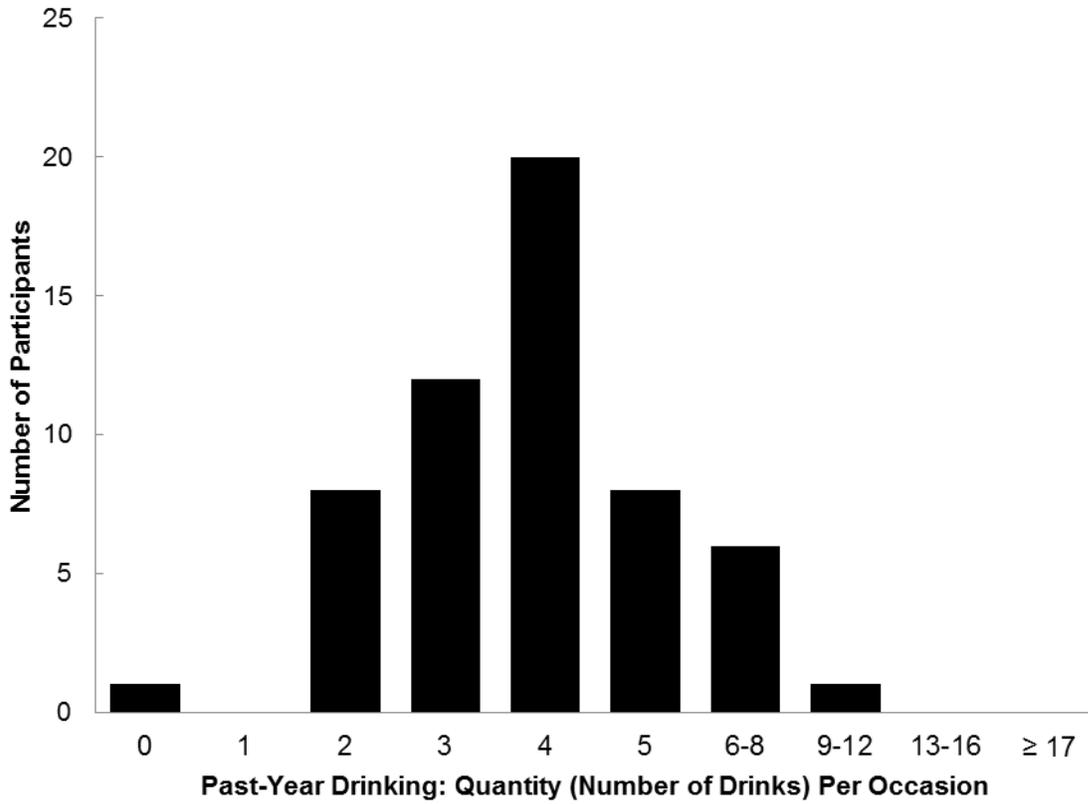
Figure 1

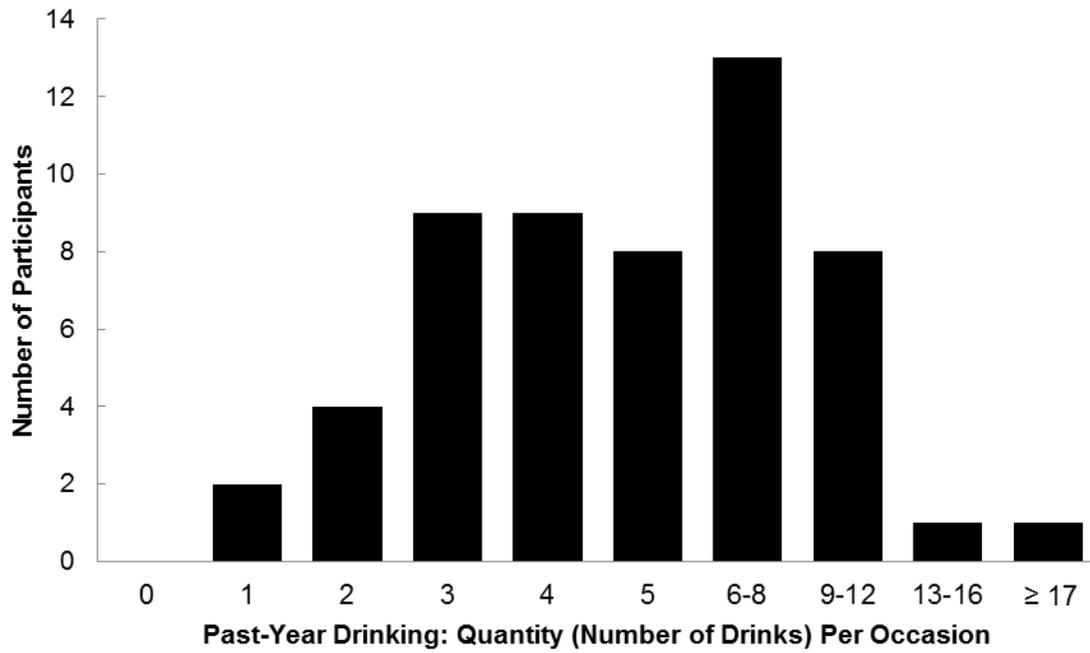*Distribution of Past-Year Quantity Per Occasion Among Female Participants*

Figure 2

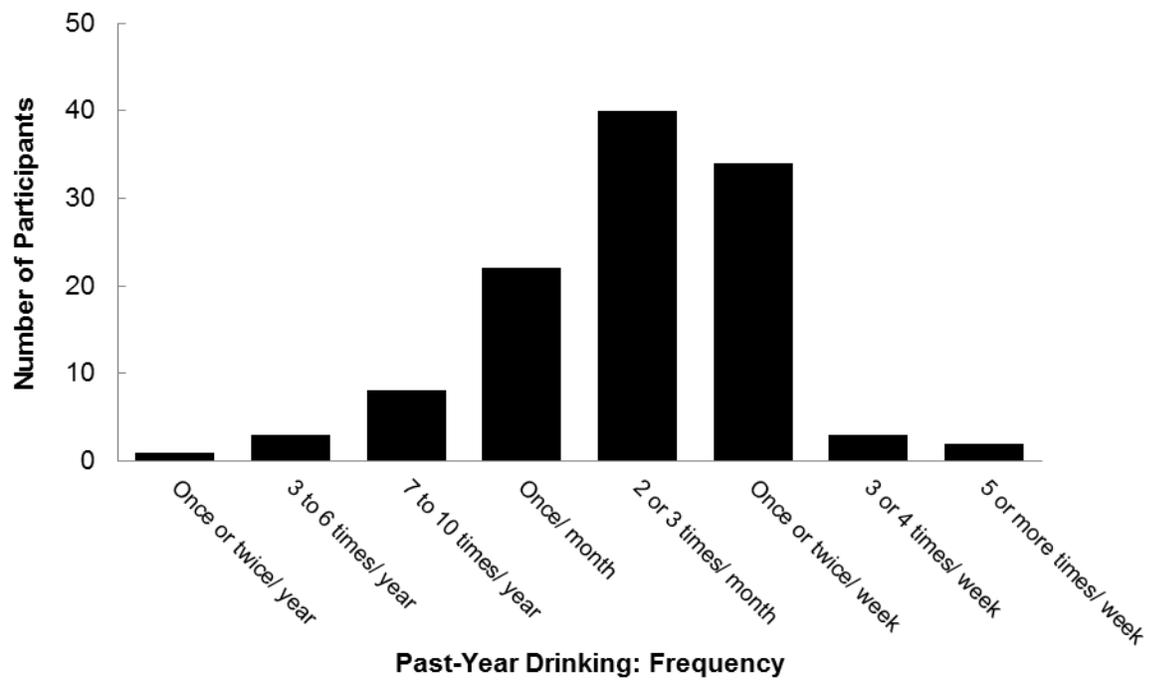*Distribution of Past-Year Quantity Per Occasion Among Male Participants*

Figure 3

Distribution of Past-Year Frequency of the Entire Sample

Figure 4

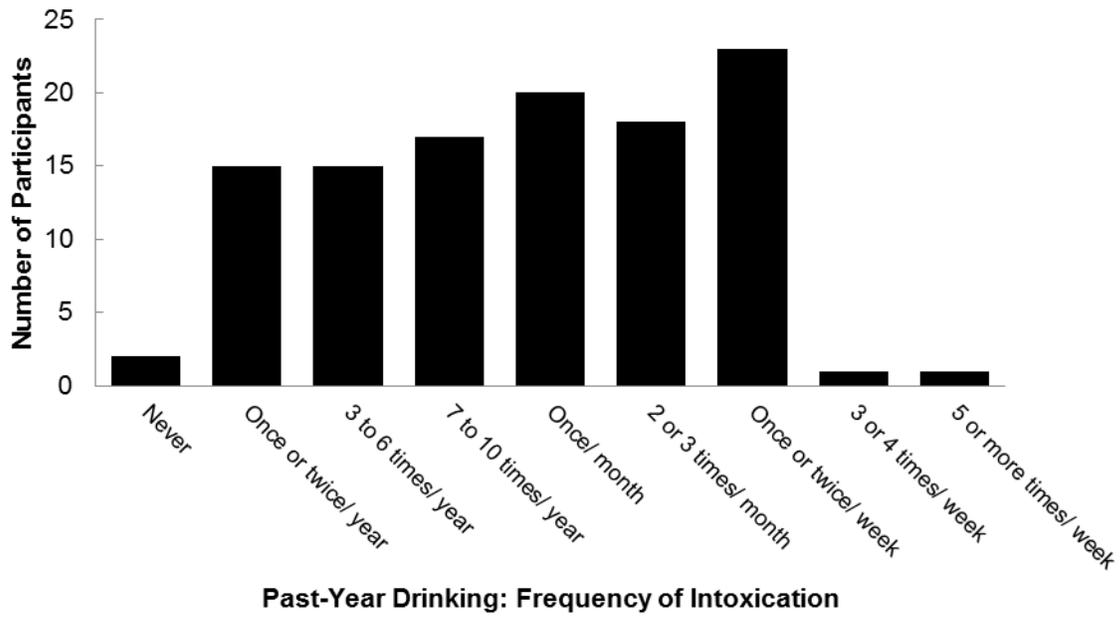*Distribution of Past-Year Frequency of Intoxication of the Entire Sample*

Past-Year Drinking: Frequency of Intoxication

Discussion

The goal of this study was to determine whether visual alcohol cues would lead to greater risk taking on the BART than those presented with neutral (i.e., non-alcoholic) visual cues. In addition, it was hypothesized that a priming effect would be moderated by alcohol expectancies; that is, participants with higher alcohol expectancies would be particularly prone to take more risks after viewing alcohol images. The primary hypothesis was not supported; participants who viewed alcohol primes did not have significantly higher AMP than those who viewed non-alcohol primes. Similarly, there was no interaction effect; mean AEQ scores were unrelated to AMP, regardless of the prime.

Although there was a specific theoretical basis for those with higher expectancies to respond to the alcohol prime, it would also be expected that drinking variables, particularly those that directly assess "risky" drinking, would be more sensitive in identifying those likely to respond to the prime. However, none of the alcohol use measures were related to BART outcomes in either condition. Importantly, self-reported alcohol use levels were similar to those that this study was intending to capture; median quantity per occasion was at binge levels, mean AUDIT score was at the level typically considered indicative of hazardous drinking, and the modal average frequency of intoxication was once or twice per week. No patterns emerged when comparing BART outcomes of the heaviest drinkers to those of the lightest. This indicates that the failure to find a priming effect was not the result of a sampling problem. Even in a sample that included binge-drinking college students, the alcohol prime did not promote risk taking on the BART.

The lack of a priming effect may have been due to the benign nature of the alcohol primes. The primes themselves, along with the laboratory setting, were chosen to maximize internal validity. Alcohol images contained pictures of alcoholic drinks in isolation; there was little to no detectable social context (e.g., of college-aged individuals playing drinking games). Had the alcohol images contained social context, determining "equivalent" images (i.e., including social context, while also not inadvertently stimulating thoughts of alcohol-related behaviors) for the non-alcohol condition would have been difficult. In addition to the primes, the laboratory environment was "sterilized" from drinking cues for the sake of internal validity. Participants in both conditions viewed the primes and completed the BART on a computer in a small laboratory room. It is possible that the sterile and rigid environment of a laboratory setting superseded any potential effect of the alcohol primes on risk taking.

Detecting the effects of alcohol-related context on risk taking on the BART may be more productive when the laboratory setting better resembles a naturalistic drinking setting. Researchers recently examined the relative influence of acute alcohol use and physical environment on BART performance (Corbin, Scott, Boyd, Menary, & Enders, 2015). In a sample of young adults with similar drinking patterns to those observed in the present study, participants consumed either alcohol or placebo, and then completed the BART in either a simulated bar context or standard lab context. Researchers hypothesized that the combination of the bar setting and alcohol administration would lead to greater risk taking on the BART than participants in the other three conditions. Contrary to expectations, there were no differences in BART performance across the groups, and among female participants in the bar setting, those who drank alcohol were less risky on the BART than females who drank placebo. While the lack of findings would suggest that alcohol-related physical context does not influence risk taking, the study design

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could not account for alcohol expectancy effects: each group received alcohol cues (Corbin et al., 2015). Given the demonstrable effect of placebo on alcohol-related behavior (e.g., Darkes & Goldman, 1993), it is possible that placebo intake promoted risk taking. Comparing BART performance to a condition without alcohol cues (environmental or otherwise) could help elucidate the effect of alcohol-related context on risk taking. Although caution is warranted when comparing group means across different samples, it is noteworthy that the average number of pumps per balloon in the present study (33 and 31 for the alcohol and non-alcohol groups, respectively) were lower than those in the aforementioned study (> 40 in each condition). Systematically comparing BART performance in the presence of rich alcohol cues against performance in the absence of cues could help to explicate this relationship.

Although the mild nature of the primes in the present study could have led to the non-significant group differences, the questionable external validity of the BART itself could have contributed, as well. Measures of alcohol use were unrelated to BART performance in the present study. Given the intended use of the BART as a laboratory analogue of real world risk behavior, it is problematic that it was unrelated to any of the self-report measures of drinking. Mixed relationships with drinking have been frequently documented in the literature. While many studies have identified the expected positive association between risk taking on the BART and self-reported drinking (e.g., Aklin et al., 2005; Fernie et al., 2010; Lejuez et al., 2002; Lejuez et al., 2005), many studies have failed to find any relationship (e.g., Skeel, Pilarski, Pytlak, & Neudecker, 2008). Negative relationships between risk taking and alcohol use have also been reported, such that those with more alcohol-related problems were more conservative (Ashenhurst et al., 2011; Courtney et al., 2012). The inconsistent relationship between drinking and BART performance suggests that the present findings are not anomalous.

Although alcohol cues did not promote risk taking on the BART in the present study, employing more arousing and naturalistic alcohol cues could provide a more definitive picture of the relationship between alcohol-related context and risk taking. Drinking and risky behavior among college-aged individuals is governed by a complex relationship of many contingencies (e.g., social and environmental). To better understand how these contingencies relate to risk taking, incorporating them into laboratory settings may allow for more accurate prediction of risk behavior.

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