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The effects of alcohol priming and alcohol-related cues on subsequent alcohol preferences

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Table of Contents

List of Tables

List of Figures

Abstract

The purpose of the current study was to investigate the effects of alcohol priming and alcohol-related cues on subsequent alcohol preferences. Researchers assigned randomly 35 university students to 1 of 3 conditions: alcohol delivered in a red disposable plastic cup (AC; alcohol cue; n = 12), alcohol delivered in a cafeteria cup (AN; neutral cue; n = 11), or alcohol placebo (P; n = 12) delivered in a red disposable plastic cup. Participants consumed their assigned beverages, and then completed the Multiple Choice Procedure (MCP), a procedure that allows participants to make discrete choices between a standard alcoholic beverage and increasing amounts of a concurrently available alternative monetary reinforcer. Although the primary analysis revealed conditions (AC, AN, P) did not differ significantly with respect to MCP crossover point (p > .05), a hierarchical multiple regression analysis revealed a model with alcohol estimation entered at step 1, condition entered at step 2, and conditionXalcohol estimation entered at step 3 explained 30.5% of the variance in MCP crossover point (p = .05). Findings suggest that substance-related cues may be important for understanding alcohol preferences.

Keywords: alcohol, priming, cues, preferences, MCP, compensatory effects, treatment

The Effects of Alcohol Priming and Alcohol-Related Cues on Subsequent Substance Preferences

Alcohol-related deaths average 88,000 per year in the United States (Esser et al., 2014). Alcohol Use Disorder (AUD) contributes to over half of alcohol-related health problems including, but not limited to, mental and behavioral disorders, various forms of cancer, cardiomyopathy, liver disease, pancreatitis, fetal alcohol syndrome, and alcohol poisoning (Connor, Haber, & Hall, 2016; Rehm et al., 2010). Twelve-month and lifetime prevalence of AUD among adults in the United States are 13.9% and 29.1%, respectively (Grant et al., 2015). Though various forms of AUD treatment exist (e.g., brief intervention, motivational enhancement, medication, in-patient rehabilitation, group therapy, cognitive and/or behavioral therapies, counseling, self-monitoring), relapse rates among those who have engaged with intervention and achieved short-term remission (ranging 6 to 36 months) are estimated to be between 20 and 80 percent, depending on the treatment, the sample, the length of time since treatment exposure, and severity of AUD (Miller & Wilbourne, 2002; Moos & Moos, 2006; NIDA, 2014). Given the number of individuals who suffer from AUD and the relatively ineffective intervention strategies that exist currently, new considerations in AUD treatment are warranted.

Most treatment methods for AUD focus on the psychological experience of craving for alcohol (e.g., Lowman, Hunt, Litten, & Drummond, 2000). Research suggests experiencing states of craving during treatment and not using coping strategies during those experiences serve as effective predictors for engaging in alcohol consumption among AUD patients (Flannery, Poole, Gallop, & Volpicelli, 2003; Garland, Franken, & Howard, 2012; Gauggel et al., 2010; Gordon et al., 2006) as well as for lapse immediately post-treatment (Papachristou, Nederkoorn, Giesen, & Jansen, 2014). In an attempt to track and combat the effects of craving during

treatment, Dulin and Gonzalez (2017) investigated the efficacy of implementing ecological momentary assessment (EMA) of craving among AUD patients. Participants received smartphone-delivered suggestions for coping strategies immediately after reporting experience of alcohol craving. Researchers found that delivery of coping strategy information effectively reduced craving-induced drinking. Given such evidence of the critical role of craving in AUD treatment, additional exploration of environmental cues responsible for inducing craving is warranted. Further, specific consideration of how environmental cues may influence the experience of withdrawal (the physiological counterpart to craving) is also necessary to fully understand lapse and relapse, though few studies examine craving and withdrawal as separate (but certainly related) constructs.

Cue-induced Withdrawal and Craving

Because experiences of withdrawal and craving for alcohol are important for understanding alcohol consumption during and post-treatment, understanding variables that may induce withdrawal and craving could be beneficial for more effective AUD treatment strategies and/or relapse prevention. Indeed, research suggests that environmental cues may play a critical role in the maintenance of problem drinking as a result of response to alcohol-related cues (e.g., Hone-Blanchet, Wensing, & Fecteau, 2014). For example, Witteman et al. (2015) found that the presentation of alcohol-related cues (e.g., televised alcohol advertisements) induced withdrawal and craving among alcohol-dependent patients enrolled in a detoxification treatment program. Additionally, Fox, Bergquist, Hong, and Sinha (2007) found that individualized alcohol-related cues (e.g., alcohol-related stimuli from a recent situation that resulted in alcohol consumption as described by the participant) induced alcohol withdrawal and craving among recently abstinent alcohol-dependent participants. Similarly, Fatseas et al. (2015) found associations between

previously-identified person-specific cues and subsequent increases in craving among alcohol, tobacco, cannabis, and opioid-dependent patients seeking treatment; results also revealed craving intensity was positively related to subsequent substance use. The influence of personal and general alcohol-related cues (e.g., sight of liquor bottle, smell of liquor) on the elicitation of craving has been demonstrated among non-dependent, social drinkers as well (e.g., Christiansen, Townsend, Knibb, & Field, 2017).

The experience of compensatory effects elicited from craving and/or withdrawal in the presence of a substance-related cue may be best understood in the context of a second-order classical conditioning paradigm (Rescorla, 1980; Siegel, 2005; Siegel & Ramos, 2002). Alcohol serves as an unconditioned stimulus (US) that elicits an unconditioned physiological response (UR) of intoxication. The UR (intoxication) then functions as a US that elicits compensatory responses (responses opposing those induced by the substance to reach equilibrium) in response to exposure to alcohol. After sufficient pairings of alcohol (US) and intoxication (US) with various drinking-related stimuli (e.g., red disposable plastic cups, a favorite bar, preferred bottle of liquor), environmental cues may take on substance-related properties and become conditioned stimuli (CS) that elicit the same compensatory responses as a function of second order conditioning (Cooper, Heron, & Heward, 2007; Drummond, 2000; Rescorla, 1980; Rescorla, 1988; Siegel, 1976).

Indeed, Newlin (1985) conducted four alcohol-conditioning sessions with six participants; during a fifth session, participants blindly consumed a placebo beverage (same ingredients as previous sessions excluding the alcohol and with the rim of the cup swabbed with alcohol) that researchers made pouring from a vodka bottle. During all sessions, researchers recorded various physiological responses before, during, and immediately following beverage consumption.

Findings suggest that the alcohol-related cues present during the placebo session (e.g., scent of alcohol, brief taste of alcohol, sight of vodka bottle) induced compensatory responses (i.e., increased finger pulse amplitude, increased finger temperature, and decreased pulse transit time), or opposite effects of the alcohol in conditioned human participants. Similarly, Coffey et al. (2010) found individuals diagnosed with post-traumatic stress disorder (PTSD) and alcohol dependence exhibited compensatory responses (i.e., salivation, increased craving) following exposure to both alcohol-related and trauma-related cues. Taken together, research suggests that exposure to alcohol-related cues may elicit withdrawal and cravings that can predict subsequent alcohol-consumption among those affected by AUD (e.g., Van Dyke & Fillmore, 2015).

Though human data support the notion that cue-induced responses may function to induce and/or maintain alcohol use, perhaps the most compelling evidence suggesting the importance of environmental cues in substance use comes from the animal literature. In particular, myriad animal studies suggest that environmental cues play a critical role in self-administration and maintenance of nicotine use among rats (e.g., Chaudrhi et al., 2006; Neugebauer, Cortright, Sampedro, & Vezina, 2014; Ramos, Siegel, & Bueno, 2002). Using an ABA design, Caggiula et al. (2001) provided rats with access to self-administration of nicotine in the presence of a cue (chamber light; A). Once responding suggested a learned association between the cue and nicotine (A), researchers removed the presence of the cue (B); consequently, self-administration significantly decreased. After re-administration of the cue (A), responding increased suggesting the presence of the cue induced nicotine withdrawal, thus eliciting higher rates of self-administration. Follow-up research provided additional evidence for the influence of nicotine cues on subsequent nicotine acquisition among rats such that rats in a nicotine-plus-cue group

exhibited significantly higher rates of self-administration of nicotine compared to rats that received the drug in the absence of any cues (Caggiula et al., 2002).

Animal studies suggest that conditioned alcohol compensatory effects are robust and likely to occur in humans in much the same way (e.g., Burattini, Gill, Aicardi, & Janak, 2006; Ciccocioppo, Angeletti, & Weiss, 2001; Ciccocioppo, Lin, Martin-Fardon, & Weiss, 2003; Katner, Magalong, & Weiss, 1999; Zironi, Burattini, Aicardi, & Janak, 2006); however, no study has adequately harnessed the compensatory effect phenomenon among humans in such a way that can aid intervention. Should research identify methods for better understanding compensatory effects among humans, such information may be used as a therapeutic tool or adjunct to existing treatments to help re-associate cues with healthier behaviors and improve substance use intervention outcomes.

Alcohol Priming

Though few studies have examined the effects of environmental cues on substance use among humans, several studies have demonstrated a priming effect: a phenomenon in which a stimulus or event occasions particular memories or behaviors that influence subsequent behavior associated with substance exposure, including alcohol consumption (e.g., de Wit, 1996). Chutuape, Mitchell, and de Wit (1994) investigated the alcohol-priming phenomenon by comparing normal social drinkers across two conditions. Participants consumed blindly an alcoholic drink (i.e., prime) or a placebo drink. Participants then chose to respond on one of two concurrent random-ratio schedules of reinforcement: an alcohol schedule or an alternate reinforcer schedule (i.e., money). Participants in the alcohol prime condition made more responses on the alcohol schedule than the alternate schedule, suggesting exposure to alcohol consumption primed subsequent alcohol preference.

The Current Study

A plethora of research supports the existence of the alcohol-priming phenomenon (Corbin, Gearhardt, & Fromme, 2008; de Wit & Chutuape, 1993; McCusker & Brown, 1990; Rose & Duka, 2006; Stockwell, Hodgson, & Taylor, 1982); however, several studies have shown no alcohol priming effect, and those that have often only yield such effects with cognitive measures and not behavioral measures (e.g., Isakowitz et al., 2014; Kirk & de Wit, 2000). It is possible that failure to observe a priming effect in some studies may be a result of alcohol-related cue exposure such that priming is occurring across experimental and control conditions (e.g., administering alcohol and placebo mixtures in red disposable plastic cups, presenting the smell of alcohol by swabbing placebo vehicles with alcohol, expectancy/cognitions related to alcohol consumption). Alcohol-related cues present in the placebo/control conditions potentially overshadow the priming effects taking place such that all conditions elicit craving, regardless of alcohol prime. Given inconsistencies in the literature, it is unclear under what conditions and for whom alcohol priming occurs. Further research is needed to fully elucidate the conditions under which priming occurs and what variables influence its occurrence.

The current study implemented a priming paradigm in order to examine the effects of an alcohol-related environmental cue (i.e., a red disposable plastic cup serving as the potential CS) on subsequent choices between alcohol and concurrently available alternative monetary reinforcers in order to assess the relative reinforcing value of these options. Red disposable plastic cups are a commonly used vehicle of alcoholic beverage administration among college students (Chrzan, 2013). In the current study, researchers randomly assigned participants to one of three alcohol/cue conditions: alcohol prime plus alcohol-related cue (AC; red disposable plastic cup), alcohol prime plus neutral cue (AN; cafeteria cup), or placebo plus alcohol-related

cue (P; red disposable plastic cup). Given previous research (e.g., Chutuape et al., 1994; Newlin, 1965), researchers hypothesized that the AC condition would yield the highest value (i.e., highest subjective, monetary value) and the P condition would yield a higher value than the AN condition (as a result of cue-induced compensatory responses overshadowing the potential priming effects).

Method

Participants

Participants included 36 university students (25 women) who self-reported consuming at least four standard alcoholic beverages in the past month to remain eligible for the study (at least 21 years or older). Additionally, participants must have self-reported engaging in at least one heavy episode of drinking (i.e., four or more standard drinks during one occasion for women, five or more standard drinks during one occasion for men) in their lifetime. Researchers excluded participants if they scored an eight or higher on the Alcohol Use Disorders Identification Test (AUDIT) or if their blood alcohol concentration was above .000 at the onset of the testing session. See Tables 1 and 2 for descriptive statistics.

Materials

Self-report measures.

Daily Drinking Questionnaire (DDQ; Modified). The DDQ was used to assess an individual's average drinking habits over a one-month time span. Participants indicated, on average, how many alcoholic beverages they consume in a given week day, as well as the typical number of hours they consume alcoholic beverages on each particular day. Data from the DDQ and the Drinking Practices Questionnaire are significantly correlated, $r(52) = .50$, $p = .001$ (Collins, Parks, & Marlatt, 1985).

Alcohol Timeline Follow-Back calendar (TLFB-A). The TLFB-A was used for self-report of alcohol use (Sobell & Sobell, 1996). The survey appeared in calendar format with room for participants to report the daily number of standard drinks in numerical form over the last 30 days. A chart at the top of the calendar indicated what was considered a standard drink (12 oz of beer, 5 oz of wine and 1.5 oz shot of hard liquor). Test-retest reliability studies indicated significant correlations for frequency of days drinking and maximal daily quantity over a 30-day period (Carey, 1997).

Rutgers Alcohol Problem Index (RAPI). The RAPI is a 23-item measure used to assess the frequency of alcohol-related problems. Participants indicated how many times particular events have happened to them while they were drinking or because of drinking within the last year. Responses were on a 4-point scale ranging from *none* (0) to *more than 5 times* (3). Sample items included: "Not able to do your homework or study for a test; Wanted to stop drinking but couldn't; and Had an argument or fight with a family member." Longitudinal studies have shown moderately strong correlations between RAPI and alcohol use intensity suggesting that this measure is a valid and useful tool in assessing problem drinking (White & Labouvie, 1989).

Drinking Motives Questionnaire (DMQ). The DMQ is a 20-item questionnaire used to assess four types of motives for drinking: social, coping, enhancement, and peer pressure motives. Each item allows for a response ranging from *never* (1) to *almost always* (6). Participants answered each question indicating how often they drink for each of the listed reasons. This measure is valid and reliable in investigating drinking motives of young adults (Stewart, Zeitlin, & Samoluk, 1996).

Alcohol Use Disorders Identification Test (AUDIT). The AUDIT consists of 10 multiple-choice questions intended to assess frequency of alcohol consumption and screen for

harmful alcohol consumption. The AUDIT is a unique measure of alcohol use because it assesses high-risk drinking behavior in addition to severity of AUD symptoms. The AUDIT is used in clinical settings to diagnose AUD, but has also been shown to be highly effective in identifying high-risk drinkers in the college population (Kokotailo et al., 2004). Each question is scored from 0 to 4, with the total possible range of scores being 0 to 40. A score of 8 or higher indicates that the person is engaging in dangerous drinking habits. Using this cutoff score of 8, the sensitivity of the AUDIT ranged from 95% to 100% for detecting hazardous alcohol consumption, from 93% to 100% for abnormal drinking behavior, and from 91% to 100% for alcohol related problems. For alcohol dependence syndrome (this terminology has been changed to Alcohol Use Disorder in the newest Diagnostic and Statistical Manual; American Psychiatric Association, 2013) the sensitivity was 100%. In the preliminary testing, the AUDIT was highly effective in discriminating between participants with hazardous, harmful, or non-hazardous alcohol consumption (Saunders, Aasland, Babor, De La Fuente, & Grant, 1993).

Multiple Choice Procedure (MCP). The MCP is a reliable and valid behavioral choice procedure that allows for assessment of the relative reinforcing value of concurrently available alternatives (e.g., drug or money) (Griffiths, Rush, & Puhala, 1996). Each participant made 45 discrete choices between a standard drink of alcohol and money. Monetary choices ranged from $0.00 to $20.00, increasing in 25-cent and 50-cent increments. The MCP instructed participants to choose between either one standard alcohol drink or an escalating monetary value (e.g., one standard drink or $2.50). The datum of interest is called the crossover point—the point at which participants stopped selecting alcohol and began selecting money. The exact crossover point is the subjective *value* of alcohol.

All choices were numbered, and corresponding numbers were written on slips of paper and put in a common source (e.g., a bag). Participants then randomly selected one choice from the hat, and that corresponding choice was provided immediately. For example, if the participant drew choice number 15A, researchers provided whichever choice the participant previously indicated for 15A. If the participant indicated they would prefer $5, they were given the $5. If the participant indicated they preferred the alcohol on the MCP form, then they were immediately given a standard drink of their choosing (vodka or whiskey with cranberry juice, orange juice, Coke, Coke Zero, Diet Coke, or seltzer water, or a Bud Light). This method served as a validation check for the MCP and yielded payments between $0.00 and $20.00. Studies have evidenced the external validity of the MCP across a variety of substances and behaviors (i.e., Benson, Little, Henslee, & Correia, 2009).

Beverage rating/standard drink estimation. Participants reported perceived alcoholic content of their beverages in terms of how many alcohol shots were in their drink as well as estimated peak BAC during the session and served as a validity check for the placebo beverage (Fillmore & Vogel-Sprott, 2000).

Biological measures. A Blood Alcohol Concentration (BAC) Monitor (BACtrack®) indicated baseline BAC (must be .000 to continue participation) and BAC throughout the session. Participants breathed into a handheld device, using new tubes per assessment, that read and reported their BAC levels. Participants were not informed of their BAC at any time.

Beverage materials. All study beverages consisted of seltzer water, Arkay Whiskey (non-alcoholic) or Evan Williams Whiskey (alcoholic), and lime juice. Researchers floated a small amount of alcohol (1 ml) on top of the placebo beverage and swabbed along the rim of the cup to give the beverage an alcoholic scent. All alcohol preparations (AC and AN conditions) included

Evan Williams whiskey and were prepared based on participant gender and weight (0.50 – 0.60 g/kg of body weight whiskey for men; women received 87% of the male dosage), consistent with previous research on alcohol priming studies in humans (Kirk & de Wit, 2000). These amounts of alcohol have been shown to produce alcohol-priming effects while maintaining low blood alcohol concentrations (approximately 0.04-0.06 g%) in social drinkers (Kirk & de Wit, 2000). Researchers delivered AC and P beverages in a red disposable plastic cup and AN beverages in a cafeteria cup.

Procedure

Researchers invited participants to attend a single, 4-hr lab session beginning between 4:00 p.m. and 5:30 p.m. Monday through Thursday. All participants were tested individually. Two research assistants (A and B) were present for all sessions. Researchers verified participant age (must have been 21 or older) by checking a government-issued form of identification. Researchers distributed and explained informed consent to participants before data collection began. Once informed consent was obtained, researchers recorded (on a Data Record Form; see Appendix B) participants' weight and baseline BAC to confirm recent alcohol abstincence. If participants had BAC readings that exceeded .000, they would have been offered assistance identifying transportation home and asked to reschedule, though this did not occur with the present study.

Research assistant A (RA-A) administered the online Qualtrics battery while research assistant B (RA-B) prepared the beverage according to randomly assigned group membership: AC, AN, or P. RA-B made the beverage (without informing RA-A about the condition to ensure a double-blind MCP administration). Upon completion of the online Qualtrics battery, RA-A informed the participant that they have 5 min to consume the contents of the cup that RA-B

would administer shortly. Once the beverage was made, RA-B administered the beverage to the participant without discussing the contents of the cup.

After 5 min elapsed, RA-B measured BAC and played an alcohol-neutral episode of *Friends*. The episode served as a time-filler while alcohol took effect. RA-B measured BAC every 5 min throughout the 22 min episode.

After the episode of *Friends* was complete, RA-A blindly administered the MCP (see Appendix A). Participants made 45 discrete choices indicating whether they preferred another beverage or an alternative reinforcer (increasing amounts of money ranging from $0.00 to $20.00). Participants then pulled a random number out of a bag that corresponded to one of the choices, and researchers distributed that choice immediately. Participants also indicated the context in which they most often enjoy drinking, as well as completed the alcohol estimation survey that served as a manipulation check for the placebo.

Once the MCP was completed, researchers recorded BAC every 30 min for the duration of the session. Sessions were a minimum of 4 hrs, and researchers required participants to remain in the lab until their BAC returned to .000.

Results

Researchers matched cases in the AC and AN conditions ($n_{condition}$ = 12) with respect to BAC just prior to MCP. Researchers randomly selected 12 cases from the P condition for analysis.

The AN condition included an outlying case with respect to MCP alcohol crossover point (i.e., ~2.5 SD above the group and sample means). Researchers conducted analyses both with and without the outlier.

Analyses Including All Cases

Primary analyses. A one-way between subjects ANOVA comparing conditions (AC, AN, P) with respect to relative reinforcing value of alcohol (MCP crossover point) revealed no mean differences across groups, $F(2, 33) = 1.16$, $p = .33$, $\eta^2 = .07$, *power* = .36 (Faul, Erfelder, Buchner, & Lang, 2009; Faul, Erfelder, Lang, & Buchner, 2007). See Table 2 and Figure 1 for additional details.

A series of exploratory hierarchical multiple regression analyses revealed that BAC measured just prior to MCP, alcohol estimation, AUDIT scores, DMQ subscores, RAPI, TLFB, and gender did not serve as significant predictors with condition (dummy coded) to explain the variance in MCP crossover point (*p*s > .05). See Table 3 for *power* statistics.

Validity checks. A series of one-way ANOVAs comparing conditions (AC, AN, P) with respect to RAPI scores (*power* = .22), TLFB reports (*power* = .83), AUDIT scores (power = .19), and DMQ subscale scores ($power_{social} = .48$, $power_{coping} = .23$, $power_{enhance} = .75$, $power_{conform} = .50$) revealed no mean differences (*p*s > .05) and served as a validity check for random assignment (Faul et al., 2009; Faul et al., 2007). See Table 4 for descriptive and inferential statistics. One-way ANOVAs comparing conditions with respect to alcohol estimation ($F(2, 33) = .74$, $p = .48$, $\eta^2 = .04$, *power* = .49) and with respect to BAC estimation ($F(2, 32) = 1.49$, $p = .24$, $\eta^2 = .08$, *power* = .28) revealed no significant mean differences and served as validity checks for the placebo manipulation (Faul et al., 2009; Faul et al., 2007). (See Table 6.) An independent t-test comparing men and women with respect to BAC just prior to MCP administration revealed no significant mean difference ($t(34) = -.80$, $p = .43$, $d < .001$, *power* = .43) and served as a validity check for the mg/kg dosing procedure (Faul et al., 2009; Faul et al., 2007).

Gender differences. Men and women differed significantly with respect to AUDIT scores ($t(12.65) = 2.40$, $p = .03$, $d = 1.12$, CI 95% [.35, 7.02]) such that men exhibited higher scores than women. Men and women did not differ with respect to DMQ subscores, RAPI, TLFB, or alcohol crossover point (ps > .05). See Table 7 for descriptive and inferential statistics.

Analyses Excluding Outlier

Primary analyses. A one-way ANOVA comparing conditions (AC, AN, P) with respect to relative reinforcing value of alcohol (MCP crossover point) revealed no mean differences across groups (*power* = .25; Faul et al., 2009; Faul et al., 2007). See Table 2 for additional details.

A series of multiple hierarchical regression analyses revealed that BAC measured just prior to MCP, AUDIT scores, DMQ subscores, and gender did not serve as significant covariates with condition (dummy coded) to explain the variance in alcohol crossover point (ps > .05). See Table 3 for *power* statistics.

A hierarchical multiple regression analysis revealed a model with alcohol estimation entered at the first step, condition (dummy coded) entered at step 2, and conditionXalcohol estimation entered at step 3 explained 30.5% of the variance in alcohol crossover point, $F(5, 29) = 2.54$, $p = .05$, $R^2 = .305$, CI 95% [.03, .55] (Steiger & Fouladi, 1992). The alcohol estimationXcondition interaction explained 20.5% of the variance in alcohol crossover point above and beyond alcohol estimation and condition ($F_\Delta = 4.29$, $p = .02$). A one-way ANOVA revealed alcohol estimation and condition were not significantly related ($p > .05$). See Tables 9 and 10.

Although not significant, a hierarchical regression analysis with RAPI entered at step 1 and condition entered at step 2 revealed a trend toward explaining variance in alcohol crossover point (RAPIXcondition entered at step 3 not significant), $F(3, 25) = 2.88$, $p = .056$, $R^2 = .257$, CI 95%

[.00, .52], *power* = .67 (Faul et al., 2009; Faul et al., 2007; Steiger & Fouladi, 1992). Condition explained 25% of unique variance in alcohol crossover point above and beyond RAPI (F_{Δ} = 4.21, p = .03), such that, on average, AC alcohol crossover points were 2.85 units higher than P (p = .04) while controlling for RAPI. See Tables 9 and 10.

Although not significant, a hierarchical multiple regression analysis with TLFB total entered at step 1 and condition entered at step 2 revealed a trend toward explaining variance in alcohol crossover point (TLFBXcondition entered at step 3 not significant), $F(3, 24) = 2.87$, p = .057, R^2 = .264, CI 95% [.00, .54], *power* = .69 (Faul et al., 2009; Faul et al., 2007; Steiger & Fouladi, 1992). Condition explained 23% unique variance in alcohol crossover above and beyond total TLFB (F_{Δ} = 3.75, p = .04) such that, on average, AC alcohol crossover points were 2.57 units higher than P (p = .05). See Tables 9 and 10.

Validity checks. A series of one-way ANOVAs comparing conditions (AC, AN, P) with respect to RAPI scores (power = .21), TLFB reports (power = .85), AUDIT scores (power = .14), and DMQ subscale scores ($power_{social}$ = 56, $power_{coping}$ = .76, $power_{enhance}$ = .19, $power_{conform}$ = .36), revealed no significant mean differences (ps > .05) and served as a validity check for random assignment (Faul et al., 2009; Faul et al., 2007). See Table 5 for descriptive and inferential statistics. One-way ANOVAs comparing conditions (AC, AN, P) with respect to alcohol estimation ($F(2, 32) = .74$, p = .49, η^2 = .04, *power* = .50) and with respect to BAC estimation revealed no significant mean differences ($F(2, 31) = 1.42$, p = .26, η^2 = .08, *power* = .30) and served as validity checks for the placebo manipulation (Faul et al., 2009; Faul et al., 2007). See Table 5. An independent t-test comparing men and women with respect to BAC before the MCP revealed no significant mean difference ($t(33) = -1.35$, p = .19, d < .001, *power*

= .19) and served as a validity check for the mg/kg dosing procedure (Faul et al., 2009; Faul et al., 2007).

Gender difference. Men and women differed significantly with respect to DMQ enhancement subscores ($t(25.35) = -2.65$, $p = .01$, $d = .82$, CI 95% [-2.90, -.36]) such that women exhibited higher levels of drinking to feel better/enhance mood. Men and women did not differ with respect to AUDIT scores (*power* = .80), DMQ social subscore (*power* = .14), DMQ coping subscore (*power* = .57), DMQ conforming subscore (*power* = .89), RAPI (*power* = .62), TLFB (*power* = .96), or alcohol MCP crossover point (*power* = .77; Faul et al., 2009; Faul et al., 2007) (*p*s > .05). See Table 8 for descriptive and inferential statistics.

Discussion

The current study aimed to examine the potential effects of alcohol priming and alcohol-related cues on subsequent alcohol preferences. Contrary to the primary hypothesis, analyses revealed no significant differences with respect to alcohol crossover point across conditions (both including all cases and excluding the outlying case); however, the AC condition yielded a higher mean crossover point than the P and AN conditions, revealing a trend toward the hypothesized findings. Additionally, no variables (i.e., BAC measured just before MCP, alcohol estimation, AUDIT, DMQ subscores, RAPI, TLFB, gender) served as significant covariates in explaining variance with respect to MCP crossover point when all cases were included in analyses; however, when the outlying case was removed, a model with alcohol estimation, condition, and alcohol estimationXcondition explained 30.5% of the variance in MCP crossoverpoint. Results suggest that the priming effect may have been over-shadowed by effects of alchohol-related cues, though more work is needed to fully elucidate such a phenomenon.

Findings also suggest that the effects of alcohol-related cues and alcohol priming may be influenced by the amount of alcohol an individual believes he/she has consumed.

Current study findings contrasted alcohol-cue literature (e.g., Van Dyke & Fillmore, 2015; Witteman et al., 2015) and alcohol priming literature (e.g., Chutuape et al., 1994; de Wit, 1996) such that primary analyses revealed no significant differences between conditions with respect to MCP crossover point; however, regression analyses suggested study condition and alcohol estimation together may predict MCP crossover point. Although no studies have investigated the role of alcohol estimation in alcohol preferences, these findings partially support results from both alcohol priming and alcohol-cue literature such that the AC condition yielded the highest crossover point given high alcohol estimation. Given the mixed results from both the current study and previous work on alcohol priming (e.g., Corbin et al., 2008; de Wit & Chutuape, 1993; Kirk & de Wit, 2000) and alcohol-related cue-induced craving (e.g., Christiansen et al., 2017), further investigation is warranted.

There are several potential explanations for the current findings' contrast with previous work and hypothesized outcomes. First, the study is statistically underpowered (as are most published studies); both sets of analyses (including all cases and excluding the outlying case) exhibited insufficient power ($\leq$ .36). Future researchers might increase sample size, alter the salience of the manipulation, or identify more sensitive behavioral outcome measures in effort to increase power. Second, it is possible that the cue-induced compensatory responses and the alcohol prime occurred but functioned to elicit withdrawal symptoms intense enough for some participants to prefer the monetary reinforcer for the purpose of purchasing their *preferred* alcoholic beverage after the session and consuming it in the setting they feel the most comfortable (e.g., home, favorite bar, etc.), thus masking the effects of the study manipulation.

To combat this potential issue, future studies might include a wider variety of beverage chocies and/or ask participants what their preferred beverage is and include that in the MCP. Alternatively, researchers might collect MCP data in the *actual* environment in which participants normally spend money on alcohol (e.g., their home, favorite bar, etc.). Researchers could also implement a different concurrent reinforcer that participants could not use to purchase alcohol after the session (i.e., a gift card to the campus bookstore).

A third potential explanation for current study findings (though aggregate data do not suggest this) may include that participants in the AN condition became more intoxicated than participants in the AC or P conditions because of the lack of compensatory response from the alcohol-related cue (i.e., specificity of tolerance). If the neutral cue failed to induce compensatory responses (as hypothesized), then the body did not "prepare" for the alcohol (i.e., did not engage in the opposing responses mimicing withdrawal), resulting in the individual experiencing greater intoxication than those in the AC and P conditions. Dafters and Anderson (1982) administered a series of ethanol doses to participants in one environment and placebo doses in a different, distinct environment to study conditioned environmental specificity of tolerance to alcohol among moderate social drinkers. When participants received a dose of ethanol in the same environmental context as the ethanol-administration sessions, tolerance was demonstrated; however, when participants received an ethanol dose in the placebo-administration environment, tolerance was *not* demonstated. Specificity of tolerance to alcohol findings have been robust among animal subjects (e.g., Mansfield & Cunningham, 1980; Siegel & MacRae, 1984) and demonstrated across other substances (e.g., Poulos & Hinson, 1984; Siegel & MacRae, 1984).

As with any study, it is also possible that extraneous cues influenced participants' responding, overshadowing the experimental manipulation. Several alcohol-related cues were necessarily present across all conditions to maintain the integrity of the placebo. Researchers informed all participants that they would be consuming alcohol during the session; however, alcohol expectancy may have elicited inadvertant craving across all conditions (e.g., Leeman, Corbin, & Fromme, 2009). Additionally, researchers used the same recipe for the AC and AN conditions, and the P condition recipe included floating a small amount of alcohol on the top of the drink and swabbing the rim of the cup; therefore, all conditions experienced the immediate taste and smell of alcohol, potentially eliciting compensatory responses equally across all conditions. Future researchers may consider including a no-alcohol-cue control condition such that participants are not exposed to any alcohol-related cues (i.e., no alcohol expectancy, no sight/smell of alcohol, neutral adminsitration).

In effort to reduce extraneous influences and isolate the study manipulations, researchers employed several experimental constraints. A double-blind administration procedure was used to reduce experimenter and participant expectancies. Random assignment to study condition improved the likelihood that all groups were similar with respect to outcome variables at the start of the study. Further, all participants must have reported at least one heavy episode of drinking during one drinking occassion (i.e., four or more standard drinks for women, five or more standard drinks for men) prior to the study suggesting that alcohol has some reinforcing value. A standardized protocol including scripted instructions was implemented across all conditions for all sessions and all sessions occurred in the same physical space during the same time of day (beginning between 4:00 p.m. and 5:30 p.m.). Researchers developed a novel drink recipe to ensure participants would not have previously made associations with the taste of the study

beverage. Pilot testing of the placebo beverage before data collection suggested that the placebo would be effective; the manipulation check (alcohol estimation) confimed that the placebo was effective. Additionally, the MCP offered participants their choice of beverage should they have received alcohol in the MCP. Researchers required all participants to stay in the lab for the full 4 hrs of the session, regardless of their MCP choices or study condition, to prevent participants from choosing money over alcohol for the sole purpose of being released early.

A variety of controls and manipulation checks also serve as strengths of the study. Dosing participants via a mg/kg gender-adjusted procedure increased the likelihood that participants would achieve similar BAC levels regardless of group, gender, or body size; data confirmed the procedure was effective. The MCP also included a validity check for the choices participants made; if participants received alcohol in the MCP researchers took note of whether participants consumed the entire contents of the second beverage (suggesting genuine preference for another beverage relative to some dollar amount). All participants that received a second beverage finished the entire contents of the beverage.

Although the current study included several strengths, limitations should also be considered. The current study was statistically underpowered thus limiting ability to confidently draw conclusions from data. Additionally, researchers recruited participants via convenience sampling; all participants were college-aged students from the same university and most were women. Though homogeneity of the sample is advantageous from an internal validity standpoint, homoegeneity was not achieved through random sampling. Future researchers should consider random sampling to achieve a homogenic sample or sampling from a more diverse population to promote potential generalizability of findings. The gender imbalance of the sample should also be addressed in future work. In addition to sampling issues, the lack of a condition absent alcohol

cues and/or a placebo delivered absent an alcohol cue dimishes the ability to examine effectively interactions between potential cue-induced withdrawal and alcohol priming.

If future researchers are able to show that priming and alcohol-related cues work together and/or function independently to maintain drinking-related behaviors, findings could inform clinicians and other health professionals regarding effective strategies with which to augment existing alcohol rehabilitation programs. Currently, most AUD rehabilitation programs emphasize complete avoidance and abstinance from alcohol-related cues; however, complete avoidance may be diffficult to obtain if typical, everyday objects or environments (e.g., a drinking glass, living room, etc.) serve as substance-related cues that may trigger compensatory effects (Myers & Carlezon, Jr., 2010). Thus, extinguishing the craving-inducing properties of substance-related cues may be effective. Research has shown that associations between substance-related cues and conditioned responses can be extinguished among animal subjects through exposure to the conditioned cues *without access to drug administration,* allowing the cues to lose their craving-inducing properties (Myers & Carlezon Jr., 2010). Vollstädt-Klein et al. (2011) assigned randomly patients to either a cue-exposure based extinction training (CET) group or a control group and induced extinction of cue-reactivity among recently detoxified AUD patients. CET patients were exposed to their preferred alcoholic beverage over nine sessions. Results revealed CET patients exhibited less cue-reactivity than the control patients, suggesting CET may effectively extinguish cue-conditioned response associations; however, this phenomenon has not been well studied among humans and warrants further examination.

Although CET has exhibited mixed results as a treatment for AUD, researchers have investigated pharmacological strategies for minimizing craving and decreasing relapse rates among AUD patients (e.g., Volpicelli, O'Brien, Alterman, & Hayashida, 1990) that may work to

supplement CET. Specifically, the use of naltrexone may enhance the efficacy of CET. Naltrexone is an opioid receptor antagonist that has been used as a moderately effective craving-minimizer for AUD patients in reducing number of drinking days, extending time to first relapse/lowering rates of relapse, and reducing the number of drinks per episode (O'Malley, Jaffe, & Chang, 1992; Ray, Chin, & Miotto, 2010). Naltrexone has significantly reduced craving among AUD patients in laboratory settings as well as in their natural environments (Miranda Jr. et al., 2010). Lukas et al. (2013) investigated the effects of naltrexone on cue-induced craving among alcohol-dependent volunteers and revealed that patients injected with naltrexone demonstrated less reactivity to alcohol cues than those injected with a placebo. Data from naltrexone therapy research coupled with findings from exposure studies for AUD (noted above) and other conditions (e.g., PTSD; Foa, Rothbaum, Riggs, & Murdock, 1991; Powers, Halpern, Ferenshcak, Gillihan, & Foa, 2010) suggest promise for therapeutic use of cue-exposure.

The literatures on the effects of alcohol priming and alcohol-related cues on subsequent alcohol consumption are mixed with respect to outcome. Mixed findings may be a result of varying methodologies related to manipulation. For example, some studies employed priming manipulations using a standard dose across participants (e.g., Hodgson, Rankin, & Stockwell, 1979) and others controlled BAC (administered g/kg controlling for gender; e.g., de Wit & Chutuape, 1993; Amlung et al., 2015). Varied placebo preparations (e.g., Chutuape et al., 1994 added small amounts of alcohol to mimic the scent) may also contribute to discrepancies in the literature as some researchers used placebo control and others used a non-alcoholic drink control (e.g., Christiansen et al., 2017 employed both placebo and non-alcoholic control; Amlung et al., 2015 used an orange juice control). Current study alcohol doses were lower than some prior study doses and previous literature suggests a positive relation between the strength of the

priming effect and the alcohol preload dose (Chutuape et al., 1994). It is possible that the current study alcohol doses were not sufficient to elicit an alcohol priming effect; however, studies have demonstrated an alcohol priming effect with the same dose or lower among humans (e.g., Rose & Duka, 2006) and at comparable doses among animals (e.g., Lê, Quan, Juzytch, Fletcher, Joharchi, & Shaham, 1998).

Inconsistencies in outcomes among extant studies (including the current study) may also be influenced by a variety of additional variables. For example, the current study examined socially drinking (non-alcohol use disordered) undergraduate college students among whom a priming effect may not be evident behaviorally; in contrast, some previous studies included participants between ages 21-35 and/or heavy or dependent drinkers. Further, in several priming studies for which there is evidence that priming occurs, the effect seems to manifest consistently with subjective self-report measures (such as desire for alcohol; e.g., Amlung et al., 2015) but is less often evident with behavioral indices (e.g., de Wit & Chutuape, 1993; Fillmore & Rush, 2001). Finally, the MCP may not be sensitive to the effects of alcohol priming.

Given inconsistencies in the literature, researchers remain unsure as to whether these phenomena occur, and, if they do, to what extent they influence alcohol consumption. Further research is necessary to uncover the true impact alcohol priming and alcohol-related cues may have on subsequent alcohol consumption. Additionally, cue research suggests cue-induced craving may occur across a variety of substances, and future researchers should investigate the role of cue-induced craving across substances, contexts, and samples. Taken together, results from the current study and previous research suggest alcohol priming and alcohol-related cues may serve as integral components to the maintenance and relapse of alcohol use among AUD individuals. Currently, there is no gold-standard treatment method for AUD patients. If

individuals with AUD and health professionals can identify the cues that aid in the maintenance of problem drinking, then they can create new associations between those cues and adaptive responses (i.e., abstinence or moderation) in conjunction with other treatment methods.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC.

Benson, T. A., Little, C. S., Henslee, A. H., & Correia, C. (2009). Effects of reinforcer magnitude and alternative reinforcer delay on preference for alcohol during a multiple-choice procedure. *Drug and Alcohol Dependence, 100*(1-2), 161-163.

Burattini, C., Gill, T. M., Aicardi, G., & Janak, P. H. (2006). The ethanol self-administration context as a reinstatement cue: Acute effects of naltrexone. *Neuroscience, 139*(3), 877-887.

Caggiula, A. R., Donny, E. C., White, A. R., Chaudhri, N., Booth, S., Gharib, M. A., Hoffman, A., Perkins, K. A., & Sved, A. F. (2001). Cue dependency of nicotine self-administration and smoking. *Pharmacology, Biochemistry, and Behavior, 70,* 515-530.

Caggiula, A. R., Donny, E. C., White, A. R., Chaudhri, N., Booth, S., Gharib, M. A., Hoffman, A., Perkins, K. A., & Sved, A. F. (2002). Environmental stimuli promote the acquisition of nicotine self-administration in rats. *Psychopharmacology, 16,* 230-237.

Carey, K.B. (1997). Reliability and validity of the time-line follow-back interview among psychiatric outpatients: A preliminary report. *Psychology of Addictive Behaviors, 11*(1), 26-33.

Chaudhri, N., Caggiula, A. R., Donny, E. C., Booth, S., Gharib, M., Craven, L., Palmatier, M. I., Liu, X., & Sved, A. F. (2006). Operant responding for conditioned and unconditioned reinforcers in rats is differentially enhanced by the primary reinforcing and reinforcement-enhancing effects of nicotine. *Psychopharmacology, 189,* 27-36.

Christiansen, P., Townsend, G., Knibb, G., & Field, M. (2017). Bibi ergo sum: The effects of a placebo and contextual alcohol cues on motivation to drink alcohol. *Psychopharmacology, 234*, 827-835.

Chrzan. J. (2013). Student and youth drinking. In *Alcohol: Social drinking in cultural context* (pp. 2-3). New York, New York: Routledge.

Chutuape, M.A., Mitchell, S.H., & de Wit, H. (1994). Ethanol preloads increase ethanol preference under concurrent random-ration schedules in social drinkers. *Experimental and Clinical Psychopharmacology,. 2*(4), 310-318.

Ciccocioppo, R., Angeletti, S., & Weiss, F. (2001). Long-lasting resistance to extinction of response reinstatement induced by ethanol-related stimuli: Role of genetic ethanol preference. *Alcoholism: Clinical and Experimental Research, 25*(10), 1414-1419.

Ciccocioppo, R., Lin, D., Martin-Fardon, R., & Weiss, F. (2003). Reinstatement of ethanol-seeking behavior by drug cues following single versus multiple ethanol intoxication in the rat: Effects of naltrexone. *Psychopharmacology, 168*(1), 208-215.

Coffey, S. F., Schumacher, J. A., Stasiewicz, P. R., Henslee, A. H., Baillie, L. E., & Landy, N. (2010). Craving and physiological reactivity to trauma and alcohol cues in posttraumatic stress disorder and alcohol dependence. *Experimental and Clinical Psychopharmacology, 18*(4), 340-349. doi: 10.1037/a0019790

Collins, R. L., Parks, G. A., & Marlatt, G. A. (1985). Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. *Journal of Counseling and Clinical Psychology, 53*(2), 189-200.

Connor, J. P., Haber, P. S., & Hall, W. D. (2016). Alcohol use disorders, *The Lancet, 387*(10022), 988-998.

Cooper, J., Heron, T., & Heward, W. (2007). Applied Behavior Analysis (2nd ed., pp. 27-45, 55 - 69, 475-476). Upper Saddle River, New Jersey: Pearson.

Corbin, W. R., Gearhardt, A., & Fromme, K. (2008). Stimulant alcohol effects prime within session drinking behavior. *Psychopharmacology, 197*(2), 327-337.

Dafters, R., & Anderson, G. (1982). Conditioned tolerance to the tachycardia effect of ethanol in humans. *Psychopharmacology, 78,* 365-367.

de Wit, H. (1996). Priming effects with drugs and other reinforcers. *Experimental and Clinical Psychopharmacology. 4*(1), 5-10.

de Wit, H., & Chutuape, M.A. (1993). Increased ethanol choice in social drinkers following ethanol preload. *Behavioral Pharmacology, 4,* 29-36.

Drummond, D. C. (2000). What does cue-reactivity have to offer clinical research? *Addiction, 95*(2), 129-144.

Dulin, P. L., & Gonzalez, V. M. (2017). Smartphone-based momentary intervention for alcohol cravings amongst individuals with an alcohol use disorder. *Psychology of Addictive Behaviors, 31*(5), 601-607.

Esser, M. B., Hedden, S. L., Kanny, D., Brewer, R. D., Gfoerer, J. C., & Naimi, T. S. (2014). Prevalence of alcohol dependence among US adult drinkers, 2009-2011. *Preventing Chronic Disease: Public Health Research, Practice, and Policy, 11*(206), 1-11.

Fatseas, M., Serre, F., Alexandre, J-M., Debrabant, R., Auriacombe, M., & Swendsen, J. (2015). Craving and substance use among patients with alcohol, tobacco, cannabis, or heroin addiction: A comparison of substance- and person-specific cues. *Addiction, 110,* 1035-1042.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. –G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41,* 1149-1160.

Faul, F., Erdfelder, E., Lang, A. -G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39,* 175-191.

Fillmore, M. T., & Vogel-Sprott, M. (2000). Response inhibition under alcohol: Effects of cognitive and motivational conflict. *Journal of Studies on Alcohol and Drugs, 61*(2), 239-246.

Flannery, B. A., Poole, S. A., Gallop, R. J., & Volpicelli, J. R. (2003). Alcohol craving predicts drinking during treatment: An analysis of three assessment instruments. *Journal of Studies on Alcohol and Drugs, 64*(1), 120-126.

Foa, E. B., Rothbaum, B. O., Riggs, D. S., & Murdock, T. B. (1991). Treatment of Posttraumatic-Stress Disorder in rape victims: A comparison between cognitive-behavioral procedures and counseling. *Journal of Consulting and Clinical Psychology, 59*(5), 715-723.

Fox, H. C., Bergquist, K. L., Hong, K., & Sinha, R. (2007). Stress-induced and alcohol cue-induced craving in recently abstinent alcohol-dependent individuals. *Alcoholism: Clinical and Experimental Research, 31*(3), 395-403.

Garland, E. L., Franken, I. H., & Howard, M. O. (2012). Cue-elicited heart rate variability and attentional bias predict alcohol relapse following treatment. *Psychopharmacology, 222,* (17-26).

Gauggel, S., Heursinger, A., Forkmann, T., Boekcer, M., Lindenmeyer, J., Cox, W. M., & Staedtgen, M. (2010). Effects of alcohol cue exposure on response inhibition in detoxified alcohol-dependent patients. *Alcoholism: Clinical and Experimental Research, 34*(9), 1584-1589.

Gordon, S. M., Sterling, R., Siatkowski, C., Raively, K., Weinstein, S., & Hill, P. C. (2006). Inpatient desire to drink as a predictor of relapse to alcohol use following treatment. *The American Journal on Addictions, 15,* 242-245.

Grant B. F., Goldstein, R. B., Saha, T. D., Chou, S. P., Jung, J., Zhang, H. … Hasin, D. S. (2015). Epidemiology of DSM-5 Alcohol Use Disorder results from the National Epidemiologic Survey on Alcohol and Related Conditions III. *JAMA Psychiatry, 72*(8), 757-766.

Griffiths, R. R., Rush, C. R., & Puhala, K. A. (1996). Validation of the multiple-choice procedure for investigating drug reinforcement in humans. *Experimental and Clinical Psychopharmacology, 4*(1), 97-106.

Hodgson, R., Rankin, H., & Stockwell, T. (1979). Alcohol dependence and the priming effect. *Behaviour Research and Therapy, 17*(4), 379-387.

Isakowitz, C., Choi, C., Kayser, K., Owens, K., Evans, M., & Irons, J. G. (April, 2014). The effects of alcohol priming on subsequent preferences for alcohol and other drugs. Poster presented at the 35th annual meeting and scientific sessions of the Society of Behavioral Medicine, Philadelphia, PA.

Katner, S., Magalong, J. G., & Weiss, F. (1999). Reinstatement of alcohol-seeking behavior by drug-associated discriminative stimuli after prolonged extinction in the rat. *Neuropsychopharmacology, 20*(5), 471-479.

Kirk, J. M., & de Wit, H. (2000). Individual differences in the priming effect of ethanol in social drinkers. *Journal of Studies on Alcohol and Drugs, 61*(1), 64-71.

Kokotailo, P. K., Egan, J., Gangnon, R., Brown, D., Mundt, M., & Fleming, M. (2004). Validity of the alcohol use disorders identification test in college students. *Alcoholism: Clinical and Experimental Research, 28*(6), 914-920.

Lê, A. D., Quan, B., Juzytch, W., Fletcher, P. J., Joharchi, N., & Shaham, Y. (1998). Reinstatement of alcohol-seeking by priming injections of alcohol and exposure to stress in rats. *Psychopharmacology, 135*, 169-174.

Leeman, R. F., Corbin, W. R., & Fromme, K. (2009). Craving predicts within session drinking behavior following placebo. *Personality and Individual Differences, 46*, 693-698.

Lowman, C., Hunt, W. A., Litten, R. Z., & Drummond, D. C. (2000). Research perspectives on alcohol craving: An overview. *Addiction, 95*(2), 45-54.

Lukas, S. E., Lowen, S. B., Lindsey, K. P., Conn, N., Tartarini, W., Rodolico, J., ... Penetar, D. M. (2013). Extended-release naltrexone (XR-NTX) attenuates brain responses to alcohol cues in alcohol-dependent volunteers: A bold FMRI study. *NeuroImage, 78*, 176-185.

Mann, K., & Hermann, D. (2010). Individual treatment in alcohol-dependent patients. *European Archives of Psychiatry and Clinical Neuroscience, 260*(2), 116-120.

Mansfield, J. G., & Cunningham, C. L. (1980). Conditioning and extinction of tolerance to the hypothermic effect of ethanol in rats. *Journal of Comparative and Physiological Psychology, 94*(5), 962-969.

McCusker, C. G., & Brown, K. (1990). Alcohol-predictive cues enhance tolerance to and precipitate "craving" for alcohol in social drinkers. *Journal of Studies on Alcohol and Drugs, 51*(6), 494-499.

Miller, W. R., & Willbourne, P. L. (2002). Mesa Grande: A methodological analysis of clinical trials of treatments for alcohol use disorders. *Addiction, 97*(3), 265-277.

Miranda Jr., R., Ray, L., Blanchard, A., Reynolds, E. K., Monti, P. M., Chun, T., ... Ramirez, J. (2014). Effects of naltrexone on adolescent alcohol cue reactivity and sensitivity: An initial randomized trial. *Addiction Biology, 19*(5) 941-954.

Moos, R. H., & Moos, B. S. (2006). Rates and predictors of relapse after natural and treated remission from alcohol use disorders. *Addiction, 101*(2), 212-222.

Myers, K., & Carlezon Jr., W. A. (2010). Extinction of drug- and withdrawal-paired cues in animal models: Relevance to the treatment of addiction. *Neuroscience and Biobehaviora l Reviews, 35,* 285-302.

Neugebauer, N. M., Cortright, J. J., Sampedro, G. R., & Vezina, P. (2014). Exposure to nicotine enhances its subsequent self-administration: Contribution of nicotine-associated contextual stimuli. *Behavioral Brain Research, 260,* 155-161.

Newlin, D. B. (1985). Human conditioned compensatory response to alcohol cues: Initial evidence. *Alcohol, 2*(3), 507-509.

NIDA (2014). Drugs, brains, and behavior: The science of addiction. Retrieved February 28, 2017, from https://www.drugabuse.gov/publications/drugs-brains-behavior-science-addiction.

O'Malley, S. S., Jaffe, A. J., & Chang, G. (1990). Naltrexone and coping skills therapy for alcohol dependence: A controlled study. *Archives of General Psychiatry, 49*(11), 881-887.

Papachristou, H., Nederkoorn, C., Giesen, J. C. A. H., & Jansen, A. (2014). Cue reactivity during treatment, and not impulsivity, predicts an initial lapse after treatment in alcohol use disorders. *Addictive Behaviors, 39,* 737-739.

Poulos, C. X., & Hinson, R. E. (1984). A homeostatic model of Pavlovian conditioning: Tolerance to scopolamine-induced adipsia. *Journal of Experimental Psychology: Animal Behavior Processes, 10*(1), 75-89.

Powers, M. B., Halpern, J. M., Ferenshcak, M. P., Gillihan, S. J., & Foa, E. B. (2010). A meta-analytic review of prolonged exposure for Posttraumatic Stress Disorder. *Clinical Psychology Review, 30,* 635-641.

Ramos, B. M. C., Siegel, S., & Bueno, J. L. O. (2002). Occasion setting and drug tolerance. *Integrative Physiological & Behavioral Science, 37,* 165-177.

Ray, L. A., Chin, P. F., & Miotto, K. (2010). Naltrexone for the treatment of alcoholism: Clinical findings, mechanisms of action, and pharmacogenetics. *CNS and Neurological Disorders—Drug Targets, 9*(1), 13-22.

Rehm, J., Baliunas, D., Borges, G. L. G., Graham, K., Irving, H., Kehoe, T., … Taylor, B. (2010). The relation between different dimensions of alcohol consumption and burden of disease: An overview. *Addiction, 105*(5), 817-843.

Rescorla, R. A. (1988). Pavlovian conditioning: It's not what you think. *American Psychologist, 43,* 151-160.

Rescorla, R. A. (1980). Pavlovian Second-Order Conditioning (Psychology Revivals): Studies in Associative Learning. (1st ed. pp. 2). New York, New York: Psychology Press.

Rose, A. K., & Duka, T. (2006). Effects of dose and time on the ability of alcohol to prime social drinkers. *Behavioural Pharmacology, 17*(1), 61-70.

Saunders, J. B., Aasland, O. G., Babor, T. F., De la Fuente, J. R., & Grant, M. (1993). Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption‐II. *Addiction*, *88*(6), 791-804.

Siegel, S. (1976). Morphine analgesic tolerance: Its situation specificity supports a Pavlolvian conditioning model. *Science*, *193,* 323-325.

Siegel, S. (2005). Drug tolerance, drug addiction, and drug anticipation. *Current Directions in Psychological Science, 14*(6), 296-300.

Siegel, S., & MacRae, J. (1984). Environmental specificity of tolerance. *Trends in Neurosciences, 7*(5), 140-143.

Siegel, S., & Ramos, B. C. (2002). Applying laboratory research: Drug anticipation and the treatment of drug addiction. *Experimental and Clinical Psychopharmacology, 10,* 162-183.

Sobell, L. C., & Sobell, M. B. (1996). Timeline Followback user's guide: A calendar method for assessing alcohol and drug use. *Toronto: Addiction Research Foundation*.

Steiger, J. H., & Fouladi, R. T. (1992). R2: A computer program for interval estimation, power calculations, sample size estimation, and hypothesis testing in multiple regression. *Behavior Research Methods, 24*(4), 581-582.

Stewart, S. H., Zeitlin, S. B., & Samoluk, S. B. (1996). Examination of a three-dimensional drinking motives questionnaire in a young adult university student sample. *Behaviour Research and Therapy, 34*(1), 61-71.

Stockwell, T. R., Hodgson, R. J., & Taylor, R. C. (1982). Alcohol dependence, beliefs and the priming effect. *Behaviour Research and Therapy, 20*(5), 513-522.

Timko, C., Moos, R. F., Finney, J. W., & Lesar, M. D. (2000). Long-term outcomes of Alcohol Use Disorders: Comparing untreated individuals with those in Alcoholics Anonymous and formal treatment. *Journal of Studies on Alcohol and Other Drugs, 61*(4), 529-540.

Van Dyke, N., & Fillmore, M. T. (2015). Operant responding for alcohol following alcohol cue exposure in social drinkers. *Addictive Behaviors, 47,* 11-16.

Vollstädt-Klein, S., Loeber, S., Kirsch, M., Bach, P., Richter, A., Bühler, M., ..., Kiefer, F. (2011). Effects of cue-exposure treatment on neural cue reactivity in alcohol dependence: A randomized trial. *Biological Psychiatry, 69,* 1060-1066.

Volpicelli, J. R., O'Brien, C. P., Alterman, A. I., & Hayashida, M. (1990). Naltrexone and the treatment of alcohol-dependence: Initial observations. *Opioids, Bulimia, and Alcohol Abuse and Alcoholism,* 195-214.

White, H. R., & Labouvie, E. W. (1989). Towards the assessment of adolescent problem drinking. *Journal of Studies on Alcohol and Drugs, 50*(1), 30-37.

Witteman, J., Post, H., Tarvainen, M., Bruijn, A., Perna, E., Ramaekers, J. G., & Wiers, R. W. (2015). Cue reactivity and its relation to craving and relapse in alcohol dependence: A combine laboratory and field study. *Psychopharmacology, 232*(20), 3685-3696.

Zironi, I., Burattini, C., Aicardi, G., & Janak, P. H. (2006). Context is a trigger for relapse to alcohol. *Behavioural Brain Research, 167*(1), 150-155.

Table 1

Descriptive Statistics for the Sample

	AC	AN	P	Total
Including All Cases				
Age	21.00 (0.00)	21.33 (.65)	21.83 (.84)	21.36 (.72)
AUDIT	6.50 (3.09)	5.42 (2.35)	8.50 (4.96)	6.81 (3.76)
DMQ-social	8.67 (2.87)	9.67 (1.67)	8.25 (3.65)	8.86 (2.83)
DMQ-coping	11.09 (2.34)	10.33 (1.83)	13.30 (5.81)	11.48 (3.73)
DMQ-enhance	8.50 (2.39)	8.08 (1.68)	7.82 (2.40)	8.14 (2.13)
DMQ-conform	11.90 (2.47)	10.75 (2.22)	11.80 (2.74)	11.44 (2.45)
RAPI	4.67 (2.69)	2.58 (1.93)	5.33 (4.69)	4.03 (3.32)
TLFB	7.22 (5.89)	7.08 (4.62)	8.50 (5.63)	7.52 (5.15)
Excluding Outlier				
Age	21.00 (0.00)	21.18 (.41)	21.83 (.84)	21.31 (.68)
AUDIT	6.50 (3.09)	4.91 (1.64)	8.50 (4.96)	6.69 (3.75)
DMQ-social	8.67 (2.87)	9.55 (1.69)	8.25 (3.65)	8.80 (2.85)
DMQ-coping	11.09 (2.34)	10.36 (1.91)	13.30 (5.81)	11.53 (3.78)
DMQ-enhance	8.50 (2.39)	7.91 (1.64)	7.82 (2.40)	8.09 (2.14)
DMQ-conform	11.90 (2.47)	10.45 (2.07)	11.80 (2.74)	11.35 (2.44)
RAPI	4.67 (2.69)	2.36 (1.86)	5.33 (4.69)	4.00 (3.37)
TLFB	7.22 (5.89)	7.18 (4.83)	8.50 (5.63)	7.57 (5.24)

Note. Means and standard deviations [*M* (*SD*)] separated by condition.

Table 2

Primary Analysis: One-Way ANOVA Comparing Condition with Respect to MCP

	N	*M (SD)*	*F*	df	*p*	η^2
Including all cases			1.16	2, 33	.33	.07
AC	12	6.48 (2.90)				
AN	12	5.68 (4.23)				
P	12	4.46 (2.38)				
Total	36	5.53 (3.28)				
Excluding outlier			1.72	2, 32	.195	.10
AC	12	6.48 (2.90)				
AN	11	4.82 (3.20)				
P	12	4.46 (2.38)				
Total	35	5.26 (2.89)				

Note. A one-way ANOVA revealed no significant mean differences across condition with respect to MCP crossover point both when including and excluding the outlier. *$p < .05$.

Table 3

Power Statistics

	Power
Including All Cases	
BAC measured just prior to MCP	.84
Alcohol estimation	.82
AUDIT	.83
DMQ subscores	> .81
RAPI	.90
TLFB	.89
Gender	.88
Excluding Outlier	
BAC measured just prior to MCP	.76
AUDIT	.86
DMQ subscores	> .84
Gender	.87

Note. (Faul et al., 2009; Faul et al., 2007).

Table 4

One-Way ANOVA Results – Random Assignment Validity Checks

	M (SD)	*F*	df	*p*	η^2
AUDIT		2.22	2, 33	.13	.12
AC	6.50 (3.09)				
AN	5.42 (2.35)				
P	8.50 (4.96)				
Total	6.81 (3.76)				
DMQ—social		.78	2, 33	.47	.05
AC	8.67 (2.87)				
AN	9.67 (1.67)				
P	8.25 (3.64)				
Total	8.86 (2.83)				
DMQ—coping		1.92	2, 30	.17	.11
AC	11.09 (2.34)				
AN	10.33 (1.83)				
P	13.30 (5.81)				
Total	11.48 (3.73)				
DMQ—enhancement		.29	2, 30	.75	.02
AC	8.50 (2.39)				
AN	8.08 (1.68)				
P	7.82 (2.40)				
Total	8.14 (2.13)				
DMQ—conform		.75	2, 29	.48	.05
AC	11.90 (2.47)				
AN	10.75 (2.22)				
P	11.80 (2.74)				
Total	11.44 (2.45)				
RAPI		2.16	2, 27	.13	.14
AC	4.67 (2.69)				
AN	2.58 (1.93)				
P	5.33 (4.69)				
Total	4.03 (3.32)				
TLFB		.19	2, 26	.83	.01
AC	7.22 (5.87)				
AN	7.08 (4.62)				
P	8.50 (5.63)				
Total	7.52 (5.15)				

Note. Researchers conducted analyses including all cases to ensure random assignment balanced groups with respect to alcohol-related variables. *$p < .05$.

Table 5

One-Way ANOVA Results – Exploratory Analyses

	M (SD)	*F*	*df*	*p*	η^2
AUDIT		2.96	2, 32	.07	.16
AC	6.50 (3.09)				
AN	4.91 (1.64)				
P	8.50 (4.96)				
Total	6.69 (3.75)				
DMQ—social		.60	2, 32	.56	.04
AC	8.67 (2.87)				
AN	9.55 (1.69)				
P	8.25 (3.65)				
Total	8.80 (2.85)				
DMQ—coping		1.78	2, 29	.19	.11
AC	11.09 (2.34)				
AN	10.36 (1.91)				
P	13.30 (5.81)				
Total	11.53 (3.78)				
DMQ—enhancement		.36	2, 31	.72	.02
AC	8.50 (2.39)				
AN	7.91 (1.64)				
P	7.82 (2.40)				
Total	8.09 (2.14)				
DMQ—conform		1.18	2, 28	.32	.08
AC	11.90 (2.47)				
AN	10.45 (2.07)				
P	11.80 (2.74)				
Total	11.35 (2.44)				
RAPI		2.39	2, 26	.11	.16
AC	4.67 (2.69)				
AN	2.36 (1.86)				
P	5.33 (4.69)				
Total	4.00 (3.37)				
TLFB		.17	2, 25	.85	.01
AC	7.22 (5.87)				
AN	7.18 (4.83)				
P	8.50 (5.63)				
Total	7.57 (5.24)				

Note. Researchers conducted analyses excluding the outlying case to ensure random assignment balanced groups with respect to alcohol-related variables. *$p < .05$.

Table 6

Placebo Validity Checks

	M (SD)	*F*	df	*p*	η^2
Including All Cases					
Alcohol Estimation		.74	2, 33	.48	.04
AC	1.75 (.54)				
AN	1.54 (.45)				
P	1.34 (1.24)				
Total	1.54 (.82)				
BAC Estimation		1.49	2, 32	.24	.08
AC	.10 (.19)				
AN	.05 (.02)				
P	.03 (.01)				
Total	.06 (.11)				
Excluding Outlier					
Alcohol Estimation		.74	2, 32	.49	.04
AC	1.75 (.54)				
AN	1.59 (.44)				
P	1.34 (1.24)				
Total	1.56 (.82)				
BAC Estimation		1.41	2, 31	.26	.08
AC	.10 (.19)				
AN	.05 (.02)				
P	.03 (.01)				
Total	.06 (.11)				

Note. A one-way ANOVA revealed no significant mean differences across condition with respect to alcohol estimation or BAC estimation. *$p < .05$.

Table 7

Gender Differences with Respect to Exploratory Variables

	M (SD)	*t*	df	*p*	*d*
BAC before MCP		-.80	34	.43	< .001
Men	.01 (.01)				
Women	.01 (.01)				
AUDIT		2.40	12.65	.03*	1.12
Men	9.36 (4.80)				
Women	5.68 (2.59)				
DMQ—social		-.57	34	.58	.21
Men	8.45 (3.86)				
Women	9.04 (2.32)				
DMQ—coping		.69	31	.50	.27
Men	12.22 (6.20)				
Women	11.21 (2.40)				
DMQ—enhancement		-1.70	33	.10	.66
Men	7.20 (1.55)				
Women	8.52 (2.24)				
DMQ—conform		.17	30	.87	.07
Men	11.56 (3.09)				
Women	11.39 (2.23)				
RAPI		-.675	28	.51	.31
Men	3.29 (2.43)				
Women	4.26 (3.56)				
TLFB		-.05	27	.96	.02
Men	7.43 (6.29)				
Women	7.55 (4.91)				
Alcohol Crossover		.48	34	.64	.18
Men	5.93 (4.00)				
Women	5.36 (2.99)				

Note. Independent t-test results analyzed with all cases. n_{men} = 11; n_{women} = 25. *p < .05.

Table 8

Gender Differences with Respect to Exploratory Variables

	M (SD)	*t*	df	*p*	*d*
BAC before MCP		-1.35	33	.19	< .001
Men	.01 (.01)				
Women	.01 (.01)				
AUDIT		2.10	10.97	.06	1.05
Men	9.20 (5.03)				
Women	5.68 (2.60)				
DMQ—social		-.78	33	.06	.31
Men	8.20 (3.97)				
Women	9.05 (2.32)				
DMQ—coping		.83	30	.41	.33
Men	12.50 (6.57)				
Women	11.21 (2.40)				
DMQ—conform		-.139	29	.89	.06
Men	11.25 (3.15)				
Women	11.39 (2.23)				
DMQ—enhancement		2.65	25.35	.01*	.82
Men	6.89 (1.27)				
Women	8.52 (2.24)				
RAPI		-.81	27	.42	.39
Men	3.00 (2.53)				
Women	4.26 (3.56)				
TLFB		.05	26	.96	.02
Men	7.67 (6.86)				
Women	7.54 (4.91)				
Alcohol Crossover		-.31	33	.76	.12
Men	5.02 (2.78)				
Women	5.36 (2.99)				

Note. Independent t-test results analyzed excluding outlying case. n_{men} = 10; n_{women} = 25. *p < .05.

Table 9

One-Way ANOVAs– Comparing Condition with Respect to Covariates

	F	df	*p*	η^2
Dependent Variable				
All Cases				
Alcohol Estimation	.74	2, 33	.49	.04
RAPI	2.16	2, 27	.13	.14
TLFB	.19	2, 26	.83	.01
Excluding Outlier				
Alcohol Estimation	.74	2, 32	.49	.04
RAPI	2.39	2, 26	.11	.16
TLFB	.17	2, 25	.85	.01

Note. Analyses revealed condition was not statistically significantly related to any of the individual predictors (alcohol estimation, RAPI, or TLFB). *$p < .05$.

Table 10

Hierarchical Multiple Regression Analyses with Covariates

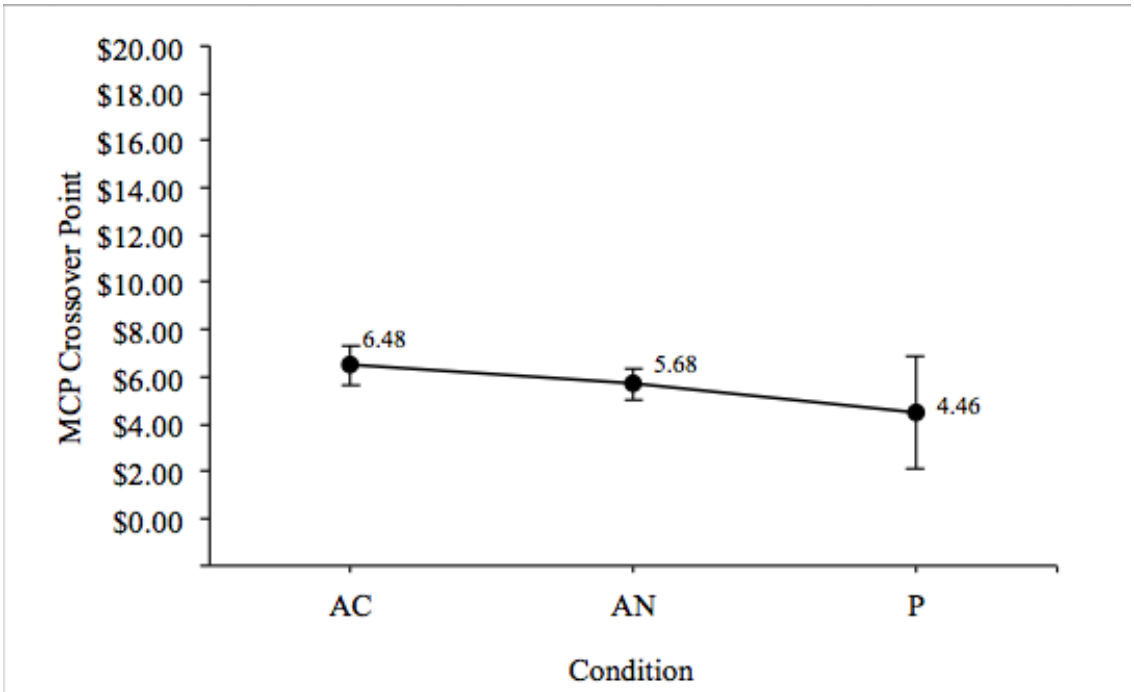
	R^2	CI 95%	R^2_{Δ}
Analysis 1			
Step 1: Alcohol Estimation	.00	---------	.00
Step 2: Condition	.10	[.00, .33]	.10
Step 3: Interaction	.30*	[.03, .55]	.20*
Analysis 2			
Step 1: RAPI	.01	[.00, .11]	.01
Step 2: Condition	.26	[.01, .51]	.25*
Step 3: Interaction	.30	[.03, .55]	.04
Analysis 3			
Step 1: TLFB	.03	[.00, .19]	.03
Step 2: Condition	.26	[.01, .51]	.23*
Step 3: Interaction	.32	[.04, .56]	.06

Note. R^2 confidence intervals obtained via R2 program (Steiger & Fouladi, 1992). Regression analyses conducted excluding the outlier. *$p < .05$.

Figure 1. MCP crossover as a function of study condition (including all cases).

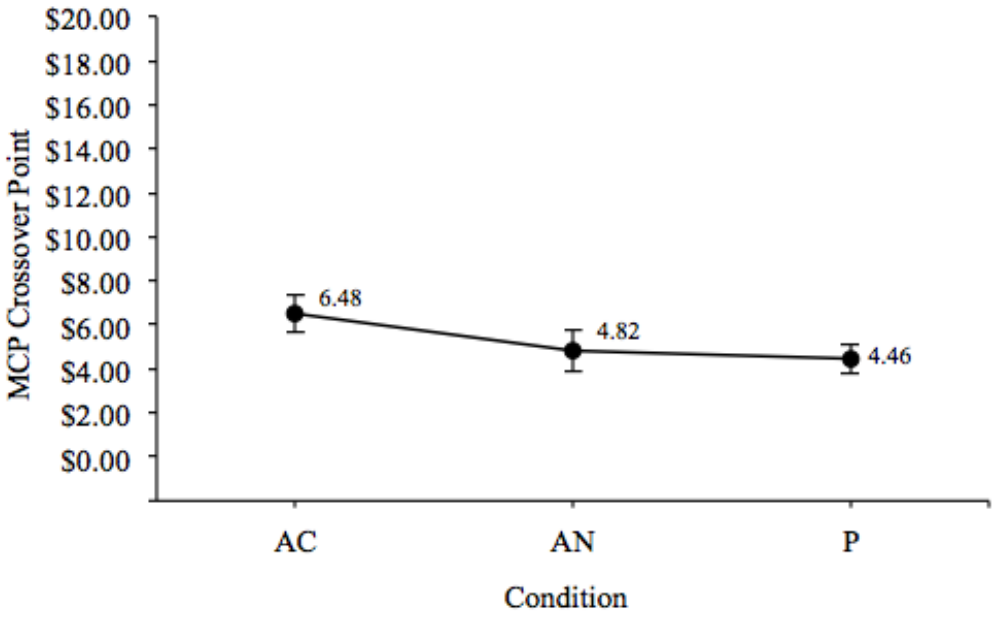
Figure 2. MCP crossover point as a function of study condition (excluding outlier).

Figure 1.



Note. A one-way between-subjects ANOVA revealed no statistically significant mean differences across conditions with respect to MCP crossover point (including all cases). Group means are indicated on the figure. Error bars represent standard error of the mean.

Figure 2.



Note. A one-way between-subjects ANOVA revealed no statistically significant mean differences across conditions with respect to MCP crossover point (analysis excluded outlier in AN condition). Group means are indicated on the figure. Error bars represent standard error of the mean.

Appendix A

Instructions for the Multiple Choice Procedure—Survey Version

This procedure has been designed to measure your relative preferences for substances and money. The procedure includes 45 different choices.

When completing the form, imagine that you are in a setting where you most often enjoy the different substances, such as a party, a bar or restaurant, or at home. For each choice, you will indicate your preference by highlighting either the substance option or the Money option. For example (see below), which you would rather have: the amount of alcohol listed, or the amount of money?

Although these are just hypothetical choices, please do your best to imagine you were making actual choices. Two examples are provided below:

Participant #1			Participant #2		
Choice	Alcohol	Money	Choice	Alcohol	Money
1	~~1 can of beer~~	$1	1	~~1 can of beer~~	$1
2	~~1 can of beer~~	$2	2	~~1 can of beer~~	$2
3	~~1 can of beer~~	$3	3	~~1 can of beer~~	$3
4	~~1 can of beer~~	$4	4	~~1 can of beer~~	$4
5	1 can of beer	~~$5~~	5	~~1 can of beer~~	$5
6	1 can of beer	~~$6~~	6	~~1 can of beer~~	$6
7	1 can of beer	~~$7~~	7	~~1 can of beer~~	$7
8	1 can of beer	~~$8~~	8	~~1 can of beer~~	$8
9	1 can of beer	~~$9~~	9	1 can of beer	~~$9~~
10	1 can of beer	~~$10~~	10	1 can of beer	~~$10~~

In these examples, Participant #1 chose Alcohol on choices 1 through 4, indicating that they would rather receive 1 can of beer to drink than receive $1, $2, $3, or $4. However, participant #1 would rather receive $5-$10 than a can of beer. Participant #2 displayed a stronger preference for alcohol, choosing a can of beer over $1-$8 dollars. Participant would rather have $9 or $10 over the can of beer.

Like the examples presented above, you should continue to choose alcohol until you reach the amount of money that you would rather have. Once you reach the dollar amount that you would chose over alcohol, you should continue to choose money until you reach the end of that form.

After you have made all of your choices, you will be given the opportunity to draw randomly one of your choices and you will receive whichever choice you draw. For example, if you draw out Form A choice number 8 then you will receive whatever you chose for Form A choice number 8—if you chose money you will receive $1.75 and you if you chose a drink then you will receive a drink (beer, or liquor with a mixer of choice).

Multiple Choice Form A

Listed below are 45 different choices. For each choice, please indicate your preference by circling either the Alcohol option or the Money option. Keep in mind that a standard can or bottle of beer contains 12 ounces, a standard serving of liquor is 1 ounce, and a standard glass of wine is 5 ounces. Remember, we will randomly draw one of the choices below and give you what you indicated you prefer.

Choice #	Alcohol	Money
1	1 standard drink	$0.00 received immediately
2	1 standard drink	$0.25 received immediately
3	1 standard drink	$0.50 received immediately
4	1 standard drink	$0.75 received immediately
5	1 standard drink	$1.00 received immediately
6	1 standard drink	$1.25 received immediately
7	1 standard drink	$1.50 received immediately
8	1 standard drink	$1.75 received immediately
9	1 standard drink	$2.00 received immediately
10	1 standard drink	$2.50 received immediately
11	1 standard drink	$3.00 received immediately
12	1 standard drink	$3.50 received immediately
13	1 standard drink	$4.00 received immediately
14	1 standard drink	$4.50 received immediately
15	1 standard drink	$5.00 received immediately
16	1 standard drink	$5.50 received immediately
17	1 standard drink	$6.00 received immediately
18	1 standard drink	$6.50 received immediately
19	1 standard drink	$7.00 received immediately
20	1 standard drink	$7.50 received immediately
21	1 standard drink	$8.00 received immediately
22	1 standard drink	$8.50 received immediately
23	1 standard drink	$9.00 received immediately
24	1 standard drink	$9.50 received immediately
25	1 standard drink	$10.00 received immediately
26	1 standard drink	$10.50 received immediately
27	1 standard drink	$11.00 received immediately
28	1 standard drink	$11.50 received immediately
29	1 standard drink	$12.00 received immediately
30	1 standard drink	$12.50 received immediately
31	1 standard drink	$13.00 received immediately
32	1 standard drink	$13.50 received immediately
33	1 standard drink	$14.00 received immediately
34	1 standard drink	$14.50 received immediately
35	1 standard drink	$15.00 received immediately
36	1 standard drink	$15.50 received immediately
37	1 standard drink	$16.00 received immediately
38	1 standard drink	$16.50 received immediately
39	1 standard drink	$17.00 received immediately
40	1 standard drink	$17.50 received immediately
41	1 standard drink	$18.00 received immediately
42	1 standard drink	$18.50 received immediately
43	1 standard drink	$19.00 received immediately
44	1 standard drink	$19.50 received immediately
45	1 standard drink	$20.00 received immediately

Appendix B

Data Record Form

Participant #: _____

RAs – please sign below

RA 1 (beverage): _____

Session Date: _____

RA 2 (Blind; MCP): _____

Condition: _____

Weight: _____

Alcohol Amount: _____

Start time: _____

Beginning BAC: _____ Beginning CO: _____

1st BAC Check (5 mins into Friends): _____ Time: _____
2nd BAC Check (10 mins into Friends): _____ Time: _____
3rd BAC Check (15 mins into Friends): _____ Time: _____
4th BAC Check (end of Friends episode): _____ Time: _____

This is when RA2 will blindly administer the MCP

MCP Choice #: _____ Choice: _____

Now BAC checks should be every 30 minutes

5th BAC Check (30 mins from #4): _____ Time: _____
6th BAC Check: _____ Time: _____
7th BAC Check: _____ Time: _____
8th BAC Check: _____ Time: _____
9th BAC Check: _____ Time: _____
End: 10th BAC Check: _____ Time: _____

End Time: _____
Notes: