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Can Cognitive Priming Influence the Reinforcing Efficacy of Alcohol within a Behavioral Economic Framework?

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by

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ABSTRACT

A considerable body of research supports the application of behavioral economic principles to study the relative reinforcing efficacy of drug and alcohol use. One self-report measure, the Alcohol Purchase Task, is thought to account for individual differences in the subjective valuation of alcohol consumption. To date, however, behavioral economic approaches have not evaluated the possible influence of memory-based expectations regarding the cognitive and behavioral effects of substance use on their measures. Alcohol expectancy research has found that more positive expectancies about the effects alcohol directly mediate drinking behavior and are associated with a number of alcohol-related outcomes. Given the importance of alcohol expectancies, the current study incorporated cognitive priming techniques into the Alcohol Purchase Task instruction set to test whether the activation of alcohol expectancy primes influenced patterns of alcohol consumption. Although previous research has primarily used the Alcohol Purchase Task in samples of heavy drinkers, we also examined differences between heavier and lighter drinkers to test whether expectancy primes would differentially influence alcohol demand. As expected, both heavier and lighter drinkers in the expectancy priming conditions purchased more alcohol overall relative to those in a non-primed condition. Results also suggest the positive-social expectancy content in the Alcohol Purchase Task increased the overall demand for alcohol relative to a modified Alcohol Purchase Task with no contextual primes, even after controlling for alcohol

consumption. Although previous behavioral economic research has examined alcohol expectancies as a secondary outcome, the current study is the first to directly examine the influence of expectancies on alcohol demand using the Alcohol Purchase Task.

CHAPTER ONE:

INTRODUCTION

An extensive line of research has supported the utility of behavioral economics approaches to examine the reinforcing efficacy of substance use in a laboratory-based setting (Bickel et al., 1990; Bickel, DeGrandpre, & Higgins, 1993; Hursh, 1993). Similar to classical economic theories of consumer decisions, behavioral economics studies decision-making given various levels of constraint on commodities. The field of behavioral economics emerged as a hybrid of operant psychology and microeconomics and relies heavily upon economic principles of demand. Behavioral economic theories have provided a novel approach to understand and predict how organisms distribute valuable resources (e.g., money and time) to obtain various reinforcers such as food, drugs, and alcohol (Soto, Grandy, Hursh, & Katz, 2011; Bickel, DeGrandpre, Higgins, Hughes, & Badger, 1995; Petry & Bickel, 1998; MacKillop & Murphy, 2007). Paradigms derived from these theories have sought to account for fundamental behavioral aspects of addiction, including impulsive decision-making and a loss of control over substance use by using behavioral economic paradigms (Bickel, Madden, & Petry, 1998).

Generally, behavioral economic measures of drug use are designed as hypothetical purchase tasks that examine how increasing prices of a given drug affects an individual's decision to use a drug relative to alternative reinforcers. Given that this area of research strongly adheres to principles of operant psychology and economics, the behavioral economic accounts of substance use are structured such that they do not account for important cognitive processes

underlying the decision to use drugs or alcohol. One important aspect underlying the decision-making process to consume alcohol is a cognitive factor known as expectancy. A considerable amount of research has supported the notion that alcohol-related behaviors are driven by the subjective expectations regarding the effects of alcohol consumption. Several research perspectives suggest that alcohol expectancies mediate the cognitive and behavioral aspects associated with alcohol use and alcohol-related outcomes in both clinical and non-clinical samples of drinkers (Brown Goldman, Inn, & Anderson, 1980; Rather & Goldman, 1994) and that specific domains of expectancies can be activated using cognitive priming techniques that have increased the amount of drinking in an ad-lib consumption paradigm (Roehrich & Goldman, 1995; Hicks et al., 2009).

To date, behavioral economic approaches have not directly addressed the impact of alcohol expectancies that are fundamental to alcohol consumption. That is, behavioral economics is largely ignoring a major component of substance use that is widely supported in expectancy literature. To that end, we extended the behavioral economic literature by linking the cognitive accounts of substance use with the operant approaches of drug- and alcohol-based behavioral economic frameworks. The purpose of the present study was to extend current behavioral economic accounts of substance use by testing whether the activation of alcohol-related expectancies via cognitive priming will increase consumption patterns on a hypothetical purchase task. One such behavioral economic task, the Alcohol Purchase Task (APT), was developed to examine individual differences in the subjective valuation for alcohol and to predict future drinking patterns in at-risk samples of college students (Murphy & MacKillop, 2006). In the original task designed by Murphy and MacKillop (2006), the APT uses a hypothetical scenario that includes inherent positive and social expectancy primes within the instruction set

(e.g., going to a bar with friends) and participants are to report how many drinks they would consume at an increasing range of prices. The present study will use the behavioral economic framework provided by the APT and incorporate a cognitive priming approach to determine the extent to which the embedded expectancies influence the responses on this and other hypothetical drug purchase tasks. The results of the current study will hopefully extend the behavioral economic accounts of substance use by incorporating cognitive-behavioral principles, such as cognitive priming techniques, to these operant measures. To that end, three levels of cognitive priming will be embedded within the APT instruction set to examine potential expectancy activation: a non-primed condition with expectancy content removed, the original APT condition, and an enhanced expectancy priming condition in which the hypothetical scenario from the original APT will be modified by adding alcohol expectancy words.

Subsequent sections will discuss behavioral economic theory in the context of substance use, as well as the relative reinforcing efficacy (RRE) of substance use and the specific demand indices generated by laboratory-based measures of RRE. Alcohol expectancy theory will also be discussed, particularly in the context of how this area of research can extend the behavioral economic framework of substance use to account for the role of alcohol-related cognition in mediating drinking behavior. The primary goals and hypotheses of the current study will also be discussed. Finally, information regarding the methodology and proposed data analyses will be discussed for the current study.

Behavioral Economic Theory

Behavioral economics emerged as a hybrid area of study based on principles of operant psychology and microeconomics. Operant psychology refers to the aspects of learning that are influenced by both the rewarding and punishing outcomes of behavior and serves as the

foundation of behavioral economic theory. The field of economics refers to the effects of fiscal constraint on the consumption of a good as demand. The law of demand states that an inverse relationship exists between price and the consumption of commodities: as the price for a commodity increases, the consumption of that commodity decreases. Additionally, behavioral economic theory predicts higher rates of substance use when a given price is relatively inexpensive or free. Individually plotting the consumption of a good as a function of price generates what are known as demand curves. Behavioral economics examines various conditions that influence the consumption of a commodity such as alcohol. Ample evidence supports applying principles of behavioral economics to examine current drug use and reliably predict future consumption patterns. Previous research has supported the utility of behavioral economic measures that generate demand curves to reliably account for the reinforcing efficacy of drug and alcohol use in both animal and human models (Nader & Woolverton, 1991; Hursh, 1993; Bickel, DeGrandpre, & Higgins, 1993; Murphy & MacKillop, 2006). Demand curves have also successfully supported the behavioral economic predictions of substance use by illustrating that higher levels of reinforcement from drugs and alcohol result in a tendency to pay higher prices to obtain these substances.

For example, Petry and Bickel (1998) tested whether behavioral economic indices of demand could account for different aspects of substance use by using fiscal constraints on the availability of drugs or alternative reinforcers. Their sample consisted of detoxified opioid addicts in an outpatient treatment program. Experimenters provided the participants with a scenario involving hypothetical money to buy various drugs at different prices. The results showed that the participants were more willing to pay higher prices for their drug of choice (heroin) than other available drugs at lower prices, such as marijuana or alcohol. The resulting

demand curves illustrated that increasing prices for heroin were associated with an increase in participants' purchases for less expensive drug alternatives and a decrease in heroin purchases. Their research has supported the value of applying behavioral economics to substance by providing new independent variables, methods of analysis, and dependent measures (Bickel, DeGrandpre, & Higgins, 1993); which, in turn, permit better understanding of the clinical phenomena of drug use (Bickel, Green, & Vuchinich, 1995). Additionally, this line of research has provided evidence for applying principles of behavioral economics to the study of naturalistic drug use in order to understand varying conditions that reduce the consumption of a drug.

Experimental Measures of Reinforcing Efficacy

Griffiths, Brady, and Snell (1978) defined reinforcing efficacy (RE) as the behavioral strengthening and maintaining properties of a drug relative to nondrug alternative reinforcers that can arise in a range of experimental conditions. Recent research has pioneered the development of an experimental measure of drug and alcohol demand. Specifically, these measures examine RE as a function of substance use when constrained by increasing prices (Bickel, Madden, & Petry, 1998; Jacobs & Bickel, 1999; Bickel & Madden, 1999; Murphy & MacKillop, 2006). These measures have successfully captured the phenomenon of individual differences in the subjective valuation of and craving for drug and alcohol use.

Laboratory-based self-reported measures of RE are comprised of several demand parameters associated with reinforcement that can be individually plotted to produce demand curves. These parameters include: the first price at which consumption of alcohol is zero (breakpoint), the maximum amount of money spent on alcoholic beverages (O_{max}), the mean price per drink at the highest expenditure level (P_{max}), total alcohol consumption when drinks are

offered at the lowest price (intensity), and the rate of decline in consumption as a function of price (elasticity). Elasticity of demand can be estimated using the following equation:

$$\log_{10}Q=\log_{10}Q_0+k(e^{-\alpha Q0C}-1)$$

In this equation, Q = consumption at a given price; Q_0=consumption when price is zero; k = α constant across individuals that denotes the range of consumption values in log powers of ten (a constant of 1 in this case); C = price; and α = the derived demand parameter reflecting the standardized deceleration of consumption. Larger values reflect a greater sensitivity to increasing drink prices. The Hursh and Silberberg (2008) equation of estimated elasticity can be fit according to the guidelines using the calculator provided on the Institute for Behavioral Resources website (www.ibrinc.org/centers/bec/BEC_demand.html).

Demand curves illustrate the demand-reward relationship of drug and alcohol use and are generated when these demand indices are plotted as a function of price. In addition, demand curves have provided a reliable approach to analyzing various contextual effects of drug self-administration procedures (Vuchinich & Simpson, 1998). Following the procedures used by Petry and Bickel (1998), researchers have developed time- and cost-effective laboratory-based self-report measures designed to address the logistical issues of modeling experimental paradigms of drug self-administration by using a hypothetical purchase task (Jacobs & Bickel, 1999; Murphy & MacKillop, 2006). More recently, a behavioral economic purchase task was developed to study the relationship of reinforcing efficacy of drinking that is associated with alcohol use and alcohol-related outcomes (2006). This new measure, known as the Alcohol Purchase Task, specifically measures demand for alcohol by examining how the function of economic constraint (price) affects the decision-making process underlying an individual's choice to drink as amount of alcohol to consume. Participants are initially provided a specific

drinking scenario, generally an outing with friends at a local bar, and are then asked how many standard drinks they would purchase at an increasing range of prices. The consumption values provided by the participants are used to generate total expenditure values for a given price level. Previous studies using this hypothetical purchase task have shown that this measure successfully captures clinical phenomena related to heavy, sustained alcohol use and is able to predict rates of future alcohol consumption (MacKillop & Murphy, 2007; Murphy et al., 2009).

Murphy and MacKillop (2006) specifically examined RRE via demand curves in the context of alcohol consumption. A sample of a wide-range of light and heavy drinking college undergraduates were presented with a hypothetical scenario involving alcohol purchases in the context of a typical alcohol-related setting. The hypothetical scenario involved a night in which participants were to imagine going to a bar with friends to see a band. Following the scenario and standard size beverage options (e.g., beer, wine, mixed drinks, or shots), participants responded to the question "How many drinks would you consume if they were _____ each?" at 14 incremental prices ranging from zero (free) up to $9.00. Responses on the APT generated demand indices that were plotted as demand curves. Their results found that heavier drinkers (defined as respondents meeting binge criteria on at least one occasion per week) were comparatively less sensitive to increasing prices and were willing to consume significantly larger amounts of alcohol than the lighter drinkers (defined as those respondents not meeting binge criteria on a weekly basis). In the same sample, heavier drinkers had significantly higher RRE for alcohol (specifically breakpoint, intensity, and O_{max} values) compared to the same demand indices of lighter drinkers. Previous research has found inherent correlations among the demand indices generated from the APT. Despite the inherent correlations among these demand indices, studies have supported the notion that these indices reveal various aspects of reinforcement,

including the subjective valuation and craving for alcohol (MacKillop et al., 2009; MacKillop et al., 2010). Several replication studies have supported the APT as a reliable measure of the reinforcing efficacy in determining future patterns of alcohol consumption in samples of heavy drinkers (MacKillop & Murphy, 2007; MacKillop et al., 2009; Hitsman et al., 2008; Herschl et al., 2012). These same studies have also supported the utility of the APT as a reliable measure to examine individual differences in the demand for alcohol as well as its novel ability to predict future alcohol consumption. A recent study by Amlung et al. (2012) compared the results from hypothetical outcomes to actual rewards using the APT in a sample of heavy drinkers. Specifically, they compared hypothetical and actual reward outcomes in terms of the decision-making process to drink as well as the behavior following participants' choices. Tangible reward outcomes were presented in the form of a bar tab involving actual money in a laboratory-based bar setting. Participants were instructed that they could either keep all of the money or use it to purchase alcohol. The results supported the notion that the resulting demand curves from hypothetical outcomes would be comparatively similar to that of real monetary outcomes. This study provided evidence for the ecological validity of the APT using outcomes related to real-world alcohol-related expenditures.

Alcohol Expectancy Theory

A considerable amount of research has supported the notion that alcohol-related behavior is driven by the subjective expectations regarding the effects of alcohol consumption. Alcohol Expectancy Theory posits that these alcohol-related expectations are stored as memories that can influence future behavior, consumption, and outcomes in upcoming situations involving alcohol use (Christiansen, Smith, Roehling, & Goldman, 1989). Alcohol expectancies refer to the memories that are formed based on an individual's previous experiences regarding the cognitive

and behavioral changes that are associated with alcohol consumption (Brown, Goldman, & Christiansen, 1985). Research has shown that alcohol expectancies can manifest prior to the initiation of alcohol use and as young as preschool aged children via cultural influences as well as parental modeling (Miller, Smith, & Goldman, 1990; Greenberg, Zucker, & Noll, 1985; Noll & Zucker, 1983). Previous research has shown that individuals who believe they have consumed alcohol will behave in accordance with their expectations of the effects of alcohol use, even in placebo paradigms (Donovan & Marlatt, 1980). Other research has found that alcohol expectancies also serve as mediators in an implicit decision-making process underlying alcohol consumption (Brown, Christiansen, & Goldman, 1987; Goldman, Darkes, Reich, & Brandon, 2006).

The process by which alcohol expectancies influence future drinking has been conceptualized, in part, as an automatic process falling outside of conscious awareness (Goldman, Del Boca, & Darkes, 1999). That is, alcohol-related memory networks are thought to directly influence alcohol consumption and alcohol-related outcomes (Rather & Goldman, 1994). Previous studies have explored this automatic process by modeling alcohol expectancies as long-term semantic memory networks resulting from previous direct or vicarious exposure to alcohol (Christiansen et al., 1989; Goldman, Brown, Christiansen, & Smith, 1991), while other studies have used alcohol-related cues to demonstrate that alcohol outcome expectancies can be implicitly activated outside of conscious thought (Stacy, 1997; Goldman, 1999). A recent meta-analysis of implicit and explicit alcohol expectancy measures suggests that examining more implicit expectancy processes (i.e., contextual decision-making that falls outside of conscious awareness) is of considerable utility and has provided an enhanced understanding of the underlying influence that cognition, behavior, and affect have on memory networks (Reich,

Below, & Goldman, 2010). A study by Reich and Goldman (2005) used an empirically supported free associate task (see Nelson, McEvoy, & Dennis, 2000) to evaluate the alcohol expectancy memory network and examine both implicit and explicit alcohol-related cognitive processes. The free associates task provides an open-ended response style to the sentence, "Alcohol makes me _____." This study recruited approximately 5000 college freshman over the course of three years. The findings of this study revealed differential alcohol expectancies among varying types of drinkers. For example, heavier drinkers were more likely to report positive effects of alcohol relative to lighter drinkers. Additionally, Rather & Goldman (1994) used multidimensional scaling (MDS) to demonstrate that heavier drinkers tend to have stronger associative memory networks for the positive effects of alcohol, while lighter drinkers have weaker memory associations between drinking and positive alcohol-related outcomes. These previous experiences that are associated with alcohol-related outcomes can be conceptualized as encoded information nodes in these associative memory networks. Overall, these theoretical models are consistent with the idea that drinking behavior is partly mediated by expectancy-related nodes that are automatically activated when an individual enters a drinking scenario that is contextually similar to that of a previously encountered alcohol-related circumstance, particularly if prior alcohol experiences are generally positive.

Previous research has demonstrated that contextual influences and the actual physiological effects of alcohol use reinforce early expectations about alcohol-related behaviors and outcomes, while sustained patterns of drinking depend on one's expectancies being confirmed or invalidated (Goldman, 2002; Oei, Fergusson, & Lee, 1998). The initiation of a drinking episode is partly influenced by the expectancies of the desirable effects (e.g., enhanced sociability or relief of negative affect) that alcohol will have in a given context. Positive alcohol

expectancies – expecting positive physiological and/or affective effects from drinking – play an influential role in alcohol-related behavior and outcomes (Brown, Goldman, Inn, & Anderson, 1980; Cooper et al., 1992; Brown et al., 1987; Palfai & Wood, 2001). That is, the initiation of a drinking episode is partly influenced by the expectancies of the desirable effects (e.g., enhanced sociability or relief of negative affect) that alcohol will have in a given context. For example, Sher and colleagues (1996) found that positive alcohol expectancies are associated with alcohol-related problems and heavy drinking, as well as the amount and frequency of alcohol use. Marlatt and George (1984) hypothesized that eliciting these positive expectancies, in conjunction with wanting to obtain the associated positive outcomes, can provide a motivational framework for the initiation of alcohol use and the amount of alcohol consumed.

To date, no behavioral economic studies have implemented an experimental paradigm to directly examine the influence of alcohol expectancies on the outcomes of behavioral economic measurement efforts. Only one cross-sectional study has examined behavioral motivations to consume alcohol using an alcohol purchase task. While alcohol expectancies and motivations are not synonymous, they are related: self-reported motivation to drink is informed by outcome expectancies. One study by Yurasek and colleagues (2011) used the APT to examine the mediational role of drinking motives (e.g., behavioral enhancement, relief of negative affect, etc). This study provided an approach similar to that of alcohol expectancy research by examining specific effects people have attributed to alcohol consumption based on their previous drinking experiences. This study used a reliable behavioral economic curve-fitting approach to create a sample of college students that reported patterns of heavier drinking within the past month. The resulting demand curves generated from the APT were compared to participants' responses on a questionnaire that assessed drinking motives as well as a questionnaire examining

alcohol-related consequences (e.g., driving a car while inebriated). The results suggested that behavioral economic principles are useful for observing the influence of self-reported motivation on drug-related behaviors and outcomes. One limitation of this study is that it provided correlational evidence for the mediational role of drinking motives associated with the reinforcing efficacy of alcohol use within a sample of heavy drinkers. As such, this line of research could be extended by using an experimental manipulation process with cognitive priming techniques to prime alcohol expectancies within the APT.

Alcohol Expectancies and Cognitive Priming Techniques

Implicit priming is said to occur when responses on a measure are facilitated by previous experiences/stimuli without conscious recollection (Schacter, 1987). In the alcohol expectancy literature, it has been demonstrated that different implicit priming techniques can influence alcohol expectancy activation. For example, Roehrich & Goldman (1995) used two types of implicit primes to influence alcohol expectancy activation and thereby increase future alcohol consumption. Participants were randomly assigned to watch one of two videotaped alcohol-related primes depicting bar settings (*Cheers* or *Newhart*). Following the *Cheers* or *Newhart* condition, the second priming technique presented participants with a modified Stroop task containing specific words: alcohol expectancy words or neutral words. Finally, participants were taken to a room designed to appear as an actual bar setting to take part in a taste-rating task for non-alcoholic beer (the participants were unaware that the beer contained no alcohol). The highest level of beer consumption resulted from the *Cheers*-alcohol expectancy word condition, followed by the *Cheers*-neutral, *Newhart*-expectancy, and *Newhart*-neutral conditions; these results suggested, therefore, that priming effects were operating for both the videotaped and expectancy word primes.

Another study by Friedman et al. (2009) assessed participants on three specific domains of positive alcohol expectancies using the Alcohol Expectancy Questionnaire (Brown, Christiansen, & Goldman, 1987): sexual enhancement, social assertiveness, and relaxation. Participants were then tested a week later using similar procedures to that of Roehrich and Goldman (1995). The Stroop task was designed such that it specifically used social expectancy words to increase the activation of sociability expectancies in an ad-lib alcohol consumption task. Following a taste-rating task, Friedman and colleagues found a two-way interaction between the prime (sociability vs. neutral) and the amount consumed in an ad-lib consumption task. They concluded that the priming of specific expectancies could elicit higher levels of drinking among those participants holding those expectancy-related beliefs. Other lines of research have also demonstrated that implicitly priming positive alcohol expectancies can influence alcohol consumption (Chenier & Goldman, 1992; Stein, Goldman, & Del Boca, 2000).

CHAPTER TWO:

PRESENT STUDY

Of particular relevance to the current study, the behavioral economic frameworks of substance use are based on principles of operant psychology that largely ignore the important underlying cognitive aspects of drug and alcohol-related behavior. One way to extend this line of research may be done by integrating cognitive priming techniques within a behavioral economic framework to examine the influence of expectancy activation upon the reinforcing efficacy of alcohol use in a hypothetical purchase task. Previous behavioral economic accounts of alcohol use have generally used behavioral economic principles to inform potential treatment approaches for problematic drinkers and to examine treatment outcomes. To that end, this line of research has shown that behavioral economic measures of RE are associated with alcohol-related problems and treatment response among heavy drinking college students (Murphy & MacKillop, 2006; MacKillop & Murphy, 2007; MacKillop et al., 2010; Herschl et al., 2011). In addition, the original instruction set of the APT provides participants with a hypothetical drinking scenario that includes both a positive and social context associated with alcohol-related behavior and outcomes (i.e., going to a bar at night with friends to see a band). The influence of this inherently positive and social alcohol-related scenario had not been assessed within the general instruction set of the APT. Given the breadth of research supporting the influential role of alcohol expectancies on alcohol-related behavior and outcomes, it would be useful to incorporate cognitive primes into the operant framework of the behavioral economic purchase tasks by

embedding differential alcohol expectancy primes within the hypothetical scenario provided in the APT. Additionally, we tested whether varying levels of expectancy priming can influence the demand indices generated from this task.

The goal of the current study was to examine whether merging principles of cognitive-behavioral processes can enhance existing behavioral economic accounts of substance use. Specifically, cognitive priming techniques were implemented within a behavioral economic framework to test whether the activation of alcohol expectancy primes would increase alcohol consumption rates that reflected as demand indices generated from a hypothetical purchase task. To that end, this study incorporated varying levels of alcohol expectancy primes into three separate instruction sets of the APT. The three expectancy priming conditions included a Non-primed instruction set, the Original APT instruction set designed by Murphy & MacKillop (2006), and an Enhanced expectancy priming instruction set. In the Non-primed instruction set, all positive and social alcohol-related expectancies in the hypothetical scenario were removed such that the effects of cognitive priming would not influence participants' responses. The second priming condition was implemented as a replication of the task used by Murphy and MacKillop in their original study (2006). The Original instruction set contains inherently positive and social alcohol expectancy primes (e.g.; going with friends to a bar to see a band). A third cognitive priming condition will incorporate an instruction set similar to the original study by Murphy & MacKillop (2006) with an added free associates task embedded within the instructions (see Reich & Goldman, 2005). The free associates task was implemented into the Enhanced priming condition with the intention that it would prompt a deeper level of processing related to the positive-social context within the purchase task instructions. The results of the

current study are discussed in the context of whether behavioral economic frameworks can be enhanced by incorporating cognitive principles underlying the decision to use drugs or alcohol.

Given this framework, our primary hypothesis was that the demand curves for the overall consumption values reported for the Original and Enhanced priming conditions would be significantly higher than the values reported for the Non-primed condition, regardless of drinker status. In turn, these consumption values would increase specific demand indices that would be reflected by the shape of demand curves generated from participant responses. The demand indices in the Enhanced and Original priming conditions that will be shifted (increased) are: O_{max} (the highest price paid for a drink), P_{max}, the total expenditure on alcohol; breakpoint, first price where consumption stops), and intensity (consumption when price is zero). Our second hypothesis predicted that preexisting patterns of drinking will be associated with the strength of the expectancy primes. We expected participants who were considered heavy drinkers would report the highest consumption values overall in the Enhanced priming condition, followed by the Original and the Non-primed conditions, respectively. Finally, we expected the responses on the FA task would be similar to those reported in previous alcohol expectancy literature. For example, previous studies have consistently found that heavier drinkers generally report more positive and social alcohol expectancy words (e.g., “happy”; “outgoing”), whereas lighter drinkers typically report more negative (e.g.) and sedating expectancy words (e.g., “sick”; “sleepy”; Reich & Goldman, 2005).

Method

Participants

Initially, a total of 593 students completed the online study (Non-primed *N*=178, Original *N*=194, Enhanced *N*=221). A total of 344 participants were excluded from the current analyses

and included those who reportedly did not consume at least one standard drink per month (*N*=209). Out of the participants who consumed less than one standard drink per month, 95 indicated that they never consumed alcohol. All participants who did not provide numerical responses for the APT were regarded as missing data and were removed via listwise deletion (*N*=135). A normality assessment determined that one female participant in the Non-primed condition was likely an outlier (reportedly consuming 210 standard drinks per month) and was excluded from the current analyses. The final sample size of the study consisted of 249 participants (Non-primed *N*=61, Original *N*=93, Enhanced *N*=95) and consisted primarily of females (27.3% males). The mean age of the final sample was 20.58 (*SD* = 2.51). In terms of quantity, lighter drinkers (*N* = 119) consumed an average of 2.27 (*SD* = 0.84) standard drinks per dinking occasion, whereas Heavier drinkers (*N* = 130) consumed an average of 3.74 (*SD* = 1.88) standard drinks per occasion. The final sample is considered ethnically diverse and is consistent with the general student demographics at the university: 61.1% Caucasian, 14.8% African-American, 9% Asian, 6.6% Mixed or Multiracial, and 8.6% categorized as "Other". Overall, 18.1% of participants were of Hispanic origin. All demographic variables, living arrangements, and discretionary income variables are presented by condition in Table 1.

Table 1. *Descriptive Statistics for Sample Demographics by Condition*

	Condition		
	Non-Primed	Original	Enhanced
Age *M(SD)*	20.84(2.38)	20.85(2.74)	20.16(2.33)
Sex (% Female)	72.1	72.0	73.7
Ethnicity (%)			
Caucasian	61.7	62.2	59.6
African-American	16.7	12.2	16.0
Asian	6.7	8.9	10.6
Mixed/Multiracial	3.3	7.8	7.4

Table 1 (Continued)

Other	11.7	8.9	6.4
Hispanic Origin (% yes)	19.4	20.7	14.7
Living Arrangements (%)			
At home with parent(s)/guardian(s)	26.2	11.8	15.8
Off-campus housing	49.2	52.7	60.0
On-campus housing	18.0	32.3	23.2
Other	6.6	3.2	1.1
Employment Status (%)			
Full-Time (part-time student)	11.5	8.6	8.4
Part-Time (full-time student)	44.3	46.2	47.4
Not employed	41.0	38.7	40.0
Other	3.3	6.5	4.2
Monthly Discretionary Income (%)*			
$0-100	39.0	30.8	37.0
$101-500	51.0	63.8	55.5
$501-1000	8.5	4.4	7.0
$1001+	1.5	1.0	0.0

*Seven participants did not report discretionary income which resulted in missing data.

Measures

Alcohol Expectancy Questionnaire (AEQ; Appendix A): The AEQ (Brown, Christiansen, & Goldman, 1987) is a 68-item self-reported measure of an individual's experiences regarding the effects of alcohol and was included as a pre-study measure. The AEQ assesses the degree to which individuals expect alcohol use to produce a variety of possible effects including global positive changes, changes in social behavior, sexual enhancement, increased aggression and/or arousal, and relaxation and tension reduction. The AEQ has

moderate internal consistency (mean coefficient alpha = .84) and has been shown to have moderate test re-test reliability over a one and two month period in adults. (coefficient alpha one month = .66; two months = .64).

Drinking Questionnaire (DQ; Appendix A): The DQ assessed typical patterns of drinking behavior within the past year using a variable multiple-choice scale. Participants estimated their typical quantities and frequencies of alcohol use. In the current study, Quantity of alcohol use was defined as the number of standard drinks consumed on a typical drinking occasion during the past month, while Frequency was defined as the number of past-month drinking occasions. The DQ was included as a prescreening measure for the current study to exclude nondrinkers and participants who reported fewer than one standard drink per month from data analyses.

Discretionary Expenditure; Appendix A: Similarly to a single discretionary income item used in previous APT studies (e.g., MacKillop et al., 2009, 2011), participants were asked to estimate the amount of money available to spend on nonessential items over the past month (e.g., clothing, entertainment, alcohol, eating in restaurants, going to the movies, etc.), excluding money budgeted for essentials (e.g., rent, textbooks, gasoline, automobile maintenance, utility bills, groceries, etc.). Three additional items gathered information regarding employment status, living arrangements, and income levels at the time of the study.

Free Associates Task (FA): The FA task (Nelson, McEvoy, & Dennis, 2000; Reich & Goldman, 2005) allowed participants to freely respond to the sentence, "Alcohol makes me ____." The instruction set read as follows (based on Reich and Goldman, 2005):

> "In the blank space provided below, please write down a word or short phrase you would use to complete the sentence 'Alcohol makes me _____.' Please write whatever first

comes to mind. Do not think too long and respond as quickly as you can."

In the current study, the FA task was included as a pre-study measure for all conditions and was incorporated as an experimental manipulation within the Enhanced Priming condition of the APT. The responses provided on the FA task were trichotomized (-1.0, 0.0, 1.0) based on established scoring procedures for the valence (pleasantness) and arousal ratings (Reich, Ariel, Darkes, & Goldman, 2012; R. Reich, personal communication, August 2013).

Alcohol Purchase Task (APT): The Alcohol Purchase Task (APT; Murphy & MacKillop, 2006) was originally developed from previous measures of laboratory drug self-administration paradigms (Jacobs & Bickel, 1999; Petry & Bickel, 1998). The responses collected from the APT generate demand curves of the RE of purported consumption as a function of increasing price. Generally, the demand curves produced from the APT conform to an inverted U-shape often found in laboratory-based self-administration studies (Bickel et al., 1995; Murphy & MacKillop, 2006). Previous studies using the APT have found that hypothetical monetary expenditure decreases quickly with increasing price (Murphy & MacKillop, 2006; MacKillop & Murphy, 2007; MacKillop et al., 2010).

The observed demand indices generated by the APT (P_{max}, O_{max}, breakpoint, and intensity) have generally demonstrated good to excellent two-week test-retest reliability good overall fit to responses (Pearson's *r* values ranged from .71–.91, M = .85, all *p*s < .002.; Murphy, MacKillop, Skidmore, & Pederson, 2009). The demand curves generated by the APT typically demonstrate good fit to the individual participant responses (mean R^2 = .82) and an excellent fit to aggregate participant data (mean R^2 = .99) (based on the regression equation developed by Hursh & Silberberg, 2008).

The Non-Primed condition instruction set will appear as follows:

> "The following questions ask how many drinks you would purchase at various prices. The available drinks are standard size domestic beers (12 oz.), wine (5 oz.), shots of hard liquor (1.5 oz.), or mixed drinks containing one shot of liquor. Please respond to these questions honestly."

The Original APT instruction set was based on the original study by Murphy and MacKillop (2006):

> "In the questionnaire that follows we would like you to pretend to purchase and consume alcohol. Imagine that you and your friends are at a bar from 9:00 p.m. until 2:00 a.m. on a weekend night to see a band. The following questions ask how many drinks you would purchase at various prices. The available drinks are standard size domestic beers (12 oz.), wine (5 oz.), shots of hard liquor (1.5 oz.), or mixed drinks containing one shot of liquor. Assume that you did not drink alcohol before you went to the bar and that you will not go out after. Please respond to these questions honestly, as if you were actually in this situation."

The Enhanced Priming APT instruction set read as follows:

> "In the questionnaire that follows we would like you to pretend to purchase and consume alcohol. Imagine that you and your friends are going out to a bar from 9:00 p.m. until 2:00 a.m. on a weekend night to see a band."

Following this prompt, participants were taken to the next screen and completed a modified version of the FA task:

> "Please take a moment to think about how alcohol will affect you in this situation. In the blank space provided below, please write down a word or short phrase you would use to complete the sentence 'Alcohol makes me _____.' Please write whatever first comes to mind. Do not think too long and respond as quickly as you can."

After completing this portion of the task, participants were directed to the next screen containing the rest of the instructions:

> "The available drinks are standard size domestic beers (12 oz.), wine (5 oz.), shots of hard liquor (1.5 oz.), or mixed drinks containing one shot of liquor. Assume that you did not drink alcohol before you went to the bar, and that you will not go out after. Please respond to these questions honestly, as if you were actually in this situation."

After reading the instructions (regardless of condition), participants were asked to respond to the question: "How many drinks would you consume if they were ____ each?" at 17 prices: zero (free), $0.25, $0.50, $1, $1.50, $2, $2.50, $3, $4, $5, $6, $7, $8, $9, $10, $12, $14. We increased the expenditure range from 14 prices in the original APT (highest price: $9) to 17 prices (highest price: $14) to more accurately reflect alcohol-related spending habits in west central Florida.

Procedure

Participants completed all pre-screening measures online prior to enrollment in the experiment. These pre-study measures included general demographic information, the AEQ (to assess baseline alcohol expectancies), the DQ, and the baseline FA task. Participants were not granted access to the present study until they had completed baseline measures.

Participants were self-assigned to one of three online study conditions via SONA. The three conditions were listed as separate studies on SONA (arbitrarily listed as "NET" followed

by 3 numbers) and appeared in sequential order in the list of all studies available to participants. After a participant selected one of the three study conditions from the list, the amount of participation credit and the name of the principle investigator were provided. No other information was provided to participants about the study. After a study condition was selected, SONA restricted access to the other priming conditions to prevent participants from completing more than one condition. The informed consent contained information that led participants to believe the study was about undergraduate spending habits. Following consent, participants were directed to a short survey regarding estimated financial information. The information collected included items regarding current living arrangements (e.g., at home, on-campus housing, etc.), estimated current income level, and employment status. Following the completion of the financial information survey, participants answered the discretionary income item. Finally, participants were taken to the APT and initially read the instructions for the task. Participants saw one price point at a time as they completed the APT and each price point required a response before allowing participants to continue to the next price. The study ended following the completion of the APT and credits were immediately assigned to participants.

Analytic Plan

We initially examined the data for distribution abnormalites and outliers. Previous researchers have primarily addressed outliers within the five APT demand variables according to the methods prescribed by Tabachnick and Fidell (2001). The Tabachnick and Fidell method (2001) changes any values ≥ 3.29 *SD*s above the mean to be one unit greater than the highest non-outlier value. In addition to addressing outliers using the Tabachnick and Fidell method (2001), researchers have generally used square root mean transformations to normalize any demand variable that remains skewed and/or kurtotic. For the purposes of the current study, we

did not address demand the outliers according to the Tabachnick and Fidell method (2001) as we determined that the raw data may provide important information for the alcohol demand indices. In all conditions of the current study, all five demand indices were skewed and kurtotic and were corrected using square root mean transformations prior to analysis. All other skewed and/or kurtotic variables (i.e., AEQ factor scores) were transformed using square root mean transformations prior to analysis.

Determining Adequate Demand Curve Fit

In order to examine overall goodness of fit, the APT data were examined using the exponential model template provided by Hursh and Silberberg (2008) in GraphPad Prism 5.0c (GraphPad Inc., San Diego, CA) using the following equation:

$$\ln Q = \ln Q_0 + k\,(e^{-\alpha P} - 1)$$

In this equation, Q = consumption at a given price; Q_0=consumption when price is zero; α = the derived demand parameter (elasticity) reflecting the decreased consumption; k = α constant across individuals that denotes the range of consumption values in log powers of ten (k = 4 in the current study); C = price. Larger elasticity (α) values reflect a greater sensitivity to increasing drink prices. For the purposes of the logarithmic transformations, we replaced all zero values with a low non-zero value of .001 to ensure proper curve fit. In addition, R^2 values were computed in each condition to ensure adequate fit for the data and whether the demand indices were equally represented across each condition.

Specific Aim 1

To examine whether the priming condition (Non-primed, Original, or Enhanced) would influence responses on the five alcohol demand indices of the APT (Intensity, Breakpoint, O_{max}, P_{max}, and Elasticity), we conducted a multivariate analysis of covariance (MANCOVA) using

Quantity and Frequency of alcohol use as covariates. In this model, we controlled for alcohol Quantity and Frequency as these variables are expected to be strongly related to the five demand indices and may potentially confound the results. A significant Wilks' Λ was followed-up with appropriate post-hoc univariate analyses of covariance (ANCOVAs) for each demand metric to determine specific differences in each condition (using Quantity and Frequency as covariates). Power analyses determined that given a sample of N = 158, we had a power of .80 to detect a 'medium' effect size (f = .25).

Specific Aim 2

To determine if heavier drinkers report higher consumption values overall in the Enhanced priming condition, we conducted a multiple regression analysis. We dichotomized drinker status ('heavier' or 'lighter') using a median split for a Quantity by Frequency variable. Based on data collected from the DQ, we calculated the monthly Quantity (amount of alcohol consumed on each drinking occasion) and Frequency (number of drinking days per month) of alcohol consumption. Quantity and Frequency were dichotomized using a median split (*Mdn* = 3 and *Mdn* =2.5, respectively). Power analyses determined that given a sample of *N=102* (*N*=51 for each drinker type), we had a power of .80 to detect a 'medium' effect size (d = .50).

Exploratory Aim

To test the hypothesis that drinker status (lighter versus heavier) would result in similar outcomes to that of previous research using FA tasks (e.g., Reich & Goldman, 2005; Reich, Ariel, Darkes, & Goldman, 2012), we divided heavier and lighter drinkers using a median split of Quantity by Frequency. We compared lighter and heavier drinkers to the FA Valence and Arousal ratings using Mann-Whitney tests. We examined differences in FA word frequencies between light and heavy drinkers. Power analyses determined that given a sample of *N=102*

(*N*=51 for each drinker type), we had a power of .80 to detect a 'medium' effect size (*d* = .50).

We collected FA word responses both as a pre-study measure and within the Enhanced priming condition. Words were scored based on established Valence and Arousal ratings and were compared using Wilcoxon signed-rank tests. Following the positive-social primes embedded within the Enhanced condition, we expect that participants' reported words had higher Valence ratings than the words originally reported at baseline. Power analyses suggested a sample size of *N*=101 to detect a 'medium' effect size and power of .80.

CHAPTER THREE:

RESULTS

Descriptive Statistics

Means, standard deviations, and percentages are presented by condition and gender for the six AEQ factor scores, Quantity, Frequency, and the Valence and Arousal ratings of the FA task in Table 2 (see page 28). As expected, males in the overall sample reported significantly higher Quantity values than females, $t(247) = 2.20$, $p = .03$, $d = .35$. Overall, males and females did not significantly differ on any of the six AEQ factor scores, frequency of alcohol use, or the FA valence and arousal ratings.

Means and standard deviations are presented in Table 3 (see page 29) for the alcohol demand indices by condition and gender. Overall, men reported higher mean Intensity values than females, though this difference was not significant, $t(247) = 1.75$, $p = .08$. Overall, females were significantly less sensitive to increasing prices (Elasticity) than men, $t(247) = 2.68$, $p = .008$, a finding that is consistent with previous studies using the APT (Skidmore & Murphy, 2011, Yurasek et al., 2012). The average price point in which participants in the Non-primed condition spent the most money on alcohol (P_{max}) was at $4.00 per drink, whereas participants in the two primed conditions spent the most money when drinks were around $5.00. On average, participants in the Non-primed condition purchased an average of 2.43 drinks ($SD = 1.52$) when prices were $4.00, were more sensitive to increasing prices (Elasticity), and spent the least

Table 2. Descriptive statistics for raw AEQ factor scores, FA Valence and Arousal ratings, and raw drinking data by condition and gender.

	Condition					
	Non-Primed		Original		Enhanced	
	Male (*N*=17)	Female (*N*=44)	Male (*N*=26)	Female (*N*=67)	Male (*N*=25)	Female (*N*=70)
FA Valence(%)						
-1.00	11.8	9.5	4.0	6.3	8.7	9.1
0.00	29.4	23.8	24.0	12.5	34.8	25.8
1.00	58.8	66.7	72.0	81.2	56.5	65.1
FA Arousal (%)						
-1.00	41.2	26.2	28.0	21.9	26.1	34.8
0.00	52.9	57.1	60.0	56.3	65.2	50.0
1.00	5.9	16.7	12.0	21.8	8.7	15.2
AEQ Factor Scores *M(SD)*						
Global-Positive	9.59(7.41)	9.0(5.21)	9.15(5.63)	9.61(5.73)	10.24(6.78)	8.07(5.66)
Sexual Enhancement	2.29(2.57)	2.86(2.38)	2.46(2.06)	3.16(2.28)	3.04(2.53	2.40(2.01)
Social & Phys. Pleasure	6.71(2.52)	7.32(1.64)	7.46(1.36)	7.08(1.76)	6.88(2.29)	6.76(2.03)
Social Assertion Scale	5.41(3.99)	5.77(3.22)	7.08(2.76)	6.91(2.66)	6.68(3.26)	6.19(3.21)
Tension Reduction	5.59(2.76)	5.91(2.26)	6.04(2.25)	5.97(2.31)	6.20(2.33)	5.21(2.47)
Aggression/Arousal	4.12(3.14)	4.36(2.11)	4.39(2.04)	5.06(2.12)	4.40(2.47)	4.16(2.36)
Quantity *M(SD)*	3.50(2.41)	3.85(2.49)	2.02(2.61)	3.64(1.30)	3.72(1.77)	3.34(1.25)
Frequency *M(SD)*	4.79(4.69)	4.36(4.21)	5.42(4.91)	3.99(3.41)	4.41(4.22)	4.45(3.37)

(*SD* = 1.76) when the price was around $5.00 and were more sensitive to increasing costs (Elasticity) than participants in the Non-primed condition. In the Enhanced priming condition, participants were the least sensitive to increasing prices and also purchased an average of 2.36 standard drinks (SD = 1.58) when drinks were $5.00. Overall, these findings suggest that the contextual priming in both the Original and Enhanced conditions affected how much money participants were willing to spend on alcohol at each price point, at all levels of drinking. Moreover, these results demonstrated that lighter drinkers were influenced by the positive-social expectancy primes embedded in the Original and Enhanced conditions relative to the lighter drinkers in the Non-primed condition.

Table 3. Means and Standard Deviations for the Demand Indices by Condition and Gender

	Condition					
	Non-Primed		Original		Enhanced	
	Females (*N*=44)	Males (*N*=17)	Females (*N*=67)	Males (*N*=26)	Females (*N*=70)	Males (*N*=25)
Intensity	5.09(2.59)	4.94(3.05)	6.16(2.98)	7.62(4.33)	5.97(2.49)	6.64(3.50)
O_{max}	14.18(10.01)	15.37(10.81)	17.30(13.99)	19.12(13.15)	16.24(9.90)	17.0(9.20)
Breakpoint	8.20(3.56)	7.79(5.00)	10.63(4.20)	10.46(4.15)	10.24(3.81)	9.22(4.04)
P_{max}	6.76(4.77)	6.07(4.67)	5.40(3.30)	5.39(3.38)	5.83(3.56)	5.84(3.98)
Elasticity	.019(.001)	.013(.001)	.014(.002)	.013(.001)	.012(.001)	.011(.002)

Pearson's r statistics were used to analyze the overall associations among Quantity and Frequency, the AEQ factor scores, Valence and Arousal ratings, and the five alcohol demand indices (see Table 4, page 30). Quantity and Frequency of alcohol use were positively correlated with all of the AEQ factors. These findings are consistent with previous expectancy research

Table 4. Overall Pearson's Correlations among AEQ Factors, Demand Indices, Quantity and Frequency.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. AEQ Global Positive Chg.	1												
2. AEQ Sexual Enhancement	.68**	1											
3. AEQ Soc. & Phys. Pleasure	.61**	.49**	1										
4. AEQ Social Assertion	.73**	.61**	.62**	1									
5. AEQ Tension Reduction	.67**	.47**	.63**	.59**	1								
6. AEQ Aggression/Arousal	.73**	.60**	.54**	.69**	.55**	1							
7. Quantity	.22**	.25**	.25**	.29**	.26**	.24**	1						
8. Frequency	.22**	.16**	.21**	.18*	.23**	.27**	.20**	1					
9. Intensity	.15*	.16**	.16**	.14*	.14*	.12*	.40**	.20**	1				
10. O_{max}	.03	.06	.13*	.09	.07	.12*	.16**	.16**	.37**	1			
11. Breakpoint	.04	.06	.11	.16*	-.001	.13*	.04	.16**	.16**	.68**	1		
12. P_{max}	.02	.04	.05	.06	-.02	.05	-.03	.04	-.01	.68**	.62**	1	
13. Elasticity (α)	.07	.04	.10	.03	-.04	-.03	-.10	-.12*	-.04	.06	.02	.12*	1

Note. **p<.01. *p<.05.

and suggest that alcohol use strongly linked to expectancies. As expected, Intensity values were significantly correlated with Quantity and Frequency of alcohol consumption, which is also consistent with previous findings (MacKillop & Murphy, 2006; Yurasek et al., 2011). The FA Valence ratings were positively associated with all factors of the AEQ with the exception of Sexual Enhancement. In other words, participants with higher alcohol expectancies – and heavier levels of drinking – were more likely to provide FA words that were considered pleasant and positive, relative to participants who drank less and provided more negative FA words.

Adequacy of Demand-Curve Model Fit

In order to examine overall goodness of fit and compute R^2 values to asses model fit, the APT data were examined using the exponential model template provided by Hursh and Silberberg (2008) in GraphPad Prism 5.0c (GraphPad Inc., San Diego, CA). The demand equation indicated excellent fit for the overall data, R^2 = .97. Although previous studies have argued that lighter drinking participants may negatively impact demand curve fit (e.g., Skidmore & Murphy, 2011), the present study has determined that the mean R^2 values for the individual conditions are considered adequate: Non-primed mean R^2 = .71, Original mean R^2 = .73, and Enhanced mean R^2=.7

Effects of Expectancy Priming on Alcohol Demand

Consistent with previous findings that used the APT (Murphy & MacKillop, 2006; Skidmore & Murphy, 2011), participants in all conditions consumed fewer drinks as prices increased (see Figure 1, page 32). To examine the overall effect of expectancy priming condition on the five alcohol demand indices, a one-way MANCOVA was conducted. As hypothesized, we found a statistically significant main effect of condition after controlling for preexisting drinking habits, $F(10, 478) = 4.65$, $p < .001$; Pillai's trace = .177, partial η^2=.09.

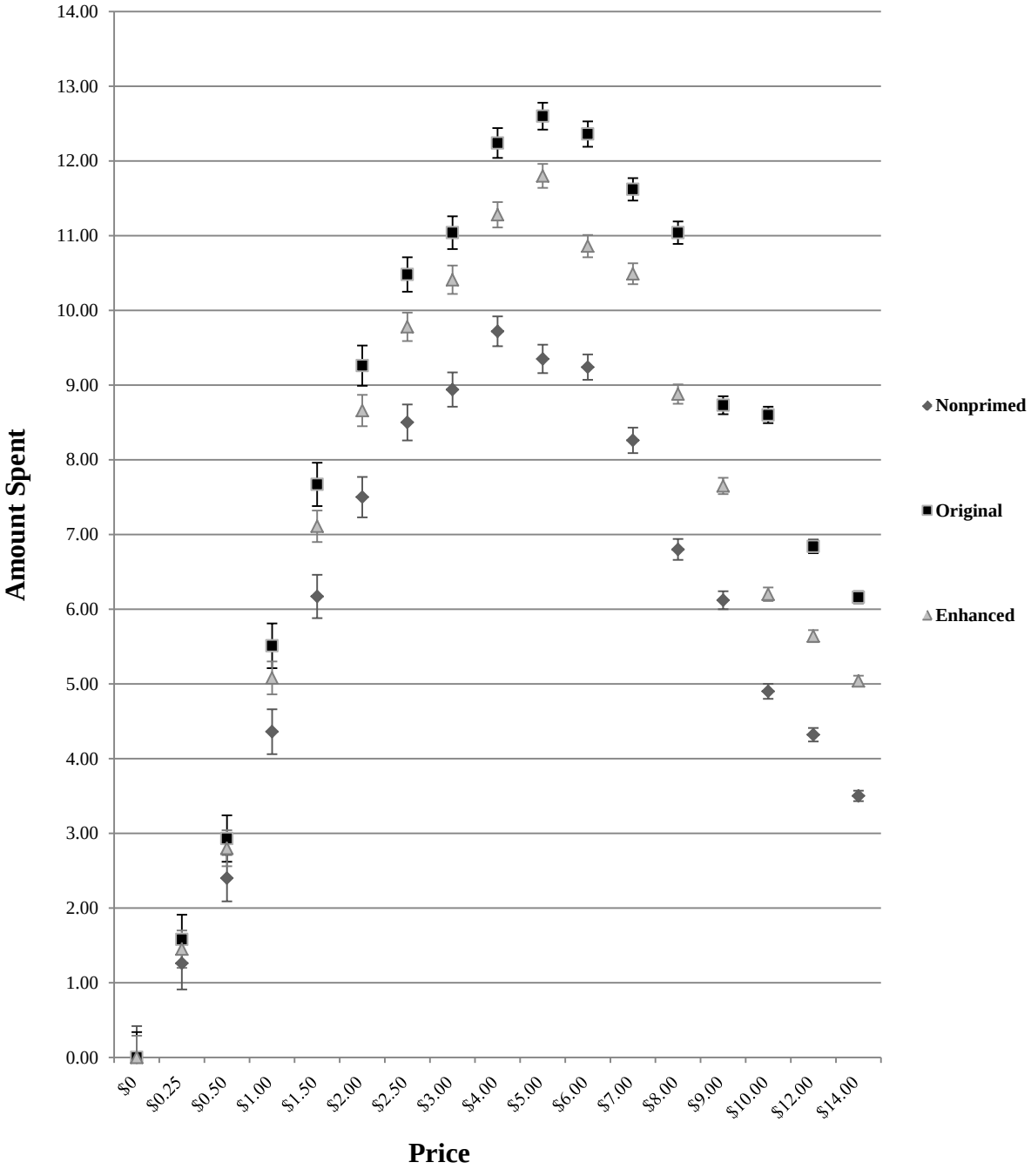

Figure 1. Mean (±1 *SE*) Expenditure Values Across 17 Price Points for the APT Conditions.

Follow-up one-way analyses of covariance (ANCOVAs; see Table 5 on page 33) found a significant, moderate effect of priming condition on Intensity, $F(2, 244) = 5.96$, $p = .003$, partial

η^2=.05, and Breakpoint, $F(2, 244) = 7.30$, p =.001, partial η^2=.06. Specifically, participants in the Original condition reported significantly higher Intensity (p =.001) and Breakpoint values (p <.001) than those in the Non-primed condition. In the Enhanced priming condition, participants reported significantly higher Intensity (p=.006) and Breakpoint (p=.003) values than those in the Non-primed condition. No significant differences were found among conditions for Elasticity (α), O_{max}, or P_{max} across conditions.

Table 5. Analyses of Covariance Results for each Demand Index for the Overall Sample.

	SS	*df*	*MS*	*F*	*p*	partial η^2
Demand Index						
Intensity	3.33	2	1.66	5.96	.003	.05
Omax	5.06	2	2.53	1.56	.213	.01
Breakpoint	7.24	2	3.62	7.30	<.001	.06
Pmax	1.14	2	0.57	0.93	.40	.01
Elasticity	0.84	2	0.01	1.45	.24	.01

Note: Computed using alpha = .01

Overall, these results suggest that participants were influenced by the contextual priming in the instruction set of the Original and Enhanced conditions, regardless of preexisting drinking habits. Specifically, participants in the primed conditions were willing to consume more when drinks were free and continued to drink at higher price points that those participants in the Non-primed condition, suggesting that the positive-social context played an influential role in alcohol-related behaviors and outcomes in our sample. Furthermore, these findings demonstrate that the priming effect was weakened in the Enhanced condition, perhaps due to the deeper level of processing involved in the embedded FA task. Although the other demand indices (Elasticity, O_{max}, and P_{max}) were not significantly affected, the average values for these demand indices in both primed conditions were higher than the Non-primed condition, suggesting some level of contextual

influence affected participant expenditures and sensitivity to increasing drink prices, regardless of drinker status.

Drinking Habits and the Effects of Expectancy Priming on Alcohol Demand

Means and standard deviations are presented in Table 6 for the five demand indices by condition and drinker status (lighter and heavier). As expected, heavier drinkers purchased more drinks on average when the cost was free (Intensity), spent more money on alcohol overall (O_{max}), were willing to purchase alcohol at higher prices (P_{max}), and continued to drink as prices increased (Breakpoint) across all conditions.

Table 6. Means for Raw Alcohol Demand by Condition and Drinker Status.

	Condition					
	Non-Primed		Original		Enhanced	
	Lighter (*N*=35)	Heavier (*N*=26)	Lighter (*N*=40)	Heavier (*N*=53)	Lighter (*N*=43)	Heavier (*N*=52)
Quantity	2.63(1.21)	5.27(2.87)	2.98(1.03)	4.82(1.96)	3.03(1.42)	3.79(1.30)
Intensity	3.89(1.61)	6.62(3.10)	5.68(2.31)	7.25(4.0)	5.53(2.0)	6.65(3.22)
O_{max}	13.32(8.98)	16.11(11.56)	15.23(9.49)	19.76(16.0)	14.73(10.15)	17.85(9.13)
BP	7.57(3.85)	8.79(4.10)	10.16(4.38)	10.91(4.0)	9.57(3.90)	10.31(3.86)
P_{max}	7.18(4.92)	5.74(4.39)	5.03(2.85)	5.68(3.61)	5.31(3.64)	6.26(3.65)

Note: BP = Breakpoint

A multiple regression analysis found that preexisting drinking habits significantly predicted two of the five demand indices (see Table 6, Appendix B), which further supports the notion that heavier drinkers would have higher values across all demand indices. Specifically, drinker status significantly predicted Intensity values ($\beta = 4.52$, $p < .001$) and accounted for 13.6% of the variance, $R^2 = .14$, $F(1, 247) = 38.86$, $p < .001$. Drinker status also significantly predicted O_{max}, $\beta = 8.36$, $p = .004$, but not Breakpoint or P_{max}. Although several demand indices were significantly

predicted by preexisting drinking habits, our findings also strongly suggest that the contextual expectancy priming served as a catalyst for alcohol use above and beyond drinking habits of the sample.

A multiple regression analysis was conducted to test the hypothesis that heavier and lighter drinkers in the Enhanced priming condition would report higher alcohol demand values above and beyond the Non-primed and Original conditions based on drinking status. When compared across conditions, there was a significant effect of condition on the lighter drinkers' reported Intensity values, $F(2, 116) = 4.82$, $p = .01$; specifically, multiple comparisons using LSD tests revealed that the lighter drinkers reported the highest Intensity values in the Original condition overall ($p = .004$; $d = .61$) followed by the Enhanced condition, $p = .01$, $d = .61$. Again, these results demonstrate that the expectancy priming embedded within the instruction set of the Original condition served as the strongest influence on demand indices above and beyond the Enhanced expectancy priming condition. Similarly, an effect of condition was found on lighter drinkers' reported Breakpoint values, $F(2, 116) = 4.72$, $p = .01$. Post-hoc LSD tests revealed that, relative to the Non-primed condition, lighter drinkers in the Enhanced priming condition reported the highest Breakpoint values overall ($p = .004$) followed by the Original condition, $p = .01$. Lighter drinkers in the Non-primed condition also reported significantly higher elasticity values, $p = .04$. In other words, lighter drinkers in the Non-primed condition were more sensitive to increasing drink prices and were more likely to reach Breakpoint sooner than lighter drinkers in the two primed conditions, arguably suggesting that the lighter drinkers in the Non-primed condition needed a stronger positive-social context to facilitate alcohol use. Interestingly, lighter drinkers in the Non-primed condition reported higher P_{max} values than participants in the Original and Enhanced conditions, although this difference was not significant ($p = .46$ and $p =$

.98, respectively). As expected, heavier drinkers in the Original condition reported higher Intensity, O_{max}, Breakpoint, and P_{max} values overall than heavier drinkers in the Non-primed and Enhanced conditions, although these differences were nonsignificant. A trending effect of condition was found for heavier drinkers' reported Breakpoint values, $F(2, 116) = 2.88$, $p = .06$. Post-hoc LSD tests revealed that heavier drinkers' reported Breakpoint values were significantly higher in the Original condition compared to the Non-primed condition, $p = .01$, $d = .60$. Overall, these findings support the notion that alcohol use among a variety of drinkers can be directly influenced by the contextual priming, although the lighter drinkers of our sample were more strongly influenced by the context.

Free Associates Task

We examined the most commonly reported words as well as the baseline Valence and Arousal ratings of the FA task. A Mann-Whitney test was conducted to determine whether drinker status (lighter versus heavier) resulted in similar trends to that of previous FA tasks (e.g., Reich & Goldman, 2005). Monthly Quantity values were compared to the FA Valence and Arousal ratings as well as the FA word responses. As expected, heavier drinkers (N=131) reported higher Arousal ratings overall for the FA task, although these differences were not significant, $U = 6211$, $p = .10$. That is, heavier drinkers generally reported more arousing words (i.e., "fun" and "happy") relative to lighter drinkers.

Participant's word responses on the FA task are presented by drinking status in Table 6 (see page 37). Overall, participants primarily reported words consistent with previous findings. Specifically, heavier drinkers reported words with generally positive valence and/or arousal ratings, such as "happy", "outgoing", "fun", and "relaxed". Lighter drinkers, on the other hand, reported similar words to those of heavier drinkers but provided words with more negative

valence and arousal ratings, such as “dizzy”, “sick”, “tired”, and “sleepy”.

Table 7. Percentages of Commonly Reported FA Words by Drinker Status.

			Drinker Status	
Word	Valence	Arousal	Heavier Drinkers (*N* = 131)	Lighter Drinkers (*N* = 118)
Happy	1	0	31.3%	14.4%
Drunk	0	-1	9.2%	6.8%
Relaxed	1	0	11.5%	7.6%
Sick	-1	-1	0.8%	3.1%
Tired	0	-1	1.5%	5.1%
Good	1	0	1.5%	0.8%

In the Enhanced priming condition, we collected baseline and experimental free associates words. A Wilcoxon signed-rank test revealed no significant differences between reported baseline and experimental Valence ($Z = -1.811$, $p = .07$) or Arousal ratings, $Z = -1.131$, $p = .26$. Although these results were not statistically significant, the trend in the data suggests that participants in the Enhanced condition were, to some extent, affected by the positive-social expectancy context of the task instructions. Moreover, these findings lend support to our findings that expectancy primes would, to an extent, influence participant responses on the APT.

CHAPTER FOUR:

DISCUSSION

The present study examined the effects of expectancy priming on alcohol demand using differential levels of priming embedded within a behavioral economic purchase task. Across all three conditions, participants in the Original and Enhanced priming conditions of the APT reported significantly higher Intensity and Breakpoint values than those in the Non-primed condition, even after controlling for Quantity and Frequency of alcohol consumption. That is, regardless of preexisting drinking habits, participants in the Enhanced and Original priming conditions consumed significantly more free standard drinks (Intensity) and were willing to purchase alcohol at higher prices (Breakpoint) than those participants in the Non-primed condition. Although we hypothesized that the Enhanced priming condition would have the strongest effect on alcohol demand metrics, the Original APT instruction set had the strongest effect overall on two of the demand metrics, Intensity and Breakpoint. One explanation may be that a deeper level of processing was involved in the Enhanced priming condition. As such, any effect of expectancy priming may have been minimized and the priming effect was weakened with the addition of the FA task. Given that lighter drinkers typically report expectancy words that are more negative and sedating, they may have reported lower levels of consumption in the Enhanced condition after truly considering how alcohol would affect them in the hypothetical drinking scenario.

Preexisting drinking habits also revealed similar effects of condition on the alcohol demand indices. Across conditions, heavier drinkers did not significantly differ on any of the

alcohol demand indices (with the exception of Breakpoint in the Original condition). Comparisons across conditions for the lighter drinkers, on the other hand, revealed significant differences on all of the demand indices (with the exception of O_{max}). These findings suggest that participants classified as heavier drinkers were not as strongly affected by expectancy priming compared to the lighter drinkers in the sample. Results from the heavier drinkers were consistent with the overall finding that the Original condition had the strongest effect on alcohol demand, particularly for Breakpoint. In the current study, it may be that the heavier drinkers consume more alcohol regardless of context than the lighter drinkers. These findings suggest that the lighter drinkers in our study may generally have a stronger preference to drink in a social context, given that nearly 60% of the lighter drinkers in our sample considered themselves "social drinkers" rather than "light drinkers" (31%). The majority of heavier drinkers in our sample also indicated they were social drinkers (57%), followed by moderate drinkers (19%), although very few considered themselves light drinkers (7%). Compared to lighter drinkers, the heavier drinkers reported higher values overall for all of the demand metrics except Elasticity and significantly higher values for Intensity and O_{max}. Heavier drinkers reported significantly lower values for Elasticity than lighter drinkers as well. That is, heavier drinkers were less sensitive to drink prices overall than the lighter drinkers in our sample.

As hypothesized, the current study found similar results to previous research using the FA task. Heavier drinkers reported more positive expectancy words, whereas lighter drinkers reported more negative expectancy words with lower valence ratings. On average, expectancy words reported within the Enhanced priming condition had higher valence ratings relative to the words reported at baseline. Although this difference was not significant, these results suggest that the Enhanced priming condition affected the pleasantness of the reported expectancy words.

Limitations

This study has several limitations to note, including the use of hypothetical measures of alcohol use among college students. The current findings are consistent with previous studies using hypothetical purchase tasks (MacKillop & Murphy, 2007; Skidmore & Murphy, 2011; Jacobs & Bickel, 1999), although we may have found different results in an actual drinking scenario using an in vivo design. It would be infeasible to systematically examine the effect of cognitive priming on alcohol demand using real alcohol in a bar setting with friends. In future studies, it may be more feasible to examine the effects of social contexts on actual alcohol expenditures in a group setting. Second, participants were not randomly assigned to conditions, which resulted in a number of issues associated with quasi-experimental designs. The present study had an unbalanced sample size in the Non-primed condition and differential drinking habits among groups. Nevertheless, our results found an effect of priming condition on the alcohol demand indices. Despite this limitation, we do not expect that these effects would be lost if the conditions had balanced groups for both condition and preexisting drinking patterns, although we would have better power to argue that group differences indeed existed. Third, there were a limited number of male participants in the present study; therefore, we cannot make any generalizable arguments regarding gender differences found in the present study. When we independently examined females across conditions, we found a significant effect of priming condition on Intensity and Breakpoint after controlling for drinking habits. Similarly, we examined males across all conditions and found a nonsignificant yet trending effect of condition for Intensity and a significant effect of condition on Breakpoint. We would expect to find results similar to that of females had we collected a larger sample of males in all conditions. The findings based on preexisting drinking habits may have been limited given that drinker status

was dichotomized using a median split. Finally, the instruction set and 17 price points of the Original condition were slightly altered to better reflect local trends of alcohol use among college student and may not be fully reflective of the results found in the original APT task used by Murphy and MacKillop (2006).

Implications

Overall, the present study provides important information for both the behavioral economic and cognitive priming literature. This study is the first to examine the relationship between contextual expectancy priming and behavioral purchase tasks by merging principles of alcohol expectancy theory and behavioral economics. Generally, previous studies using behavioral economic purchase tasks have often used these measures as tools to inform clinical practice by examining at-risk heavy drug or alcohol users. The current study found results similar to previous research using the APT within a variety of drinkers, including lighter drinkers. Moreover, the present findings support the utility of purchase tasks using samples with differential consumptive habits.

It is important to note that the current study found evidence that the positive-social context embedded within these behavioral economic purchase tasks affected participant demand for alcohol, regardless of previous drinking habits. In other words, both heavier and lighter drinkers were more likely to spend more money and drink larger quantities of alcohol overall than participants who received no positive-social primes. These findings suggest that current lines of research using behavioral economic purchase tasks should consider both how the positive-social expectancies embedded within these tasks are affecting participants' responses as well as broaden the utility of these tasks to a wider range of drinkers and drug users.

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APPENDIX A:

MEASURES

Alcohol Expectancy Questionnaire (AEQ)

This is a questionnaire about the effects of alcohol. Read each statement carefully and respond according to your own personal feelings, thoughts, and beliefs about alcohol **now**. We are interested in what **you** think about alcohol, regardless of what other people might think.

If you think that the statement is true, or mostly true, or true some of the time, then mark the number 1, for "AGREE". If you think the statement is false, or mostly false, then mark the number 0, for "DISAGREE". When the statements refer to drinking alcohol, you may think in terms of drinking any alcoholic beverage, such as beer, wine, whiskey, liquor, rum, scotch, vodka, gin, or various alcoholic mixed drinks. Whether or not you have had actual drinking experiences yourself, **you are to answer in terms of your beliefs about alcohol**. It is important that you respond to **every question**.

PLEASE BE HONEST. REMEMBER, YOUR ANSWERS ARE CONFIDENTIAL.

RESPOND TO THESE ITEMS ACCORDING TO WHAT YOU PERSONALLY BELIEVE TO BE TRUE ABOUT ALCOHOL

1. Some alcohol has a pleasant, cleansing, tingly taste.
2. Drinking adds a certain warmth to social occasions.
3. When I'm drinking, it is easier to open up and express my feelings.
4. Time passes quickly when I'm drinking.
5. Drinking makes me feel flushed.
6. I feel powerful when I drink, as if I can really influence others to do what I want.
7. Drinking gives me more confidence in myself.
8. Drinking makes me feel good.
9. I feel more creative after I've been drinking.
10. Having a few drinks is a nice way to celebrate special occasions.
11. When I'm drinking I feel freer to be myself and do whatever I want.
12. Drinking makes it easier to concentrate on the good feelings I have at the time.

13. Alcohol allows me to be more assertive.
14. When I feel "high" from drinking, everything seems to feel better.

15. I find that conversing with members of the opposite sex is easier for me after I've had a few drinks.
16. Drinking is pleasurable because it's enjoyable to join in with people who are enjoying themselves.
17. I like the taste of some alcoholic beverages.
18. If I'm feeling restricted in any way, a few drinks make me feel better.
19. Men are friendlier when they drink.
20. After a few drinks, it is easier to pick a fight.
21. If I have a couple of drinks, it is easier to express my feelings.
22. Alcohol makes me need less attention from others than I usually do.
23. After a few drinks, I feel more self-reliant than usual.
24. After a few drinks, I don't worry as much about what other people think of me.
25. When drinking, I do not consider myself totally accountable or responsible for my behavior.
26. Alcohol enables me to have a better time at parties.
27. Drinking makes the future seem brighter.
28. I often feel sexier after I've had a couple of drinks.
29. I drink when I'm feeling mad.
30. Drinking alone or with one other person makes me feel calm and serene.
31. After a few drinks, I feel brave and more capable of fighting.
32. Drinking can make me more satisfied with myself.
33. My feelings of isolation and alienation decrease when I drink.
34. Alcohol helps me sleep better.
35. I'm a better lover after a few drinks.
36. Alcohol decreases muscular tension.
37. Alcohol makes me worry less.
38. A few drinks makes it easier to talk to people.
39. After a few drinks I am usually in a better mood.

40. Alcohol seems like magic.
41. Women can have orgasms more easily if they've been drinking.
42. Drinking helps get me out of a depressed mood.
43. After I've had a couple of drinks, I feel I'm more of a caring, sharing person.
44. Alcohol decreases my feelings of guilt about not working.
45. I feel more coordinated after I drink.
46. Alcohol makes me more interesting.
47. A few drinks makes me feel less shy.
48. Alcohol enables me to fall asleep more easily.
49. If I'm feeling afraid, alcohol decreases my fears.
50. Alcohol can act as an anesthetic, that is, it can deaden pain.
51. I enjoy having sex more if I've had some alcohol.
52. I am more romantic when I drink.
53. I feel more masculine/feminine after a few drinks.
54. Alcohol makes me feel better physically.
55. Sometimes when I drink alone or with one other person it is easy to feel cozy and romantic.
56. I feel like more of a happy-go-lucky person when I drink.
57. Drinking makes get togethers more fun.
58. Alcohol makes it easier to forget bad feelings.
59. After a few drinks, I am more sexually responsive.
60. If I'm cold, having a few drinks will give me a sense of warmth.
61. It is easier to act on my feelings after I've had a few drinks.
62. I can discuss or argue a point more forcefully after I've had a drink or two.
63. A drink or two makes the humorous side of me come out.
64. Alcohol makes me more outspoken or opinionated.
65. Drinking increases female aggressiveness.
66. A couple of drinks makes me more aroused or physiologically excited.
67. At times, drinking is like permission to forget problems.
68. If I am tense or anxious, having a few drinks makes me feel better.

Drinking Questionnaire (DQ)

1. Which of the following best describes you?
   (0) Abstain from alcohol
   (1) Used to drink in the past, but now abstain from alcohol
   (2) Light drinker
   (3) Social drinker
   (4) Moderate drinker
   (5) Regular drinker
   (6) Heavy drinker
   (7) Recovering alcoholic

2. During the past year, about how frequently did you drink alcohol? Please indicate the response below which comes closest to describing your drinking pattern.
   (0) Never
   (1) Once or twice during the year
   (2) 3 to 6 times per year
   (3) 7 to 10 times per year
   (4) About once a month
   (5) 2 or 3 times per month
   (6) Once or twice a week
   (7) 3 or 4 times a week
   (8) 5 or more times per week

3. Which of the following alcoholic beverages do you consume most often?
   (0) Beer
   (1) Wine
   (2) Hard Liquor or spirits, mixed drinks
   (3) I don't drink

4. On occasions when you drink, about how many drinks do you typically consume? Please estimate the actual number of drinks, where:

   1 drink = approximately: **1 can of beer**, or **1 glass of wine** or **wine cooler**, or **1 serving of liquor** or a mixed drink

   (0) None; I don't drink
   (1) One drink
   (2) 2 drinks
   (3) 3 drinks
   (4) 4 drinks
   (5) 5 drinks
   (6) 6-8 drinks
   (7) 9-12 drinks
   (8) 13-16 drinks
   (9) 17 or more drinks

5. During the past year, how frequently did you drink enough alcohol to get "drunk or high"? Please indicate the response below which comes closest to describing your drinking pattern.

(0) Never; I don't drink
(1) Once or twice during the year
(2) 3 to 6 times per year
(3) 7 to 10 times per year
(4) About once a month
(5) 2 or 3 times per month
(6) Once or twice a week
(7) 3 or 4 times a week
(8) 5 or more times per week

Discretionary Income

1. What are your current living arrangements?
   a. At home with parent(s) or guardian(s)
   b. On-campus housing (e.g., dormitory)
   c. Off-campus housing
   d. Other (please write-in)
   _____

2. What is your current employment status?
   a. Not employed
   b. Employed part-time (full-time student)
   c. Employed full time (part-time student)
   d. Other (please write-in)
   _____

3. What is your estimated monthly income?
   a. $0 - $100
   b. $101 - $400
   c. $401 - $800
   d. $801-$1000
   e. $1001 - $1500
   f. $1500+

4. In the blank space provided below, please estimate the amount of *discretionary income* you have available each month. Discretionary income refers to any money you have to spend on *non-essential* items, such as clothing, music/app purchases, dining out, going to the movies, etc. Do **not** include money budgeted for essentials such as rent, gasoline, auto maintenance, textbooks, utility bills, cable bills, groceries, etc.