The Effects of Happy Hour Drink Specials in the Alcohol Purchase Task

By

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Abstract

Operant behavioral economics is a discipline within behavioral psychology that integrates concepts and principles from microeconomic theory to examine animal (humans and non-humans alike) behavior. Research in behavioral economics – primarily demand curve analyses – has yielded valuable insights into the role of environmental effects on reinforcer consumption. Demand curve analyses examine how changes in a price of a good affect changes in consumption of that good. Due to practical and ethical concerns, preparations in demand curve analyses have shifted toward using hypothetical purchase tasks, where respondents report the quantity of a good they would be willing to purchase at various prices. There is strong evidence to suggest that happy hour drink specials are associated with undesirable outcomes such as increased amount of drinking, increased likelihood of being highly intoxicated (above the 80 mg/dl legal limit for driving under the influence), and increased likelihood of experiencing negative outcomes related to drinking (e.g., getting into fights). Public policy efforts have been made to ban or at least restrict alcohol drink specials. Drink special policies across the 50 states indicate wide variability, ranging from complete happy hour bans to no bans or restrictions. The purposes of the current experiments are to determine whether self-reported consumption of alcohol on an alcohol purchase task increases when participants imagine a hypothetical "happy hour" scenario and whether there are differences in change in consumption depending on whether participants reside in states with different happy hour restrictions (i.e., whether happy hours are banned). Results from the current experiments extend previous literature on alcohol purchase task vignette manipulations and provide some insight as to whether repealing happy hour bans in states where it is currently banned results in increased alcohol consumption.

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Behavior analysis has a long and rich history of examining reinforcer value. A reinforcer, by definition, is a consequence that follows behavior and either maintains or increases the probability of that behavior occurring in the future. Reinforcers come in nearly any form including food, water, shelter, and drugs (Griffiths, Bigelow, & Henningfield, 1980). For nearly a century, scientists have attempted to develop a measure capable of measuring and scaling the value of reinforcers (e.g., Herrnstein, 1961; Hodos, 1961; Hursh, 1980; Hursh & Silberberg, 2008; Skinner, 1938). With each attempt, scientists have become closer to realizing this goal; yet, each attempt has presented barriers to achieving a unitary metric of reinforcer value. What is necessary is a measure that (1) allows comparisons between qualitatively different reinforcers, (2) takes into consideration aspects of the reinforcer itself (e.g., dose, magnitude) separate from the economic context, and (3) is sensitive to experimental manipulations that result in orderly and predictable changes in reinforcer value. I provide a brief description of the various approaches to measuring reinforcer value.

Operant Approaches to Measuring Reinforcer Value

Response rate. Skinner (1938) observed that an organism will engage in a behavior that results in a consequence and there is a probability that the organism will engage in the same behavior again to obtain that consequence. If the consequence is a desirable one and the organism continues to engage in the response that leads to that outcome, we call the outcome a reinforcer. With all else being equal, Skinner noted that a rat who has been deprived of food for some time will engage in a higher rate of responding (i.e., lever presses per unit of time) as compared to a rat who has not been deprived of food for as long. He concluded that the rate of responding (i.e., response rate) may reflect the strength of the eating reflex. However, because response rate can be directly influenced by the reinforcement contingency (i.e., schedule of reinforcement) imposed (Ferster & Skinner, 1957), the notion of response rate as an index of reinforcer strength becomes problematic as it is no longer strictly reflective of the properties of the reinforcer itself. For example, variable-interval schedules typically maintain steady response rates, whereas fixed-ratio schedules typically result in periods of rapid responding followed by a pause in responding after a reinforcer is delivered. Further, response rates can be relatively invariant when relatively dense schedules (i.e., high rates) of reinforcement are imposed as opposed to variable response rates when leaner schedules (i.e., low rates) of reinforcement are imposed. Scaling reinforcer value based on response rates alone is, therefore, dependent on the schedule type and density of reinforcement schedule and not based on aspects of the reinforcer itself. This is not to say response rate should be abandoned, as it is indeed a useful metric in countless situations. For example, in traditional operant analyses, a goal might be to examine the effects of different schedules on behavior (usually keeping the type of reinforcer and levels of deprivation constant) and as such, response rate as the dependent measure is preferred. Contrast that with the goal of the behavioral economist who is interested in scaling the value of different reinforcers. With this as the goal, preference is for scaling value based on some common (and comparable) schedule type over a range of schedule densities.

Relative response rate. As noted previously, response rate as an index of reinforcer value is problematic because it is influenced by the schedule and density of reinforcement imposed. Rather than examining response rate associated with one reinforcer in isolation, Herrnstein (1970) proposed the notion of relative response rate where relative choice allocation provides an indicator of reinforcer value. He observed that an organism will allocate responding to alternatives proportional to the amount of reinforcement obtained from each of the alternatives and termed this relation matching (Herrnstein, 1961). However, the notion of relative response rate is problematic because it does not take into account the influence of income and price, variables that may influence how an organism allocates its responding. To illustrate, take the case of Elsmore, Fletcher, Conrad, and Sodetz (1980) as discussed in Hursh and Silberberg (2008) where baboons chose between food and infusions of heroin and the experimenters imposed constraints on how many lever presses they could engage in each day (i.e., income). When income was generous and the baboons had relatively more lever presses, they tended to choose heroin more often than food. However, when income was reduced the baboons allocated relatively more responding towards food, the biologically essential good. The matching relation does not take into account the relation between income and price, thus it does not predict changes in preference. Relative response rate, by definition, scales value *relative* to an alternative reinforcer (although typically the same reinforcer) under study (i.e., a choice procedure). A measure capable of scaling reward value should allow for comparisons between goods, but not require the presence of an alternative reinforcer.

Ratio breakpoint. Hodos (1961) proposed the measure of progressive-ratio (PR) breakpoint, which does not require a choice procedure. Distilled into its simplest form, a PR schedule is a series of fixed-ratio schedules that increase across successive reinforcers earned. In a PR schedule, the breakpoint is the ratio value at which an organism fails to meet the required number of responses and, thus, fails to earn a reinforcer (Jarmolowicz & Lattal, 2010). Hodos found PR breakpoint was systematically related to manipulations known to affect reinforcer value. For example, when rats responded for varying concentrations of sweetened condensed milk diluted with water, PR breakpoints tended to decrease systematically with decreased concentrations. Hodos observed similar orderly relations with PR breakpoints when levels of deprivation from and magnitude of the milk reinforcer were manipulated. However, PR breakpoints are not without their limitations. First, PR breakpoints give information about only one aspect of the relation between responding and the reinforcer: the cost at which the organism fails to earn the reinforcer. The researcher does not know the relation between responding at other costs. Second, PR breakpoints can vary in orderly ways with the progression of ratio values used (Hodos & Kalman, 1963); thus, as with response rate, PR breakpoint as a measure of reinforcer strength cannot always be separated from the reinforcement contingency in effect.

In the late 1970's, Griffiths, Brady, and Bradford (1979) proposed relative reinforcing efficacy (RRE), a theoretically homogeneous concept that integrated the previous measures of reinforcer value (e.g., response rate, relative response rate, PR breakpoint). Griffiths et al.

defined RRE as:

> "Reinforcing efficacy refers to the behavior-maintenance potency of a dose of drug which can be manifest under a range of different experimental conditions. The meaning of the term is derived from and established by the convergence of operations in which multiple outcome measures can be taken to be more or less interchangeable. For instance, it could be expected that with a progressive ratio procedure, if dose A maintains higher breaking points than dose B, then in the choice procedure dose A should be preferred to dose B and with a response rate measure dose A should maintain higher rates than dose B." (pg. 192).

The concept of RRE provides a seemingly face-valid measure of reinforcer value, that different measures of value converge into one higher-order construct. However, there were inconsistencies between these measures that compromised the internal validity of the RRE construct. For example, Bickel and Madden (1999) compared the RRE of money versus cigarettes and found that while PR breakpoints were consistently higher for cigarettes (as compared to money), preference between the two goods switched as response requirements increased and peak response rate varied across participants. To reconcile such inconsistencies between measures, behavioral scientists have found value in the BE concept of demand.

Demand. The concept of demand as an indicator of reinforcer strength is rooted in the BE framework. As discussed earlier, the field of BE is primarily interested in how environmental constraints affect consumption of reinforcers. Within this framework, demand is the amount of a reinforcer an organism earns and consumes at a given price and a demand curve (see Figure 1) is produced when a series of different prices are assessed and the corresponding amounts of the commodity earned and consumed are plotted (Bickel, Marsch, & Carroll, 2000). Examining reinforcer strength within a demand approach differs from the aforementioned approaches in several fundamental ways. First, the demand approach typically uses fixed-ratio schedules of reinforcement where the schedule values increase in a fashion similar to those in a PR. The interpretation of price is more easily interpreted when using fixed-ratio schedules. Second, the demand approach, although preferred but not always implemented, assesses consumption within a closed-economy such that all goods are earned by completing the schedule requirements and never received noncontingently. So long as comparisons are made under the same experimental conditions, the value of the reinforcer can be scaled in relation to the amount of work required to earn the good and the value of different reinforcers can be compared because price is comparable. The emphasis on economy-type is important because, unlike some of the alternative approaches described above, the BE demand approach emphasizes examination of the response-reinforcer relation at the molar level. Briefly turning back to the notion of RRE, because the demand approach emphasizes evaluation across a range of prices and a number of different metrics arise from the demand curve analysis, the demand approach by definition stipulates that there is "...no single measure [that] can provide a definitive assessment of [RRE]" and "...suggest[s] that reinforcing efficacy is not a homogeneous phenomenon, but rather may be viewed as a heterogeneous phenomena" (Bickel et al., 2000; p. 54).

Demand Curves

Aspects of the demand curve. A demand curve analysis results in several different key metrics, with each metric describing a different aspect of the response-reinforcer relation. Central to the demand curve analysis is elasticity, which is the proportional change in consumption of the good as a function of the proportional change in the price of the good. The demand curve is typically graphed (and, depending on the approach, quantified) in log-log coordinates to reflect elasticity (i.e., the slope of the tangent line). The portion of the demand curve when consumption is insensitive to changes in price and elasticity is > -1 (i.e., more positive than -1) is referred to as inelastic demand. As price increases and consumption becomes sensitive to those increases in price (and elasticity is < -1; i.e., more negative than -1), the demand curve becomes elastic. Put simply, in the inelastic portion of the demand curve, a proportional unit increase in price results in a less than 1 unit decrease in consumption, whereas in the elastic portion of the demand curve, a proportional unit increase in price results in a greater than 1 unit decrease in consumption (see Figure 2 black curve). The point of unit elasticity, where a 1 unit change in price is met with a 1 unit change in consumption, is termed P_{max}. When total response output (i.e., price X quantity of the good consumed; also referred to as an expenditure curve) is determined, P_{max} is the price associated with the greatest amount of responding (i.e., peak work output), termed O_{max} (see Figure 2 gray curve). Demand intensity is the quantity of the good consumed at no price or at very low price. Finally, as with PR schedules, breakpoint is the first price at which no reinforcers are earned (see Figure 3). Importantly, the aforementioned indices can be calculated empirically or derived (i.e., estimated) using nonlinear regression analyses.

Aspects modulating demand. Seemingly minor differences in the experimental arrangement can lead to substantial effects on behavior. An experimental arrangement that requires the organism to earn all of its daily intake of a good is called a closed economy (Hursh, 1978). The closed economy is an ideal arrangement to examine differences in demand between goods because it isolates the response-reinforcer feedback function. That is, differences in consumption are scaled to differences in the price of the goods and, thus, the amount of work required to earn them. The closed economy ensures a state of equilibrium between the supply (i.e., the schedule of reinforcement; price) and the demand (i.e., the quantity of the good consumed at a given price) of the good. Under closed economic conditions, increases in the price (i.e., lower supply) of an essential good such as food result in increases in the amount of work performed to defend the quantity of the good consumed. In contrast to a closed economy, an open economy is an experimental arrangement where there is some independence between the amount of work required to earn daily intakes of a good. Open economies can vary in the degree to which the response-reinforcer function is independent (Imam, 1993). A completely open economy would be one in which all quantities of the good are provided for free. Typical examples of open economies are when subjects are maintained at a percent of their ad libitum feeding weight, provided some duration of supplemental access to the good outside of the experimental session, or when levels of deprivation are artificially imposed (e.g., sessions terminate after a specified number of reinforcer deliveries). A state of equilibrium between the supply and the demand of the good is not always achieved in the open economy.

Consider the experiments conducted by Hursh (1978) where two Rhesus monkeys responded to earn food and water. In the experimental chamber, food was delivered according to two independent variable-interval (VI) schedules (i.e., the first response after a variable amount of time is reinforced) and water was delivered according to a third independent VI schedule. During the course of the experiment, the water source and one food source was set on VI60 s schedules, whereas the second food source was set on schedules ranging from VI30 s to VI480 s. In the first experiment, the monkeys earned their entire daily intake of food and water in the experimental session (i.e., closed economy), whereas in the second experiment, daily food and water intake were kept constant (i.e., open economy; sessions terminated after delivery of 150 food pellets and total water intake was held constant at 280 ml). In the closed economy, as the price of food increased (i.e., supply decreased) the monkeys increased their rate of responding as to defend their levels of consumption when supply was more readily available. However, in the open economy, rate of food responding tended to decrease with increases in the price of food. With all other aspects of the experiments being equal, differences in responding were attributed to the economic system in place. Additionally, in both experiments relative rates of responding across the two food sources matched the relative rates of reinforcement associated with those food sources. Interestingly, only in the closed economy was rate of water responding proportionally related to food availability. In the open economy, rate of responding for water appeared to be controlled by the artificially imposed daily intake. Thus, economy type not only influences demand for goods in isolation, but also influences relative responding of goods that have certain relations.

The relation between goods can be classified, to some degree or another, as substitutable, complementary, or independent. A substitutable relation is exemplified by examining the two food sources in the aforementioned experiments conducted by Hursh (1978). As the food from the alternative source became more readily available (i.e., price decreased), responding shifted from the constant priced food source towards the “cheaper” alternative. To reiterate, relative rates of food responding matched the relative rates of reinforcement between the two food sources (as expected because these two goods were perfect substitutes for one another). A good can serve as a substitute for another commodity and simultaneously a complement for another. A complementary relation is observed when decreases (or increases) in consumption of one good result in decreases (or increases) in consumption of another good. Instead of examining the food-food relation in the experiments conducted by Hursh (1978), it is advantageous to look at the food-water relation. In the closed economy, changes in the rate of water responding tended to vary with changes in the availability of food. That is, when food was more readily available, the monkeys tended to increase their rate of responding for water in order to meet the increase in food consumption. Finally, an independent relation is observed when changes in consumption of one good does not affect consumption of another good.

Three additional classes of variables are known to influence demand: the (1) endogenous biological factors, (2) organism's reinforcement history, and (3) reinforcer itself. Differences in genetics can result in differences in demand. For example, Rasmussen, Reilly, and Hillman (2010) compared demand for sucrose pellets between lean and obese Zucker rats. Obese Zuckers are rats genetically modified as to inhibit the expression of leptin receptors (i.e., leptin is a hormone that helps inhibit appetite-suppressing signals) causing a dysregulation of satiety (Zucker & Zucker, 1961). Compared to the lean Zucker rats, Rasmussen et al. found the obese strain consumed greater quantities of sucrose pellets and engaged in more behavior to obtain those pellets at lower prices, but not at higher prices. Notably, the obese Zucker rats displayed statistically significantly higher peak response output (i.e., O_{max}) as compared to the lean strain. There is some evidence to suggest a history of exposure to a reinforcer can increase the value of that reinforcer (Ahmed & Koob, 1998; Christensen, Silberberg, Hursh, Roma, & Riley, 2008). As an example, Christensen, Silberberg, Hursh, Roma, and Riley (2008) used non-naive rats that had previously completed a demand assay for self-administered intravenous cocaine (see Christensen, Silberberg, Hursh, Huntsberry, & Riley, 2008) and exposed them to a history of self-administering intravenous cocaine on a series of fixed-ratio schedules (i.e., seven sessions at fixed-ratio 3). Following this procedure, the researchers exposed the rats to the same demand assay used originally in Experiment 2 of Christensen, Silberberg, Hursh, Huntsberry, and Riley (2008). Results of the second demand assay (i.e., following a history of cocaine infusions) revealed greater demand for cocaine as compared to the initial demand assessment. Interestingly, when Christensen, Silberberg, Hursh, Roma, and Riley (2008) used the same aforementioned procedure to evaluate changes in demand for food, no differences in demand were observed. These results provide support for the demand analysis as a framework to reveal differences between drugs of abuse (e.g., cocaine) and biologically-essential reinforcers (e.g., food) and highlight that different reinforcers may influence demand in general.

Recall that the central characteristic of demand that differs from previous formulations of reinforcer value is elasticity (i.e., the proportional change in consumption as a function of proportional change in the price of the good), rather than response rate, as a measure of reinforcer value. The absolute value of the slope, when price and consumption are plotted in double logarithmic scales, is termed the elasticity coefficient (Hursh, 1980) and in many operant BE experiments, a range of prices are assessed such that the elasticity coefficient changes from less than 1 to greater than 1. That is, many operant BE experiments are specifically designed to assess the transition from inelastic to elastic demand. As a result, when plotted in double logarithmic scales, the shape of the demand curve is downward sloping. Since response rate can be mathematically derived from a known price and quantity of the good (i.e., unit price X quantity consumed), a response output (i.e., expenditure) curve, associated with the demand curve, can be created. The expenditure curve is characteristically shaped like a "∩", where the inelastic portion of the demand curve is associated with the left-hand, increasing phase of the response output curve up to a peak (i.e., P_{max}) and the elastic portion associated with the right-hand, decreasing phase (i.e., response output declines with a greater than one unit proportional decrease in consumption in the demand curve). As noted by Hursh (1980), elasticity is not an intrinsic property of the good; rather, elasticity can be influenced by the variables discussed earlier, such as the economy type, the availability of substitutes and complements, biological factors, reinforcement history, and the reinforcer itself. However, differences in elasticity between goods can serve as an index of reinforcer value, *ceteris paribus* (i.e., variables known to affect elasticity are controlled for).

By definition, any meaningful comparisons of elasticity must be made under the same units of price and consumption. That is, price should be expressed as unit price, or a cost-benefit ratio describing the amount of work required to earn one unit of the good. Costs of a good can take on different forms. For example, cost may be the number of presses on a lever, the effort required to pull a plunger, or the amount of time before the good is delivered. Assuming other aspects of an experiment are held constant and consumption is expressed as a function of unit price, these costs should not affect the overall shape of the demand curve (Hursh, Raslear, Shurtleff, Bauman, & Simmons, 1988). The concept of unit price has been especially helpful in the field of behavioral pharmacology (e.g., Bickel, DeGrandpre, & Higgins, 1993; Greenwald & Hursh, 2006; Madden, Bickel, & Jacobs, 2000; Shahan, Bickel, Madden, & Badger, 1999). For historical context and in preparation for discussing current approaches to assessing demand, I will briefly discuss past human operant approaches for studying demand.

The Human Operant Demand Approach

Although there have been numerous drug self-administration studies that have adopted aspects of the BE demand approach (e.g., PR schedules; see Higgins & Hughes, 1998), I highlight one that exemplifies the demand approach. In a study by Bickel and Madden (1999), four adult smokers pulled Lindsley plungers (requiring approximately 2 kg of force) to earn access to either three cigarette puffs or $0.20 when cigarettes and money were available in isolation and concurrently. When reinforcers were available in isolation, the number of plunger pulls required to earn the reinforcer increased in a progressive fashion across days. When reinforcers were concurrently available, response requirements were randomized across participants. In addition to traditional measures of RRE (e.g., breakpoint, peak response rate, relative preference), the number of reinforcers earned as a function of schedule requirements were analyzed using the linear elasticity equation (Hursh, Raslear, Bauman, & Black, 1989; Equation 1). For all participants, cigarette puffs maintained higher PR breakpoints. Peak response rates were variable across participants and reinforcers. For two participants, money was associated with higher peak response rates whereas for another participant cigarette puffs resulted in a higher peak response rate. Peak response rates between the two reinforcers were undifferentiated for the last participant. Although cigarette puffs were preferred at low schedule requirements, preference shifted to money as price increased. At the highest schedule requirement, money was preferred by all participants. Results from the BE analysis revealed values of P_{max} and elasticity appeared to relate to breakpoint. Additionally, visual examination of the demand curves (under conditions where only one reinforcer was available) were consistent with and tended to predict changes in preference between the two reinforcers.

There is little doubt that experiential drug self-administration studies have substantially advanced the field's understanding of the drug-behavior relationship. However, these approaches raise a number of ethical and practical concerns that cannot be dismissed. The approaches can be time-consuming and require subjects to repeatedly experience administrations of the drug, which may cause unanticipated consequences. Expensive equipment is required to ensure appropriate doses are administered and sometimes medical facilities or trained personnel are required in case of safety complications. Recently, efforts have been made to translate the BE demand approach to a framework that is ethically more acceptable and cost and resource efficient. This new approach adopts the BE demand methodology into a self-report measure.

Hypothetical Purchase Task

Jacobs and Bickel (1999) conducted what is considered the seminal hypothetical purchase task (HPT) study. In their experiment, they recruited 17 opiate-dependent cigarette smokers enrolled in outpatient therapy to participate. Participants completed three HPTs for heroin, cigarettes, and concurrently available heroin and cigarettes. Participants first read the following instructions:

> "In the questionnaires which follow we would like you to pretend to purchase heroin and cigarettes as you would have before entering treatment. Please answer the questions honestly and thoughtfully. The goods you may buy and their prices are listed on the following sheets. You may buy as much or as little as you'd like, and there are no consequences to your using the heroin. So, assume this is a study that has been approved by the police and all other organizations. Also, assume that you are NOT in treatment; you are not receiving buprenorphine, naltrexone, or Antabuse. In other words, the only drugs you will receive are those you purchase here. Also, assume that you have no other drugs available to you. You cannot purchase more drugs or cigarettes, or any other drugs or tobacco products except those you choose below. Therefore, assume you have no other drugs or cigarettes stashed away, you have no prescriptions for anything, and you cannot get drugs or cigarettes through any other source, other than those you buy here. Also, assume that the heroin and cigarettes you are about to purchase are for your consumption only. In other words, you can't sell them or give them to anyone else. You also can't save up any heroin or cigarettes you buy and use them another day. Everything you buy is, therefore, for your own personal consumption within a 24-hour period." (pg. 415)

The instructions were precisely worded to control for extraneous and inter-individual influence, and importantly, to approximate the closed economic conditions of more traditional demand assays. For example, informing the participants, "Also, assume that the heroin and cigarettes you are about to purchase are for your consumption only," "You also can't save up any heroin or cigarettes you buy and use them another day," and "Everything you buy is...for your own personal consumption within a 24-hour period" approximate these closed economic conditions. Further, to approximate the previously established human operant frameworks, participants reported the number of bags of heroin or single cigarettes they would be willing to purchase and consume at increasing prices, akin to the escalating response requirements of a PR schedule. Prices used were as follows: $0.01, 0.05, 0.13, 0.25, 0.50, 1.00, 3.00, 6.00, 11.00, 35.00, 70.00, 140.00, 280.00, 560.00, and 1,120.00.

The linear elasticity model (Equation 1; Hursh et al., 1988) provided good fits at both the individual (R^2_{range}: .74 – .99) and group levels (R^2= .96 for cigarettes; .99 for heroin). Demand analyses revealed systematic, but inconsistent results insofar as preference for cigarettes or heroin was dependent on unit price. For the majority of participants, cigarette consumption was higher than heroin at low prices, but heroin consumption remained higher than cigarettes at high prices for all participants. This trend was reflected in breakpoint analyses where breakpoints for heroin were generally higher than cigarettes. Additionally, breakpoint was highly correlated with values of P_{max}, O_{max}, and elasticity. Important to note is that these results reflected the same general findings of Bickel and Madden (1999). Taken together, this study was the first to demonstrate the potential clinical utility of the HPT.

Seven years after the seminal HPT article was published, Murphy and MacKillop (2006) adapted the framework of Jacobs and Bickel (1999) to examine the relative reinforcing efficacy of alcohol among college-aged drinkers. A large sample of 267 undergraduate students completed several measures related to alcohol including the Daily Drinking Questionnaire (DDQ; Collins, Parks, & Marlatt, 1985), the Rutgers Alcohol Problem Inventory (RAPI; White & Labouvie, 1989), and an Alcohol Purchase Task (APT) adapted from the HPT used by Jacobs and Bickel (1999). In the Murphy and MacKillop APT variant, participants read the following instructions:

> "Imagine that you and your friends are at a bar from 9 p.m. to 2 a.m. to see a band. The following questions ask how many drinks you would purchase at various prices. The available drinks are standard size beer (12 oz), wine (5 oz), shots of hard liquor (1.5 oz), or mixed drinks with one shot of liquor. Assume that you did not drink alcohol before you went to the bar and will not go out after." (pg. 222)

Similarly, participants reported the number of drinks they would consume at the following prices: $0 (free), 0.25, 0.50, 1.00, 1.50, 2.00, 2.50, 3.00, 4.00, 5.00, 6.00, 7.00, 8.00, and 9.00. Note the narrow range of prices as compared to Jacobs and Bickel.

The linear elasticity model (Equation 1; Hursh et al., 1988) provided an excellent fit to the aggregate data ($R^2 = .995$) and good fits at the individual level (R^2_{range}: $.56 - .98$). With a Bonferroni correction reducing a significant P-value to 0.002, most empirical and derived measures were statistically significantly correlated with one another except for the correlations between observed P_{max} and observed/derived intensity and between elasticity and observed intensity. In terms of clinical utility, observed/derived intensity and observed/derived O_{max}

were statistically significantly correlated with all three self-reported drinking measures (i.e., number of drinks/week, number of heavy drinking episodes/week, RAPI; Pearson r_{range}= $.23 - .70$). Breakpoint was statistically significantly correlated with number of drinks per week (Pearson $r = .21$) and number of heavy drinking episodes per week (Pearson $r = .24$). In addition, participants were classified as either heavy drinkers (reported at least one weekly heavy drinking episode; Mean drinks/week = 18.34) or light drinkers (no weekly heavy drinking episodes; Mean drinks/week = 4.46). Analysis of variance revealed statistically significant differences in breakpoint, observed/derived intensity, and observed/derived O_{max} between the two drinking groups. Collectively, the results of Murphy and MacKillop (2006) provide further evidence of the clinical utility of the HPT (and more specifically, the APT).

Variations in the wording of instructions have been used in subsequent studies. For example, Murphy, MacKillop, Skidmore, and Pederson (2009) used the following instructions (differences in the instructions used by Murphy & MacKillop, 2006 in bold):

> "**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 **party on a weekend night** from 9:00 p.m. until 2:00 a.m. 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 **or use drugs** before you went to the **party**, and **that you will not drink or use drugs after leaving the party. You cannot bring your own alcohol or drugs to the party. Also, assume that the alcohol you are about to purchase is for your consumption only. In other words, you can't sell the drinks or give them to anyone else. You also can't bring the drinks home. Everything you buy is, therefore, for your own personal use within the 5 hour period that you are at the party. Please respond to these questions honestly, as if you were actually in this situation.**" (pg. 398)

The degree to which differences in instructions affect responses on the APT (or HPTs generally) are unknown; however, literature suggests that responding is sensitive to variations in the instructions. For example, several studies have found instructions that specify next-day responsibilities reduce demand for alcohol (Gentile, Librizzi, & Martinetti, 2012; Gilbert, Murphy, & Dennhardt, 2014; Skidmore & Murphy, 2011) and that demand is reduced to a greater extent when those next-day responsibilities are "important" (e.g., test, interview) and scheduled earlier in the day (e.g., 8:30 a.m. vs 12:30 p.m.). In addition, Henley, DiGennaro Reed, Kaplan, and Reed (2016) found that participants were less likely to pass out flyers when monetary payment for passing out the flyers was delayed by 4 weeks vs 1 hour.

Additional Applications of the Hypothetical Purchase Task. Between 1999 (introduction of the seminal HPT) and now (2016), the general framework of the HPT has been applied to a range of drug and non-drug reinforcers. I only briefly highlight some of these applications given the focus of this paper is on the APT. Several drug reinforcers have been evaluated using the HPT including cigarettes (e.g., Bidwell, MacKillop, Murphy, Tidey, & Colby, 2012; Few, Acker, Murphy, & MacKillop, 2012; Grace, Kivell, & Laugesen, 2014; Jacobs & Bickel, 1999; Koffarnus, Wilson, & Bickel, 2015; MacKillop, Brown, et al., 2012; MacKillop, Few, et al., 2012; MacKillop et al., 2016, 2008; MacKillop & Tidey, 2011; Madden & Kalman, 2010; O'Connor, Bansal-Travers, Carter, & Cummings, 2012; O'Connor et al., 2014; Quisenberry, Koffarnus, Hatz, Epstein, & Bickel, 2015; Wilson, Franck, Koffarnus, & Bickel, 2016), marijuana (e.g., Aston, Metrik, & MacKillop, 2015; Collins, Vincent, Yu, Liu, & Epstein, 2014), bath salts (e.g., Johnson & Johnson, 2014), heroin (e.g., Jacobs & Bickel, 1999), cocaine (e.g., Bruner & Johnson, 2014), ultraviolet indoor tanning (e.g., Reed, Kaplan, Becirevic, Roma, & Hursh, 2016), and anabolic steroids (e.g., Pope et al., 2010). In addition, several non-drug reinforcers have been evaluated using an HPT including gasoline (e.g., Reed, Kaplan, Roma, & Hursh, 2014), food (e.g., Epstein, Dearing, & Roba, 2010; Roma, Hursh, & Hudja, 2016), luxury (e.g., vacations) and essential items (e.g., toilet paper; Roma et al., 2016), and money (e.g., Henley et al., 2016).

Psychometrics of the APT. A number of studies have evaluated the psychometric properties of the APT (and HPTs more generally). In the following section, I briefly describe these findings mainly focusing on those relevant to the APT.

Reliability.

Temporal stability. Murphy et al. (2009) evaluated the test-retest reliability of the APT. Thirty-eight participants completed the APT at time 1 and of those 38 participants, 17 were randomly selected to complete the same APT 14 days (time 2) following the initial assessment. Demand metrics were determined empirically (i.e., observed) and using nonlinear regression (applying both Equations 1 and 6). No statistically significant differences in mean levels of consumption were found between the two time points. At the individual level, consumption values at the two time points were highly and statistically significantly correlated, with Pearson *r*s ranging from .71-.91. No differences were observed between the demand metrics at the two time points. This was true for both the empirical and derived measures. Also noteworthy is that Few et al. (2012) demonstrated a cigarette purchase task (CPT; a variant of the APT with similar structure) resulted in temporally stable responding between testing sessions separated by 1 week. Correlations between demand indices were statistically significantly related (Pearson's rs = .76-.99, ps < .001).

Internal reliability. To evaluate the internal consistency of the APT, Amlung and MacKillop (2012) recruited 91 regular drinking undergraduate participants to complete two versions of the APT that differed in the order of price presentation. In one version, price per drink increased in the typical ascending fashion, whereas the second version presented the same prices in a pseudo-randomized order. Overall, participants responded consistently between the two versions. Although intensity and breakpoint were not statistically significantly different between the two versions, measures of O_{max}, P_{max}, and α did significantly differ. However, these differences tended to be small. These results suggest that a sequential price progression does not systematically bias the results.

Validity.

Predictive validity. MacKillop and Murphy (2007) demonstrated the predictive validity of the APT by showing that empirical measures of intensity, elasticity, breakpoint, O_{max}, and P_{max} all statistically significantly and independently predicted the number of drinks per week consumed at six months following the a brief alcohol intervention. After controlling for gender, baseline drinks per week, treatment condition, and reinforcement ratio, all measures except intensity incrementally predicted post-intervention drinks per week. In addition, Murphy et al. (2015) evaluated three different brief alcohol interventions among 133 heavy drinking college students. Results indicated baseline intensity significantly predicted quantity of drinks consumed per week and alcohol problems present at a 1-month follow-up. Alcohol demand was reduced immediately following two of the three brief interventions with reductions in intensity and O_{max} significantly predicting reductions in drinking at a 1-month follow-up. Relatedly, Madden and Kalman (2010) showed that elasticity for cigarettes (assessed using a CPT) following one week of bupropion treatment predicted smoking cessation.

Concurrent and convergent validity. Literature suggests demand indices derived from the APT tend to correlate with self-report measures of drinking quantity and alcohol related problems (e.g., Bertholet, Murphy, Daeppen, Gmel, & Gaume, 2015; MacKillop, Miranda, et al., 2010; Murphy & MacKillop, 2006; Murphy et al., 2009). Relatedly, demand indices tend to be sensitive to categorical classifications of severity of alcohol use; that is, elevated indices of demand is associated with greater severity of alcohol use (e.g., Murphy & MacKillop, 2006; Smith et al., 2010; Teeters & Murphy, 2015; Teeters, Pickover, Dennhardt, Martens, & Murphy, 2014). Several studies suggest responses on APTs with hypothetical outcomes tend to be consistent with responses on versions of the APT where outcomes are actually experienced (e.g., Amlung & MacKillop, 2015; Amlung, Acker, Stojek, Murphy, & MacKillop, 2012). Finally, research using the APT in cue-reactivity paradigms shows responses are sensitive to acute experimental manipulations (e.g., Amlung & MacKillop, 2014; Amlung, McCarty, Morris, Tsai, & McCarthy, 2015).

Construct validity. Recently, Kiselica, Webber, and Bornovalova (2016) conducted a meta-analysis examining the construct validity of the APT. Sixteen articles met the inclusion criteria of reporting "...at least one bivariate relationship of a reinforcing efficacy metric with an alcohol-related outcome [alcohol consumption, binge/heavy drinking, alcohol-related consequences, alcohol use disorder (AUD) symptoms]" (pg. 808). Data were analyzed using random-effects models with inverse variance weighting and method of moments estimation. Overall, effect sizes tended to range from non-significant to strong. Intensity tended to show the strongest relations with alcohol-related outcomes (effect sizes r_{range}: .34-.51), followed by O_{max} (effect sizes r_{range}: .23-.39). Although breakpoint was statistically significantly related to all alcohol-related outcomes, effect sizes tended to be small (effect sizes r_{range} = .15-.19). P_{max} was only statistically significantly related to alcohol consumption and binge/heavy drinking (effect sizes *r*s = .05 and .03, respectively). Finally, measures of elasticity were statistically significantly related to all alcohol-related outcomes except binge/heavy drinking (effect sizes r_{range}: -.11- -.20).

The relatively weak effect sizes observed by Kiselica et al. (2016) may, in part, be due to the vast differences in the procedural implementation of the APT as well as methods by which responses were analyzed. Currently, not only is there is no "standard" approach to administering the APT, there is also no "standard" approach to analyzing responses generated from it. In the following sections, I discuss the various methods used to analyze responses on the APT (and HPTs in general) and variations in the structure of the APT.

Quantitative Models of Demand

In the behavioral economic literature, several models have been proposed to characterize patterns of responding on demand curve assays (i.e., experiential operant; HPT). In addition, these models have been fit to demand curve data using various fitting methods. In the following sections I introduce these fitting methods and describe the proposed models, but first I will briefly discuss broad concepts related to regression analyses.

Regression models are used to describe relations between variables and focus can be shifted to either predictive or descriptive relations based on the questions being asked. Regardless of focus, in statistics the real-world relation between variables is termed the "data-generating process" (DGP) and it is this unknown, unobservable stochastic process that is attempted to be modeled. Regression analysis allows the scientist to estimate or approximate this relation. However, these estimates come with an amount of uncertainty because (1) the true DGP is unknown, (2) observations may have some degree of error in their measurement, and (3) the scientist rarely observes all the variables that exist in the true DGP. Ideally, the scientist collects additional data and/or refines the model to decrease this amount of uncertainty. Different fitting methods may be used depending on the focus of the relation and question being asked. A predictive relation is one where the scientist is interested in determining some quantity of an outcome or the probability that an outcome is likely to occur based on other pieces of information. A descriptive relation is one where the scientist is more interested in how variables interact or in uncovering some underlying process. Demand curve analyses are predominately used descriptively where the behavioral economist is more interested in how certain individual and environmental characteristics affect how consumption changes with changes in price (e.g., Hursh, 1984; Jacobs & Bickel, 1999). Demand curve analyses are also used predictively, for example in determining the price point at which consumption substantially decreases with increases in price, for example to inform tax and public policy (e.g., Hursh & Roma, 2013; MacKillop, Few, et al., 2012; Reed, Kaplan, et al., 2016).

Fitting methods.

Pooled regression. The pooled regression fitting method fits the quantitative model to the entire dataset, disregarding individual-specific classification of responses. That is, all x (i.e., unit prices) and y (i.e., consumption) values across all participants are entered into the regression model at once. An advantage of the pooled regression is that it takes into account all the individual's responses at each price. It fits a single curve to all of the participants' pooled data. However, because individual responses at each price can vary considerably, the presence of extreme values (relative to the mean) could influence the parameter estimates. This technique is rarely used in the literature.

Between regression (regression on the group averages). The between regression, or regression on the group averages, is one of the more common fitting methods used in the literature. Participant responses are averaged at each price and these averaged data are subsequently entered into the regression model. Although an advantage of the between method is that it is less sensitive to deviations at each price point, this comes at the expense of taking into account individual variability at each of the price points.

Fixed effects regression (regression on the individual). The fixed effects regression, or regression on the individual, is by far the most prominent fitting method used in the literature. In this regression method, a model is fit for each individual. An advantage of this method is that it can estimate parameters for each individual, however it does not take into account how individual responses fluctuate around the overall mean response pattern (as this mean response pattern may be reflective of the DGP). Yu, Liu, Collins, Vincent, and Epstein (2014) claim this approach may give rise to an "overparameterized" model that leads to large standard errors and estimates that may be influenced by extreme cases (e.g., relatively poor fits leading to biased estimates).

Mixed effects regression. Mixed effects regression models consist of both fixed and random effects. These models are useful under the assumption that the overall data themselves arise from an overarching DGP, but also that certain attributes of the data (e.g., clustering; repeated measures) are affected in systematic ways. For example, a researcher may be interested in predicting elementary students' test scores from a variety of predictor variables. These predictor variables could be the student's socioeconomic status (SES), gender, and race. Other predictor variables could be the student's teacher or school. The researcher might treat the student-specific attributes (i.e., SES, gender, race) as fixed effects. It may be the case that different teachers are differentially effective at promoting learning. Thus, the researcher might treat the effect of different teachers as a random effect (also a level-2 predictor since any given teacher teaches a number of different students).

In the behavioral economic demand literature, individuals are treated as level-2 variables and prices as level-1 variables because each individual experiences all the prices. That is, prices are clustered within individual. In contrast to the fixed effects models described above, mixed effects regression takes into account the group average at each price point, while also allowing an estimate of the individual variability around the average. Downsides of this fitting method is that not all statistical programs can fit the mixed-effects models and that extra steps are required to make statements about the random effects at the individual level.

Fixed effects models.

Linear elasticity model. The linear elasticity model, proposed by Hursh, Raslear, Bauman, and Black (1989), was the first quantitative equation to describe behavioral economic demand curve data.

$$lnQ_{ij} = lnL_i + b_i ln(P_j) - a_i P_j, i = 1, ..., n, j = 1, ..., k \tag{1}$$

where Q_{ij} is the amount of consumption for the i-th participant at the j-th price point, P_j is the j-th price point, L_i is the derived amount of consumption as P_j approaches 0, b_i is the slope of the demand curve at initial price, and a_i is the parameter representing decreases in consumption with increases in price. Note, the original introduction of Equation 1 did not include an assumption of the distribution of the error term. The equation assumes elasticity (E) decreases linearly with price (the following equations adapted from Hursh et al., 1989; pg. 400):

$$-E = \Delta\frac{d(logQ)}{d(logP)} = b - aP \tag{2}$$

with this assumption, total consumption (Q) is derived as follows:

$$Q = LP^b e^{-aP}$$

$$lnQ = lnL + bln(P) - aP$$

total response (R) output as:

$$R = \Delta PQ(LP^{1+b})(e^{-aP})$$

and the price (P_{max}) that results in maximum response output as:

$$P_{max} = \frac{(1+b)}{a} \tag{3}$$

and maximum response output (O_{max}) at point P_{max}:

$$O_{max} = LP_{max}^{1+b} e^{-(1+b)} \tag{4}$$

Nonlinear elasticity model. As seen previously, the linear elasticity model can take the following nonlinear form:

$$Q_{ij} = L_i P_j^{b_i} e^{-a_i P_j}, i = 1, \ldots, n, j = 1, \ldots, k \tag{5}$$

where Q_{ij}, P_j, L_i, b_i, and a_i are the same as in Equation 1. An advantage of this model is its ability to accommodate 0 consumption values, but this specific form has rarely been used in the literature (see Yu et al., 2014).

Exponential model. Limitations of Equation 1 led to an alternative method of quantifying behavioral economic demand curve data. In some cases, estimates from Equation 1 result in unrealistic values (Hursh & Silberberg, 2008). Specifically, estimates of L may be inflated and estimates of b take on positive values, indicating an initial increase in consumption at low prices. Increases in consumption with increases in price are not to be expected as such patterns would violate the law of demand (e.g., Samuelson & Nordhaus, 1985).

The exponential model (Equation 6 below) proposed by Hursh and Silberberg (2008) describes demand similarly to the linear elasticity model (Equation 1), but does so by offering several advantages. First, the equation returns a single fitted parameter (α) describing not the change in elasticity, but rather the *rate* of change in elasticity as a function of price. The single fitted parameter is made possible by standardizing the demand function in terms of its log range of consumption values (a weighting parameter; k) and by the level of maximum demand (i.e., demand intensity [Q_0]; cf. Hursh & Winger, 1995). Second, it results in more realistic estimates of consumption at near 0 price (i.e., Q_0) and does not predict increases in consumption at low prices. Finally, fits (as measured by R^2) tend to be as high or higher than those from Equation 1. For completeness, the following is adapted from Hursh and Silberberg (2008):

$$logQ = k(e^{-\alpha P}) + minimum$$

$$logQ = logQ_0 + k(e^{-\alpha P} - 1)$$

$$P_s = Q_0 C$$

$$logQ_{ij} = logQ_{0i} + k(e^{-\alpha_i Q_{0i} C_j} - 1), i = 1, ..., n, j = 1, ..., k \tag{6}$$

where Q_{ij} represents consumption for the i-th participant at the j-th price point, C_j is the j-th price of the reinforcer (unit price), and Q_{0i}, k, and α_i are as described in the above paragraph. Since the exponent includes the product of Q_{0i} and C_j, which standardizes price in relation to baseline levels of consumption, reinforcer value is isolated to the α_i parameter (given the same k value). Note, as with Equation 1, the original formulation of Equation 6 did not include an assumption of the distribution of the error term.

Similar to Equation 1, researchers can derive additional metrics, such as essential value (EV), P_{max}, and O_{max}.

$$EV = \frac{1}{100 \alpha k^{1.5}} \tag{7}$$

$$P_{max} = \frac{0.084k + 0.65}{Q_0 \alpha k^{1.5}} \tag{8}$$

$$O_{max} = (logQ_0 + k(e^{-\alpha Q_0 P_{max}} - 1))P_{max} \tag{9}$$

Exponentiated model. Recently, Koffarnus, Franck, Stein, and Bickel (2015) proposed an alternative equation to that of Equation 6. The proposed equation addresses the concern of dealing with 0 values in Equation 6, which standard practice has been to either omit the 0 values completely or replace them with arbitrarily small non-zero values (e.g., .1, .01, .001). The "exponentiated" model takes the following form:

$$Q_{ij} = Q_{0i} \cdot 10^{k(e^{-\alpha_i Q_{0i} C_j} - 1)}, i = 1, ..., n, j = 1, ..., k \tag{10}$$

where the parameters are the same as in Equation 6. Koffarnus, Franck, et al. demonstrate the supposed advantages of Equation 10 by evaluating both an empirical dataset (Experiment 1) and a simulated dataset (Experiment 2) and show that Equation 10 recovers the true values more accurately than Equation 6 when 0 values are either omitted or changed to .1, .01, or .001.

Several potential issues relate to this formulation and the procedures used in Koffarnus, Franck, et al.. First, when using the "least-squares" approach in fitting Equation 6, relative differences are minimized (consumption is in logarithmic units). This is not the case with Equation 10 where absolute differences are minimized (consumption is in linear units). Hursh (ABAI, 2016) argues that minimizing absolute differences may lead to placing greater weight on differences at low prices rather than at higher prices, which is where consumption more readily changes as a function of price. The same rationale might also apply to Equation 5 since consumption is also fit on a linear scale. Second, Koffarnus, Franck, et al. selected their data "...as a basis for model comparison because they exemplify the issues with zero consumption values..." (pg. 3). The price progression used (i.e., $0.00 [free], 0.10, 1.00, 3.00, 10.00, 30.00, 100.00, 300.00, and 1,000.00) differed substantially from what is typically used in HPT studies and resulted in nearly 50% of the respondents reporting 0 consumption as soon as the fifth price (i.e., \$10.00). The degree to which Equation 10 outperforms Equation 6 using a validated form of an HPT is unknown.

Mixed effects models. To date, two mixed effects models have been proposed to account for behavioral economic demand curve data; these are the nonlinear mixed effects model and the left-censored mixed effects model.

Nonlinear mixed effects model. The nonlinear mixed effects model, proposed by Yu et al. (2014), uses as its base Equation 5. It states:

$$Q_{ij} = L_i P_j^{b_i} e^{-a_i P_j} + \varepsilon_{ij}, i = 1, ..., n, j = 1, ..., k \tag{11}$$

$$\begin{pmatrix} L_i \\ a_i \\ b_i \end{pmatrix} = \begin{pmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \end{pmatrix} + \begin{pmatrix} b_{1i} \\ b_{2i} \\ b_{3i} \end{pmatrix} = \beta + \mathbf{b_i}, \mathbf{b_i} \sim MN(0, \Psi), \varepsilon_{ij} \sim N(0, \sigma^2 f(p_j)),$$

$$\Psi = \begin{pmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{13} \\ \sigma_{12} & \sigma_2^2 & \sigma_{23} \\ \sigma_{13} & \sigma_{23} & \sigma_3^2 \end{pmatrix}$$

where i is the level-2 subscript (i.e., individual) and j is the level-1 subscript (i.e., price point). Note that this is the style used by Pinheiro and Bates (2006). The parameters Q_{ij}, P_j, L_i, b_i, and a_i have the same interpretations as in Equations 1 and 5. Fixed effects are indicated by the β and random effects by the $\mathbf{b}$, the latter of which follows a multinormal distribution (MN) with a mean of 0 and a variance-covariance matrix equal to Ψ. In the variance-covariance matrix, values along the main diagonal indicate variances of L_i, a_i, and b_i and values on the off diagonals indicate the covariances. The residuals (ε_{ij}) follow a normal distribution with a mean of 0 and heteroscedastic variances as a function of price. The residuals' variances are such because at low prices variability in consumption tends to be higher. As price increases, variability in consumption tends to decrease (see Figure 4). The three derived indices elasticity, P_{max}, and O_{max} are calculated identically to Equations 2, 3, and 4, respectively.

Left-censored mixed effects model. The left-censored mixed effects model proposed by Liao et al. (2013) is a two-pronged model where zero values are treated as values below some threshold or limit of detection (i.e., left-censoring). That is, the model assumes that a participant who reports zero might actually be willing to purchase some fractional quantity or amount of the good. This threshold is specified a priori (e.g., .5 units).

$$log_{10}Q_{ij} = \mu_{ij} + \varepsilon_{ij} = log_{10}Q_{0i} + k(e^{-\alpha_i P_j} - 1) + \varepsilon_{ij} \tag{12}$$

$$\begin{pmatrix} log_{10}Q_{0i} \\ \alpha_i \end{pmatrix} = \begin{pmatrix} \beta_1 \\ \beta_2 \end{pmatrix} + \begin{pmatrix} b_{1i} \\ b_{2i} \end{pmatrix} = \beta + \mathbf{b_i}, \mathbf{b_i} \sim MN(\mu, \Psi), \varepsilon_{ij} \sim N(0, \sigma_e^2),$$

$$\mu = \begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix}$$

$$\Psi = \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{pmatrix}$$

where i is the level-2 subscript (i.e., individual) and j is the level-1 subscript (i.e., price point), noting again the style of Pinheiro and Bates (2006). Similar to above, fixed effects are indicated by the β and random effects by the $\mathbf{b}$, the latter of which follows a multinormal distribution with means (μ_1, μ_2) and a variance-covariance matrix equal to Ψ. The residuals follow a normal distribution with a mean of 0 and variance of σ_e^2. There are two disadvantages of this equation. One, there are few statistical programs that are able to fit this two-pronged model (Liao et al. use SAS; SAS Institute Inc., Cary, North Carolina). Two, it may be conceptually erroneous to assume that all of a given participant's reported zero values are actually some fractional quantity greater than zero, but less than one. Rather, it might actually be the case that zero values beyond breakpoint indicate the participant would not purchase any fractional quantity.

Sans curve fitting.

Empirically derived measures. Many of the demand indices described in the preceding section can be determined empirically, without the need for nonlinear regression modeling. As long as a price of $0.00 (i.e., free) is assessed, intensity of demand is equal to the amount of consumption at that price. O_{max} can be empirically determined by multiplying values of consumption by their respective prices (i.e., by creating an expenditure curve) and finding the maximum value. P_{max} is simply the price associated with O_{max}.

Area under the curve. Area under the curve (AUC) has recently been proposed as an (a)theoretical measure of demand (Amlung, Yurasek, McCarty, MacKillop, & Murphy, 2015). AUC for demand takes the same functional form for AUC for discounting (Myerson, Green, & Warusawitharana, 2001):

$$AUC = \sum_{j=1}^{k} (x_{j+1} - x_j)[(y_j + y_{j+1})/2]; j = 1, ..., k \tag{13}$$

where x_j is the j-th price and y_j is the amount of consumption at the j-th price. The areas of trapezoids created between each adjacent point are summed to create a singular AUC value corresponding to the entire amount of consumption across all prices. To normalize individual AUC out of 1, a referent demand curve is first generated by finding the highest consumption value across all participants in the sample then inputting that value for the consumption at each price and finding the total area under that curve. Individual AUC values are then divided by that value. Amlung, Yurasek, et al. found measures of AUC were statistically significantly correlated with contemporary measures of demand (e.g., intensity, breakpoint, O_{max}, P_{max}) and statistically significantly predicted self-reported measures of weekly drinking and alcohol related problems. Although promising, additional studies are needed to validate AUC. For example, one limitation of AUC is that the range of prices may artificially inflate or otherwise influence the resulting score. When the area of trapezoids is calculated, those trapezoids between closely adjacent prices are weighted less than trapezoids between largely spaced prices.

Brief assessment of alcohol demand. The brief assessment of alcohol demand (BAAD; Owens, Murphy, & MacKillop, 2015) is composed of three items aimed to reflect three key measures obtained from a demand assay: intensity, O_{max}, and breakpoint. The BAAD asks the following questions:

1. If drinks were free, how many would you have? (0-10)

2. What is the maximum total amount that you would spend on drinking (approximately)? ($0-$40; $4 increments)

3. What is the maximum you would pay for a single drink? ($0-$20; $2 increments)

Associated with each question is a range of numbers reflecting either the number of drinks or a monetary amount (specific values above in parentheses), approximating a Likert-type format. Respondents answer by indicating the value associated with each question. Owens, Murphy, and MacKillop exposed participants to a cue-reactivity paradigm and found statistically significant increases in responses for all three questions as compared to pre-cue exposure. As an initial validation, the BAAD appears to be an efficient technique to obtain important demand indices, but additional studies will need to assess the correspondence between results from the BAAD and those from traditional demand assays and the degree to which responses from the BAAD are sensitive to typical measures of problems associated with and quantities of alcohol consumption.

Where is the error term?. Many of the equations specified above were specified without an explicit assumption of the error term. This was purposeful because the original formulations themselves did not specify error terms. By error term, I mean the distribution of the residuals – the difference between the observed quantity (*y*-value) and the predicted quantity ($\hat{y}$-value). For example, ordinary least squares (OLS) assumes that the errors follow a normal distribution with a mean of 0 and a standard deviation equal to σ^2. Nonlinear least squares (the method by which equations specified in the section above are evaluated) can hold the same assumption. The relevance of the error term is illustrated by comparing the "mathematically equivalent" Equations 6 and 10. Under the assumption that the error term associated with Equation 6 follows a $N(0, \sigma^2)$, then the mathematical transformation of taking 10 to the power of each side (to get rid of the logarithms) would result in a multiplicative error term (e.g., lognormal distribution; $lnN[0, \sigma^2]$).

Review of the Literature

Purpose and methods. Recall that the meta-analysis conducted by Kiselica et al. (2016) resulted in generally moderate to weak relations with alcohol-related outcomes. These results may have been in part due to the vast differences in the procedural implementation of the APT as well as methods by which responses were analyzed. Currently, there does not appear to be a "standard" approach to administering the APT, nor does there appear to be a "standard" approach to analyzing responses generated from it. Therefore, the purpose of this literature review is to provide a survey on the use of APTs. Specifically, variations in the use of APTs are highlighted with specific emphasis on procedural and analytical methods.

To begin the literature review, I conducted a Google Scholar search on March 7th, 2016 using the following query: "behavioral economic" AND "purchase task" OR "simulated demand". On the same day, I searched Google Scholar via Publish or Perish using the same query. Publish or Perish resulted in 148 results. Cross-referencing these results with the Google Scholar (proper; i.e., www.scholar.google.com) search yielded a total of 165 results.

- Phase 1: Each entry was categorized as one of the following: empirical, book, chapter, review, thesis, dissertation, theoretical, or NA.
- Phase 2: Retain all empirical entries through the year 2015. Examine the title and/or abstract for any reference to the use of an HPT.
- Phase 3: Retain all entries that appear to reference the use of an HPT. Examine the

title, abstract, and/or methods section for any reference to the use of an APT.

- Phase 4: Retain all entries that appear to reference the use of an APT. Thirty-eight entries remained.

Articles were coded for demographic and procedural characteristics (i.e., participant sample, number of participants, mean and standard deviation of participants' ages, type of compensation, additional measures; see Table 1), structural characteristics of the APT itself (i.e., number of prices, prices used, vignette; see Table 2), and characteristics of data analysis (i.e., software used, changes to any zero values, value of and method of obtaining k, use of Equation 6; see Table 3). Note, while I identified 38 articles meeting the criteria for my literature review, there are 39 entries in each of the aforementioned tables. The additional entry is due to separate coding for the second experiment in Gentile et al. (2012).

Variations among APT study methods.

Participant demographics and compensation. Table 1 displays summary information related to the demographic and procedural characteristics of the 38 articles identified in the literature search. Twenty-seven of the 38 articles (71.1%) used strictly undergraduates or college students as their participant sample, nine (23.7%) articles used strictly participants from the community (including Swiss men approaching army recruitment; Bertholet et al., 2015), and two (5.3%) articles recruited participants from both the university and the community. Criteria for inclusion varied but most studies required some threshold of drinking. For example, many studies required prospective participants to have engaged in at least one heavy drinking episode within the past 30 days, with one heavy drinking episode defined as 4+ or 5+ drinks in a single setting for females and males, respectively. Some studies required a similar criteria but at different cutoffs. Examples include at least 20+ or 28+ drinks per week for females and males, respectively, 7+ or 14+ drinks per week for females and males, respectively, and 21+ drinks per week for males. Other criteria were more general, for example having at least one alcoholic drink during the past month or having consumed at least one alcohol beverage during the past six months. Only four studies (10.5%) required a minimum score on an alternative alcohol measure (e.g., 7+ or 8+ on the Alcohol Use Disorders Identification Task [discussed in the next section]). All four of these studies recruited participants from the community.

The lowest sample size used was 17 (e.g., Murphy et al., 2009) and the highest sample size was 4790 (e.g., Bertholet et al., 2015). Mean age tended to fluctuate around 20 years old. The lowest mean age was 18.5 (e.g., Gilbert et al., 2014) and the highest mean age was 42.4 (e.g., MacKillop, Miranda, et al., 2010). One study (e.g., Murphy et al., 2013) did not report participants' ages. Ten studies (26.3%) compensated participants exclusively with either research credit or extra credit, eight studies (21%) compensated participants exclusively with money, and five studies (13.2%) compensated participants with either money or academic credit. Two studies (5.3%) did not provide any compensation and 13 studies (34%) did not report compensation of any kind.

Alcohol measures in addition to the APT. Every study identified provided some type of assessment in addition to the APT. In the following sections, I describe additional assessments or measures specifically related to alcohol consumption and/or outcomes (see last column in Table 1).

Daily drinking questionnaire. The Daily Drinking Questionnaire (DDQ; Collins et al., 1985) assesses weekly alcohol use (both frequency and quantity) by asking respondents to imagine a typical week during the past three months and report the number of hours spent drinking and the number of standard drinks consumed for each day of the week (i.e., Monday-Sunday). Collins et al. (1985) demonstrated the DDQ to have adequate convergent validity when compared to a lengthened form of the DDQ, the Drinking Practices Questionnaire (Cahalan, Cisin, & Crossley, 1969). The DDQ results in three measures: (1) the number of days during the past month meeting binge drinking criteria (i.e., 4/5 drinks in a single occasion for women and men, respectively), (2) average number of drinks per week, and (3) average number of hours spent drinking per week. Twenty of the 38 articles (52.6%) assessed weekly alcohol use via the DDQ.

Young adult alcohol consequences questionnaire. The Young Adult Alcohol Consequences Questionnaire (YAACQ; Kahler, Strong, & Read, 2005; Read, Kahler, Strong, & Colder, 2006; Read, Merrill, Kahler, & Strong, 2007) consists of 48 dichotomous (i.e., yes/no) endorsement questions representing a total score consisting of eight subscales. Subscales include: social/interpersonal, academic/occupational, risky behavior, impaired control, poor self-care, diminished self-perception, blackout drinking, and physiological dependence. Read et al. (2006) found YAACQ total scores correlated with alcohol use measures (e.g., alcohol quantity, frequency) and scores on the Rutgers alcohol problem index (discussed below). In addition, Read et al. (2007) provided further validation of the YAACQ demonstrating the questionnaire's internal consistency, test-retest reliability, and concurrent validity. Importantly, Read et al. (2007) also found scores on the YAACQ early in the semester adequately predicted academic performance at the end of the semester; specifically, college students who scored higher on the YAACQ tended to display lower grade-point averages at the end of the semester. Ten articles (26.3%) used the YAACQ.

Timeline followback. Seven articles (18.4%) assessed drinking use using the Timeline Followback procedure (TLFB; Maisto, Sobell, Cooper, & Sobell, 1979; Sobell, Maisto, Sobell, & Cooper, 1979; Sobell & Sobell, 1992, 1995). In the TLFB procedure, participants retrospectively report the number of days they had consumed alcohol and the amount of alcohol they had consumed each of those days, up to a 1 yr timeframe in the past. The TLFB procedure has been modified to shorten the window of recall, including a 90-day and 28-day version. Although originally developed for in-person interview settings, which this form has been shown to have high reliability and validity (Sobell & Sobell, 1992; Sobell, Sobell, Leo, & Cancilla, 1988), responses on computerized versions of the TLFB do not significantly differ from responses obtained during in-person interviews (Sobell, Brown, Leo, & Sobell, 1996). In addition, although slightly less reliable, the TLFB has been shown to result in similar levels of estimating alcohol use as compared to automated telephone calls (Searles, Helzer, & Walter, 2000). Several measures can be obtained from the TLFB including: (1) number of drinking days during the 28-day period and (2) total number of drinks consumed during the 28-day period. The 28-day TLFB has been the most common timeframe among APT articles.

Adolescent reinforcement survey schedule. The Adolescent Reinforcement Survey Schedule (ARSS; Holmes, Heckel, Chestnut, Harris, & Cautela, 1987; Holmes, Sakano, Cautela, & Holmes, 1991) is a self-report questionnaire, developed for adolescents, that estimates the amount of relative reinforcement obtained from engaging in various activities. An adapted version, the ARSS-Substance Use Version (ARSS-SUV; Murphy, Correia, Colby, & Vuchinich, 2005), presents participants with 54 activities in which they rate the frequency with which they engaged in each activity (within the past 30 days) and the enjoyment associated with each activity. Frequency ratings range from 0 (i.e., 0 times in the past 30 days) to 4 (i.e., more than once a day) and enjoyment ratings range from 0 (i.e., unpleasant or neutral) to 4 (i.e., extremely pleasant). Participants complete the ARSS-SUV twice; once for activities when alcohol or other drugs are involved and once for activities when no alcohol or other drugs are involved. For each completion of the ARSS-SUV, frequency and enjoyment ratings are multiplied to produce cross-product scores (range: 0-16). Finally, a ratio is obtained by dividing the cross-product score for when alcohol or other drugs are involved by the sum of substance-related and substance-free cross-product scores. This ratio is the amount of reinforcement obtained by substance-related activities with larger scores reflecting relatively greater reinforcement coming from substance-related activities. Four studies (10.5%) used either the ARSS or ARSS-SUV.

Rutgers alcohol problem index. The Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989) is a 23-item questionnaire assessing adolescent problem drinking. The RAPI is internally consistent (i.e., .92, .93), displays moderate to strong correlations with alcohol-use intensity (i.e., .20 - .57; note, alcohol-use intensity as described here refers to a composite score of three questions relating to the frequency of drinking, amount of drinking, and frequency of getting drunk when drinking; White & Labouvie, 1989), and has excellent test-retest reliability (i.e., .89 at 1 mo, .92 at 1 yr; Miller et al., 2002). The RAPI was originally constructed using a sample of 1,308 males and females ranging in age from 12-21 yrs old. An abbreviated 18-item version has also been developed, which shows high correlations with the full version (i.e., Pearson $r = .99$; White & Labouvie, 2000). The RAPI is scored by summing the weights of each of the 23 questions, resulting in a total possible score of 69. Clinical samples' scores range from 21-25; nonclinical samples' scores range from 4-8, noting that these ranges are for adolescents ranging in age from 14-18 yrs old. Three studies (7.9%) used the RAPI.

Alcohol use disorders identification task. The Alcohol Use Disorders Identification Task (AUDIT; Dawson, Grant, Stinson, & Zhou, 2005; Saunders, Aasland, Babor, De La Fuente, & Grant, 1993) is a 10-item questionnaire related to alcohol behavior and alcohol-related consequences. The AUDIT was initially developed through a World Health Organization collaborative effort using a large international sample of almost 2,000 participants. The AUDIT is appropriate for use with both males and females across a range of ages. It displays high convergent validity with alternative alcohol use assessments (Allen, Litten, Fertig, & Babor, 1997) and shows excellent test-retest reliability (AUDIT total score: Pearson $r = .93$; Miller et al., 2002). Finally, the AUDIT is scored by summing the weights of each of the 10 questions; with total scores of 8 or greater meeting criteria for hazardous and harmful alcohol use (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001). Two articles (5.3%) used the AUDIT.

Structural characteristics of the APT. Table 2 displays an overview of the different structural characteristics of APTs identified through the literature review. Characteristics include the number of prices used, the price structure, and the vignette.

Number of prices. Only two articles (5.3%) did not specify the number of prices used and one of these articles (e.g., Owens, Murphy, & MacKillop, 2015) did not use any price sequence. Rather, they used the BAAD. Of the articles reporting the number of prices used, except Gilbert et al. (2014) where they only assessed free price, the minimum number of prices used was 11 (i.e., Bertholet et al., 2015). The maximum number of prices used was 26 (i.e., Gray & MacKillop, 2014); however, only the first 21 prices were actually analyzed given the lack of variability in responding above $70.

Price structure. Five articles (13.2%) reported using a randomized price sequence (e.g., Amlung & MacKillop, 2014; Gentile et al., 2012; Kiselica & Borders, 2013; MacKillop et al., 2014) and, as previously mentioned, two articles either did not specify or did not use any price sequence. Of the remaining articles that reported and used a price sequence, 30 (78.9%) articles reported the initial price assessed was free and three articles reported the initial price assessed was $0.01. Overall, the order of prices resembled a PR-like progression with relatively smaller step-sizes at low prices and increasing as prices increased. The highest price assessed was $1,120 as reported by three articles; however, two of these articles reported analyzing prices up to $70 (e.g., Gray & MacKillop, 2015; Owens, Ray, & MacKillop, 2015).

Vignette. The degree to which articles reported aspects of the vignette vary greatly. Five articles (13.2%) did not report any information related to the instructions or vignettes. Several articles described the general framework of the APT, sometimes specifying only that participants were asked how many drinks they would purchase at a given set of prices. Others provided full vignettes. Some vignettes were "state-based", meaning instructions specified consumption during a specified time frame, usually within that day (e.g., "For use during a 1 hour self-administration phase", "Right now"). The majority of vignettes were "trait-based", meaning instructions specified consumption during a typical drinking situation or during a specific situation (e.g., "Imagine you are drinking in a TYPICAL SITUATION...", "Imagine that you and your friends are at a bar from 9pm to 2am...").

Methods of data analyses. Table 3 displays the characteristics of different data techniques, including software used, changes to zero values, values of and method of obtaining k, and whether Equation 6 was used to fit demand data.

Software used. Fourteen articles (36.8%) did not report any software used. Of the articles that did report software used, many reported using GraphPad Prism. Several reported using either a calculator from or a template from the Institutes for Behavior Resources, Inc. website (www.ibrinc.org). Other software reported, but not necessarily specifically for use in demand analyses, included SPSS, SAS, and Mplus. No articles I identified reported using the R software.

Changes to zero values. Twenty-four of the 38 articles (63.2%) did not report any changes to zero values. Five articles (13.2%) reported removing zero values completely. Seven articles (18.4%) reported replacing zero values with .01. Two articles (5.3%) reported replacing zero values with .001. Three articles (7.9%) explicitly reported changing free price (i.e., $0.00) to either .01 or .001.

Use of equation 6 and values of and calculating k. Twenty-four articles (63.2%) reported using Equation 6. Values of *k* ranged from 1-4. Five of the 24 articles (20.8%) using Equation 6 did not report the value of *k* nor the method of obtaining it. Nine articles (37.5%) reported a *k* value but did not report the method of obtaining it. The most common method of obtaining *k* was by finding the best-fit value from the overall mean curve. Two articles explicitly reported using an iterative solver available from the Institutes for Behavior Resources, Inc.

Conclusion. Based on the results of my literature review, a "prototypical" experiment using an APT would consist of the following characteristics. Alcohol measures in addition to the APT would likely include the DDQ, YAACQ, and TLFB. It is unsurprising that the YAACQ is one of the most widely used measures given undergraduates were the participant demographic in nearly 75% of the articles reviewed. The APT itself would contain at least 11 prices ranging from free ($0.00) to at least $9.00 and presented in ascending order. The vignette would most likely specify being at a party or a bar with friends at night where standard sized drinks are available for purchase. A well designed APT would include assumptions such as having not drank before the party, that all drinks are for the participant's consumption only, and that drinks are not available elsewhere. Data would consist of replacing zero values with .01 and subsequently analyzed using Equation 6 where *k* would be determined by finding the best-fit value from the overall mean curve. However, the data analytic strategies in this scenario probably represent the "prototypical" method, not necessarily the most appropriate method.

Past Research on Vignette Manipulations

Academic constraints. Through conducting my literature review, I identified four studies (Gentile et al., 2012; Gilbert et al., 2014; Skidmore & Murphy, 2011; Teeters & Murphy, 2015) that have compared demand metrics based on manipulating instructions in the APT. I provide a brief overview of that research here. In the first of such studies, Skidmore and Murphy (2011) recruited 207 heavy drinking college students (53.1% female; $M_{age} = 19.50$) to complete three versions of an APT that differed with respect to next day responsibilities. Using a within-subjects design, participants first read a standard vignette that contained the following instructions (p. 61):

> 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 party on a Thursday night from 9:00 PM until 2:00 AM to see a band. Imagine that you do not have any obligations the next day (i.e., no work or classes).
>
> 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 that contain one shot of liquor. Assume that you did not drink alcohol or use drugs before you went to the party and that you will not drink or use drugs after leaving the party. Also, assume that the alcohol you are about to purchase is for your consumption only during the party (you can't sell or bring drinks home). ***Please respond to these questions honestly, as if you were actually in this situation.***

The second APT specified a next-day test where participants were instructed to, "...report the number of drinks they would purchase/consume if they had a test to take the next morning" (p. 61). One additional sentence was provided: "The only difference from the last scenario is that we now ask that you imagine that you have a test (worth 25% of your course grade) for a college class the next morning at 10:00 AM" (p. 61). The third and final APT specified a next-day class. In this version participants were instructed to, "...report the number of drinks they would purchase/consume if they had a class to attend the next morning" and the additional sentence provided read: "The only difference from the last scenario is that we now ask that you imagine that you have a college class the next morning at 10:00 AM, but there is no test and the teacher does not take attendance" (p. 61).

Five demand indices were examined – four of which were empirically generated. Empirically generated demand measures included intensity, O_{max}, P_{max}, and breakpoint. Elasticity (i.e., α) was derived from equation 6. Results from a series of repeated measures ANOVAs revealed statistically significant effects of vignette framing on all five demand measures. That is, the no-responsibility condition resulted in the highest (or lowest for the case of α) mean values and the next-day test condition resulted in the lowest (or highest for the case of α) mean values.

To address limitations of the study by Skidmore and Murphy (2011) – notably, the use of a within-subjects design leading to the potential for carryover effects and viewing all prices sequentially and on one page – Gentile et al. (2012) used a between-subjects design to "... examine whether the presence, timing, and nature of the work of a next-day academic constraint influence reported alcohol consumption among college students" (p. 392). In the first of two experiments, 164 undergraduate students (71% female; $M_{age} = 19.88$) completed one of four versions of an APT that differed in the scheduled time of a hypothetical next-day class. Participants in the control group (i.e., no constraint) read the following vignette (p. 392):

> Imagine that you and your friends are at a bar from 9 p.m. to 2 a.m. The following questions ask how many drinks you would purchase at various prices. The available drinks are a standard size beer (12 oz.), a glass of wine (5 oz.), a shot of hard liquor (1.5 oz.), or a mixed drink with one shot of liquor. Assume that you did not drink alcohol before you went to the bar and will not go out after.

Participants in one of the three next-day class conditions (i.e., class at 8:30 a.m., 10:30 a.m., 12:30 p.m.) read a slightly modified vignette (p. 392):

> Imagine that you and your friends are at a bar from 9 p.m. to 2 a.m., but you have a class at [8:30 a.m./10:30 a.m./12:30 p.m.] the next day. The class is an upper-level seminar within your major and there are 12 students in the class. The following questions ask how many drinks you would purchase at various prices. The available drinks are a standard size beer (12 oz.), a glass of wine (5 oz.), a shot of hard liquor (1.5 oz.), or a mixed drink with one shot of liquor. Assume that you did not drink alcohol before you went to the bar and will not go out after.

Participants answered the following question associated with a range of prices: "How many drinks would you consume if each drink cost ____?". In contrast with other APT administrations, prices in this study were not only randomized (i.e., $5.00, $0.25, $7.00, $10.00, $0.50, $3.00, $1.00, $0 (free), $4.00, $0.75, $8.00, $2.00, $6.00, and $9.00), but that each price was presented on a separate page of the computer screen. Statistical differences across all conditions were examined for derived measures of Q_0 and α using a sum of squares F-test and follow-up comparisons were conducted by comparing the parameters' 95% confidence intervals. Derived measures of P_{max} and O_{max} were also computed using an iterative Microsoft Excel solver provided by Dr. Steven Hursh.

Equation 6 provided excellent fits to the mean data ($R^2 \geq .98$ for all conditions). The sum of squares F-test comparing values of α revealed statistically significant differences. Pairwise comparisons of 95% confidence intervals indicated all conditions were significantly different from each other except for the 8:30 a.m. and 10:30 a.m. class conditions. The sum of squares F-test comparing values of Q_0 indicated statistically significant differences. Pairwise comparisons showed Q_0 in the no-constraint condition significantly differed from all other three conditions, but no differences in Q_0 were observed between the latter conditions.

In the second experiment, 66 undergraduate students (80.3% female; $M_{age} = 19.20$) completed one of four versions of an APT that differed slightly from those used in experiment 1. The specific conditions included a(n) (1) 8:30 a.m. class; (2) 8:30 a.m. exam; (3) 12:30 p.m. class; and (4) 12:30 p.m. exam. The vignette was presented as follows (p. 395):

> Imagine that you and your friends are at a bar from 9 p.m. to 2 a.m., and you have a(n) [exam/class] at [8:30 a.m./12:30 p.m.] the follow- ing day. The following questions ask how many drinks you would purchase at various prices. The available drinks are a standard size beer (12 oz.), a glass of wine (5 oz.), a shot of hard liquor (1.5 oz.), or a mixed drink with one shot of liquor. Assume that you did not drink alcohol before you went to the bar and will not go out after.

As before, each price was displayed on a separate page and the price sequence was randomized. Several prices were added and the randomized price sequence was displayed as follows: $5.00, $0.25, $7.00, $13.00, $10.00, $0.50, $3.00, $15.00, $1.00, $0 (free), $4.00,

\$12.00, \$0.75, \$8.00, \$2.00, \$11.00, \$6.00, \$9.00, and \$14.00. Data were analyzed similar to experiment 1.

Equation 6 provided fits to the mean data all exceeding R^2 of .95. Sum of squares F-tests across conditions were statistically significant for both derived values of Q_0 and α. Values of α were high for both morning conditions compared to both afternoon conditions and higher for the early morning exam as compared to the early morning class. Q_0 in the 8:30 a.m. exam condition was significantly lower than the other three conditions. Overall, results from Gentile et al. (2012) show that responding on the APT is sensitive to differential instructions and that decreases in demand indices were systematic with respect to the degree of constraint (e.g., a morning exam led to the greatest reduction, morning classes led to greater reductions than afternoon classes).

Extending the work of Gentile et al. (2012), Gilbert et al. (2014) evaluated how next-day constraints – academic and otherwise – affected drinking the night-before. Participants were 80 undergraduate freshman (50% female; $M_{age} = 18.5$) who reported at least one heavy drinking episode during the previous 30 days. In terms of characteristics of the APT, participants were provided definitions of standard drinks and were told to imagine that they were attending a party that began at 9:00 p.m., that they could leave at any time, and that drinks were free. For each of the nine next-day constraint scenarios, participants answered how many drinks they would have at the party if they had X the next morning at 9:00 a.m., where “X” was each of the following: no next-day responsibilities, a college class at 9:00 a.m., class at 10:00 a.m., class at 11:00 a.m., class at noon, an internship at 9:00 a.m., extracurricular activity at 9:00 a.m., volunteering at 9:00 a.m., and paid employment at 9:00 a.m.

Paired t-tests (with Bonferroni corrected alpha levels) indicated statistically significant differences between each of the constraint conditions compared to the no-constraint condition ($M_{drinks} = 9.81$; $SD_{drinks} = 5.48$). The smallest difference was found for the next-day class at 12 p.m. ($t[77] = 6.74, p < .001, d_{rm} = .83$) associated with a sample mean of 6.64 drinks ($SD_{drinks} = 3.64$). The internship condition resulted in the fewest mean number of drinks consumed ($M_{drinks} = 2.21$; $SD_{drinks} = 2.38$).

Driving after drinking. Rather than manipulating hypothetical next-day constraints in the instructions of the APT, Teeters and Murphy (2015) examined the effects on responding of a hypothetical scenario in which participants were to be driving home after the party. Four hundred and nineteen undergraduate students (75.9% female; $M_{age} = 20.37$) who reported using alcohol during the past month participated. Participants viewed two versions of the APT. The first, standard version of the APT contained the following instructions (p. 898):

> In the questions that follow we would like you to make decisions about how many drinks you would have in various situations. The available drinks are standard size domestic beers (12 oz.), wine (5 oz.), shots of hard liquor (1.5 oz.), or mixed drinks containing 1 shot of liquor. Please respond to these questions honestly, as if you were actually in this situation. Please imagine that you and your friends are at a party from 9:00 PM until 1:00 AM. Assume that you did not drink alcohol or use drugs before you went to the party, and that you will not drink or use drugs after leaving the party.

The second, adapted version contained the same instructions as the standard with the addition of the following sentence at the end: "Imagine that you were driving home at 2:00 AM at least 1 hour after you stopped drinking". Seventeen prices were assessed ranging from $0.00 to $20.00 and participants responding to the following question at each price: "How many drinks would you have if they were $____ each?". In addition to the APTs, participants reported how many times during the past three months they had driven within two hours of drinking. Participants reporting driving after three or more drinks were classified as DAD^{+} and DAD^{-} otherwise.

Three empirical and one derived demand measures were determined. The three empirical demand measures included intensity, breakpoint (i.e., price resulting in zero levels of consumption), and O_{max}. Elasticity (i.e., α) was derived using Equation 6. Overall, greater alcohol demand (i.e., all four measures) was positively associated with driving after drinking. There were statistically significant reductions in all of the observed demand indices between the standard and modified versions of the APT. Mean intensity for the standard APT was 7.28 drinks and decreased to a mean of 4.59 drinks for the modified version (a 36.9% reduction).

Drink Specials and Excessive Alcohol Consumption

From 2006 to 2010, there was an annual average of 87,798 alcohol-attributable deaths and 2,500,000 years of potential life lost (Stahre, Roeber, Kanny, Brewer, & Zhang, 2014). During this time period, excessive drinking was responsible for one in ten working age (20-64 year olds) adults' deaths. Binge drinking (4+/5+ drinks per occasion for women and men, respectively), heavy drinking (8+/15+ drinks per week for women and men, respectively), and drinking among individuals 21 years of age or younger defines excessive alcohol consumption (Center for Disease Control and Prevention, 2016). Prolonged excessive alcohol consumption can lead to a number of health related diseases such as high blood pressure, heart disease, stroke, various cancers, social and mental health problems, and alcohol dependence (World Health Organization, 2014). Apart from devastating health consequences, it is estimated that excessive alcohol consumption cost the U.S. $250 billion in 2010 (Sacks, Gonzales, Bouchery, Tomedi, & Brewer, 2015), and increase of more than $25 billion from the estimated $223.5 billion in 2006 (Bouchery, Harwood, Sacks, Simon, & Brewer, 2011). Among the various strategies recommended to reduce excessive alcohol consumption include increasing alcohol excise taxes (Elder et al., 2010), regulating the number and density of alcohol retailers in a given area (Campbell et al., 2009), holding alcohol-serving establishments responsible for harm and injury as a result of illegal service (e.g., serving intoxicated or underage individuals; Rammohan et al., 2011), and limiting days and hours of sales (Hahn et al., 2010; Middleton et al., 2010).

Research conducted during the past several decades have generally supported the notion that alcohol consumption is price sensitive. That is, alcohol consumption tends to increase as alcohol price decreases and vice versa (for an overview of this research, see Chaloupka, Grossman, & Saffer, 2002). Price of alcohol can be lowered due to reduced taxes, manufacturer and retail competition, and/or drink specials such as "happy hours." Happy hour "...is a term for a set period of time, often advertised, when an establishment serves alcohol at a discounted rate" (Baldwin, Stogner, & Miller, 2014, ; p. 18). It is a "discount drink policy"

(Babor, Mendelson, Greenberg, & Kuehnle, 1978). Several studies have examined how these discount drink specials affect alcohol consumption and most of this research has been conducted with college-aged students and young adults. Using survey methods (over 10,000 college student respondents) and direct observation (830 on-premise and 1,684 off-premise establishments), Kuo, Wechsler, Greenberg, and Lee (2003) examined the relation between rates of binge-drinking, past 30-days drinking, and annual drinking and total alcohol environment scores. Total alcohol environment scores were aggregate scores reflecting the presence of various types of alcohol specials and promotions at both on-premise (e.g., bars, clubs, restaurants) and off-premise (e.g., liquor stores, convenience stores, grocery stores) locations. Higher total alcohol environment scores were reflective of greater alcohol specials and promotions. Rates of binge-drinking ($r_{Pearson} = 0.49$), past 30-days drinking ($r_{Pearson} = 0.41$), and annual drinking ($r_{Pearson} = 0.35$) were all significantly correlated with total alcohol environment scores. Further, binge-drinking rates were significantly correlated with the presence of beer specials ($r_{Pearson} = 0.42$, $p < 0.0001$) and planned promotions in the next 30 days ($r_{Pearson} = 0.37$, $p < 0.0001$). Overall, results from Kuo et al. suggest college students' excessive drinking is sensitive to alcohol price and that alcohol specials are significantly related to greater alcohol consumption.

In another study, Baldwin et al. (2014) examined the relation between happy hour specials, happy hour drinking behavior, and negative outcomes. A total of 2,349 college-aged students participated and the sample demographic was reflective of the broader university. Participants completed surveys that consisted of several questions. One question asked, "Compared to normal drinking, how does your drinking change when you attend a bar with a happy hour or drink special?". Participants who reported that they drink more, drink more quickly, or drink more and more quickly were collapsed into one group (i.e., increase drinking during happy hour; 64.1%). Those who reported that their drinking does not change or that they drink less and/or more slowly were collapsed into a separate group (i.e., did not increase drinking during happy hour; 35.9%). Participants responded yes or no if they've: (1) ever driven a vehicle after consuming five or more drinks; (2) had any alcohol-related arrests; (3) been arrested or cited for driving under the influence; (4) had unprotected sex with a stranger while under the influence; and (5) engaged in any "malicious fighting" while under the influence. A ten-item Likert-type scale (1-6) assessed the severity of relationship, health, emotional, financial, and legal problems related to alcohol use. Finally, participants reported past month alcohol frequency ranging from 0 (none) to 5 (twenty or more days). Women, underage drinkers, non-athletes, members of Greek-affiliated organizations, those with low GPAs, more affluent students, unemployed students, and students living on campus were all more likely to increase their drinking habits during happy hour specials. Individuals who reported increased drinking during happy hours were 1.88 and 2.18 times more likely to drive and get into fights, respectively, while intoxicated. With all else being equal, changes in drinking patterns during happy hour specials significantly predicted alcohol related problems ($\beta_{OLS} = .13,\ p < 0.01$).

In an attempt to address limitations of Baldwin et al. (2014) and Kuo et al. (2003), mainly the sole use of self-report measures, Thombs, Dodd, Webb, Lacaci, and Werch (2008) used a combination of self-report and objective (e.g., breath alcohol concentration) measures to determine the influence of drink specials on intoxication level. Data were collected on three consecutive nights (Wednesday-Friday) during the last week of classes of the fall (2007) and spring (2008) semesters at two different colleges located in southeast U.S. Observation periods occurred outside of bars each night between 7:00 P.M. and 10:00 P.M. and again between 11:00 P.M. and 2:00 A.M. Upon exiting the bars, prospective participants were approached and asked to participate in the study. Of the approximately 600 individuals approached, 291 subsequently participated. Participants were asked a series of questions (e.g., When did you start drinking today?; How many drinks have you had today?; Did you take advantage of any drink specials tonight at this establishment?) and asked to blow into a breathalyzer. A logistic regression with seven predictors (took advantage of a drink special that night; legal drinking age; hours spent drinking; self-reported number of drinks consumed that day; money spent on cover charges and alcohol that night; gender; number of minutes between last drink and breathalyzer test) was used to predict whether the participant was highly intoxicated (BAC greater than or equal to 80 mg/dl, the legal limit for driving under the influence) or not. The overall model accounted for 34.9% of the variance (i.e., Nagelkerke pseudo-R^2) in intoxication level. Participants who reported taking advantage of a drink special that night were 4.38 times more likely to be highly intoxicated and underage drinkers were nearly three times more likely to be highly intoxicated. Number of minutes between last drink and blowing into the breathalyzer and gender were not significant predictors of having a BAC greater than or equal to 80 mg/dl.

As discussed previously, much of the research examining the effects of drink specials has used college students as the participant demographic. Although their participant samples are arguably not representative of the broader demographic, two studies have used populations other than college students. In one of these studies, and one of the first studies examining the effects of happy hour drink specials, Babor et al. (1978) recruited 34 non-alcohol dependent adult males ($M_{age} = 24$) from the community to participate in alcohol research. Twenty casual drinkers (less than five episodes of drunkenness per month) and 14 heavy drinkers (meeting two of four possible criteria; e.g., more than five episodes of drunkenness per month, more than 15 drinking occasions per month) lived in a clinical research ward (Drug Abuse Research Center at McLean Hospital) for 30 days. During their stay, participants earned points by responding on an operant manipulandum set on a fixed-interval 1s schedule and 3600 points could be exchanged for one dollar. For all participants, alcoholic drinks (12 oz can of beer, 1 oz vodka, bourbon, gin, and scotch all with an optional mixer) were available for purchase at any time day or night for $0.50 per drink. For approximately half of the participants, a happy hour condition was in place each day from 2 to 5 p.m. where drinks were available for purchase at $0.25 per drink. Data on the number, time of day, and type of drinks purchased, as well as breathalyzer readings scheduled for multiple times during the day were gathered. Casual drinkers drank an average of 20.9 and 10.1 drinks during the happy hour and nonhappy hour conditions, respectively. Heavy drinkers drank more irrespective of condition. In the happy hour condition, heavy drinkers drank an average of 117.6 drinks whereas in the nonhappy hour condition, they drank an average of 49.6 drinks. Main and interaction effects were statistically significant such that heavy drinkers "...consumed approximately five times the amount of alcohol as casual drinkers in their respective happy and nonhappy hour conditions" (p. 38). In comparing the time of day in which drinks were purchased and consumed, both casual and heavy drinkers purchased more alcohol during the happy hour as compared to those in the nonhappy condition at other times of the day. Finally, self-reports of the amount of alcohol consumed outside of the research setting was significantly correlated with the amount of alcohol consumed during the research session for both groups ($r_{HappyHour} = 0.76$, $p < 0.001$; $r_{NonhappyHour} = 0.57$, $p < 0.05$).

Given the relatively clear associations between happy hour drink specials and subsequent deleterious effects on drinking related outcomes, such as an increased amount of drinking, increased BAC, and increased likelihood of experiencing negative consequences, it may be of no surprise that public policy efforts have been made to ban or at least restrict alcohol drink specials. Restrictions in sales of drink specials varies greatly across states, ranging from complete bans to some restrictions to no restrictions at all. The most recent tabulation of happy hour restrictions (current as of July, 2014) is available from www.ncsc.org/.../~/media/microsites/files/traffic-safety/copy%20of%20happyhourregulations.ashx. I have provided this summary in Table 4 and cross-referenced these results with changes in happy hour laws since July, 2014. Since July, 2014, Illinois is the only state that has lifted the happy hour ban (while still maintaining some temporal and amount restrictions) and additional details can be found in the footnote of Table 4. Thus, eleven states in total (i.e., Alaska, Delaware, Hawaii, Indiana, Maine, Massachusetts, North Carolina, Oklahoma, Rhode Island, Utah, Vermont) completely ban happy hours. Nine states (i.e., Alabama, Illinois, Louisiana, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Virginia) have restrictions in place that restrict the times in which happy hour can be offered (e.g., may not reduce price between 9 PM and 10AM; may not reduce price between 12 AM and 2:30 AM). Nine states (i.e., Arkansas, Illinois, Kansas, New Mexico, New York, South Carolina, Tennessee, Virginia, Washington) restrict the amount of discount for drinks (e.g., may not reduce price below cost). Six states (e.g., Arizona, Connecticut, Michigan, Nebraska, New Hampshire, New Jersey) only ban unlimited drink specials. Finally, 18 states (plus the District of Columbia; e.g., California, Colorado, Florida, Georgia, Idaho, Iowa, Kentucky, Maryland, Minnesota, Mississippi, Missouri, Montana, Nevada, North Dakota, South Dakota, West Virginia, Wisconsin, Wyoming) do not ban or restrict implementation of happy hours.

Method

Purpose

Overall, the research on the effects of happy hour drink specials on drinking related outcomes (amount drank, BAC, negative consequences) is compelling. Whether these effects are due to the decreased price per drink, the apparent increased "...social connotation" (Babor et al., 1978; p. 39) of happy hour, the time of day, the novelty of happy hour, or simply the framing of drink specials is unknown. As such, using a comprehensive version of the APT, the purpose of experiment 1 was to evaluate the framing of hypothetical drink specials on subsequent self-reported consumption of alcohol. In addition to attempting to replicate the results of the first experiment, experiment 2 examined the novelty aspect of happy hour by comparing changes in demand intensity between participants residing in states with different happy hour laws (i.e., banned, not banned). A goal of experiment 2 was to simulate public policy change by examining whether state status moderates changes in intensity.

General method

Participant sample. Participants were recruited from Amazon Mechanical Turk (mTurk; www.mturk.com), an online crowdsourcing platform where individuals (i.e., Workers) complete tasks (termed human intelligence tasks or HITs) posted by requesters (Buhrmester, Kwang, & Gosling, 2011). There are over 500,000 Workers on mTurk (Paolacci & Chandler, 2014). Past research suggests Workers are on average 36 years old, 64.85% are female, and

66.7% have household incomes less than $60,000 (Paolacci, Chandler, & Ipeirotis, 2010). mTurk is becoming an increasingly popular means of conducting behavioral and psychological research (e.g., Bickel et al., 2014; Buhrmester et al., 2011; Jarmolowicz, Bickel, Carter, Franck, & Mueller, 2012; Johnson, Herrmann, & Johnson, 2015; Reed, Becirevic, Atchley, Kaplan, & Liese, 2016). In order to obtain seemingly high-quality responses, Workers were required to meet the minimum following qualifications: (1) have at least 100 approved HITs, (2) have at least 95% of their previous HITs approved, and (3) be located in the United States. Within the range of previous studies, (e.g., Horton & Chilton, 2010; Johnson et al., 2015; Reed, Becirevic, et al., 2016; Roma et al., 2016), Workers in experiment 1 and experiment 2 were compensated with $0.50 and $1.00, respectively, for completing the HIT.

In experiment 1, all Workers (who met the aforementioned qualifications) were eligible to participate. Because experiment 2 simulated a potential public policy change, recruitment was restricted to two pools of states. One sample of participants was recruited from states where happy hours are banned (i.e., Alaska, Delaware, Hawaii, Indiana, Maine, Massachusetts, North Carolina, Oklahoma, Rhode Island, Utah, Vermont) and the other sample from states where happy hours are not banned (i.e., California, Colorado, Florida, Georgia, Idaho, Iowa, Kentucky, Maryland, Minnesota, Mississippi, Missouri, Montana, Nevada, North Dakota, South Dakota, West Virginia, Wisconsin, Wyoming). Data for experiment 1 were collected between 11-02-2016 and 11-03-2016 and data for experiment 2 were collected between 11-07-2016 and 11-13-2016.

Measures. All materials were created and administered using Qualtrics® Research Suite (a popular online survey software; www.qualtrics.com) and were the same across both experiments.

Demographic questions. Demographic questions included the following: primary language, gender, state of residence, marital status, household income, number of dependents, age, race/ethnicity, height, weight, education, employment status, primary profession/field of study, and smoking status. Many of the demographic questions were adopted from Roma et al.

(2016). The full demographics form can be found in Appendix A.

27-item monetary choice questionnaire. The 27-item Monetary Choice Questionnaire (MCQ; Kirby, Petry, & Bickel, 1999) is a delay discounting task consisting of 27 dichotomous choice items. For each item participants are instructed to choose between a small amount of money delivered immediately and a larger amount of money delivered after some delay. Participants were given the following instructions:

> For each of the next 27 choices, please mark which hypothetical reward you would prefer: the smaller reward today, or the larger reward in the specified number of days. While you will not actually receive the rewards, pretend you will actually be receiving the amount you indicate and answer honestly.

Upon scoring the responses (see Kaplan et al., 2016 for specific instructions), a *k* value is obtained that reflects an individual's tendency to devalue outcomes based on the delay to receiving those outcomes. The 27-item MCQ is one of the most extensively researched and used discounting tasks (Duckworth & Seligman, 2005; Kirby, 2009; Kirby & Petry, 2004). Although an extensive review of the discounting literature is beyond the scope of this paper, this task was included in the procedures to act as a distractor task in between the standard and modified versions of the APT (see below). Appendix B displays the 27-item MCQ.

Typical alcohol consumption. The Daily Drinking Questionnaire (DDQ; Collins et al., 1985) assessed weekly alcohol use (both frequency and quantity) during a typical week in the past month. The DDQ resulted in three measures: (1) the number of days during the past month meeting binge drinking criteria (i.e., 4/5 drinks in a single occasion for women and men, respectively), (2) the number of drinks per week, and (3) the number of hours spent drinking per week. Appendix C displays the DDQ.

Alcohol severity. The Alcohol Use Disorders Identification Task (AUDIT; Dawson et al., 2005; Saunders et al., 1993) is a 10-item questionnaire related to alcohol behavior and alcohol-related consequences. It is scored by summing the weights of each of the 10 questions; with total scores of 8 or greater meeting criteria for hazardous and harmful alcohol use (Babor et al., 2001). Appendix E displays the AUDIT; however responses on the AUDIT were not analyzed in current study.

First time alcohol. Five questions asked participants about initial alcohol use. The questions included age of first sip, age of first drink (i.e., finishing the entire drink), age of first purchase for personal consumption, age first started drinking regularly, and age of first intoxicated event. These responses were collected but not analyzed in the current study.

Alcohol purchase tasks. Three versions of the APT were constructed. Based on the literature review, the most comprehensive APT vignette was used by Murphy et al. (2013, pg. 131). This vignette is similar to the standard, validated version of the APT used by Murphy et al. (2009, pg. 398) with the addition of the sentence, "Imagine that you do not have any obligations the next day (i.e., no work or classes)." Given the modified versions of the APT included wording related to a "happy hour" and that the mTurk population is, on average, older than the average aged college student participant (Paolacci et al., 2010), the word "party" in the Murphy et al. (2013) vignette was replaced with the word "bar." The full vignette of the standard version reads 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 at a bar on a weekend night from **9:00 p.m. until 2:00 a.m.** to see a band. Imagine that you do not have any obligations the next day (i.e., no work or classes). 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 or use drugs before you went to the bar, and that you will not drink or use drugs after leaving the bar. You cannot bring your own alcohol or drugs to the bar. Also, assume that the alcohol you are about to purchase is for your consumption only. In other words, you can't sell the drinks or give them to anyone else. You also can't bring the drinks home. Everything you buy is, therefore, for your own personal use within the **5 hour period** that you are at the bar. Please respond to these questions honestly, as if you were actually in this situation.

In an attempt to increase the likelihood of participants attending to important aspects of the vignette, prior to responding participants were required to correctly answer the following three multiple choice questions: (1) In this pretend scenario, how many hours do you have to consume the drinks?; (2) In the pretend scenario, how much did you drink before the bar?; and (3) In the pretend scenario, what is the drink special?.

Based on the standard version, two modified APTs relating to "happy hour" scenarios were constructed To do this, the second sentence of the vignette (i.e., "Imagine that you and your friends are at a bar on a weekend night from 9:00 p.m. until 2:00 a.m. to see a band.") was replaced with the following sentences (note, the two wordings in brackets and separated by the "/" correspond with the two different versions): "Imagine another typical weekend later the same month as the last scenario (same bar, same group of friends, etc.). Now imagine that from 9 p.m. until 2 a.m., the bar has a Happy Hour Drink Special where drinks are [½ off (50% off)/buy one get one free (BOGO)]." For the remainder of this paper, I refer to the half-off (50% off) condition as "HP", the buy one get one free condition as "BOGO", and the standard condition as "control."

Regardless of version, below the vignette a statement read, "How many standard drink purchases would you make at each price:" A three column table was displayed below this statement. The first (i.e. left) column presented a price and associated drink. The specific text differed slightly based on condition, however the same price sequence (indicated by the X.XX in the following) was displayed regardless of condition. In the unmodified version, the text read, "$X.XX per drink." In the HP version, the text read, "$X.XX per drink on sale for $Y.YY per drink" (where Y.YY was half the price of X.XX). Finally, in the BOGO version, the text read, "$X.XX per drink on sale for $X.XX per 2 drinks." Prices were the same price sequence used in Murphy et al. (2013): $0.00 (free), 0.25, 0.50, 1.00, 1.50, 2.00, 2.50, 3.00, 4.00, 5.00, 6.00, 7.00, 8.00, 9.00, 10.00, 15.00, and 20.00. The second (i.e., middle) column presented a heading that read (depending on condition), "Number of [standard/half price/buy one get one free] drink purchases you would make:" and presented boxes where participants typed in their responses. The third (i.e., right) column presented a heading that read, "Number of drinks you would consume:" and also presented boxes. Javascript coding was used to automatically populate these boxes when a participant entered a number into the box in the middle column of its respective row. The value that appeared was conditional on the vignette condition. In the control and HP conditions, the calculated value was the same as that in the middle column. In the BOGO condition, the calculated value was double the value that the participant entered into the middle column (to disambiguate whether a single BOGO purchase resulted in one or two drinks). Appendix F displays the modified vignettes and first few prices as shown in Qualtrics.

Procedures. Upon selecting the HIT on the mTurk platform and clicking on the survey link, participants viewed an information statement (Appendix G), at the end of which they were able to either agree or disagree to participate. After agreeing, all participants completed the unmodified APT followed by the demographics form and the 27-item MCQ. Then participants completed one of the modified APTs or the unmodified APT (the group that completed the standard version twice served as the control group). Presentations of the second APT (un/modified versions) were randomized across participants. Following a second presentation of the APT, participants completed the DDQ, AUDIT and questions related to first alcohol use. Then a single question asked: "Please answer the following question to the best of your ability: In the state in which you reside, are happy hours?: (a) banned; (b) restricted; (c) not banned." After completing this question, participants were able to provide any comments to the researcher, the survey ended, and participants received a unique passcode in which they entered into a box on the mTurk platform indicating their completion of the HIT.

Data analytic plan. All data were analyzed using R statistical software (R Core Team, 2016). Additionally, data from both experiments were analyzed in the same manner so analyses are described here for brevity. Important to note is that participant data in experiment 2 were analyzed separately (but using the following process). In other words, data from participants recruited from the banned states were analyzed as a group and data from participants recruited from not banned states were analyzed as a separate group. Demographic variables were compared across groups within each experiment. Continuous measures (i.e., age, duration of time to complete the survey) were compared using a Kruskal-Wallis.

Categorical measures were compared using Fisher's Exact Test (Agresti, 1992). Then, a series of Kruskal-Wallis one-way ANOVAs were used to determine whether alcohol consumption differed among the three groups. Measures from the DDQ included number of binge drinking episodes during the past 30 days, total number of drinks consumed, and total number of hours spent drinking during a typical week.

Raw consumption values generated from the APTs were initially examined for outliers. Within each price, consumption values greater (or less) than ± 4 *SDs* above (or below) the mean (e.g., Bujarski, MacKillop, & Ray, 2012; MacKillop, O'Hagen, et al., 2010; Owens, Ray, & MacKillop, 2015) were recoded as the next highest (or lowest) non-outlying value. This recoding strategy was applied within each APT condition at time 1 and time 2, separately. Data were then flagged for unsystematic patterns of responding by applying the three criteria proposed by Stein, Koffarnus, Snider, Quisenberry, and Bickel (2015). The three criteria proposed by Stein et al. include: (1) trend (i.e., a global reduction in consumption; requiring at least a 0.025 log-unit reduction in consumption per log-unit range in price), (2) bounce (i.e., price-to-price increases in consumption; requiring less than or equal to 10% of prices increments resulting in consumption increasing no more than 25% of initial consumption), and (3) reversals from zero (requiring no instances of two consecutive zeros followed by a nonzero consumption value). Response sets that passed all three criteria were used for subsequent analyses.

Systematic, recoded data were analyzed using the `beezdemand` (Kaplan, 2016) package. Resulting demand metrics, empirical (e.g. intensity, BP_1, P_{max}, O_{max}) and derived (i.e., EV), were examined for outliers based on the approach typical of past research (e.g., Gilbert et al., 2014; Skidmore & Murphy, 2011). That is, values greater (or less) than ± 3.29 *SDs* above (or below) below the mean were recoded as the next highest (or lowest) non-outlying value (see also Tabachnick & Fidell, 2013). The measures were additionally transformed using logarithmic and square root functions and were examined using the Shapiro-Wilk test of normality (Shapiro & Wilk, 1965), which tests the the null hypothesis that the sample comes from a Normal distribution. Through visual inspection, both types of transformations usually produced histograms that more closely resembled the Normal. However, nearly all transformed values were statistically significant (i.e., reject the null that the sample comes from a Normal distribution) and sometimes led to missing data (in the case of the logarithmic transformation). As such, raw values were used in all subsequent analyses (including calculating percent change).

The primary analysis compared change in demand intensity across the three experimental groups. Similar to Gilbert et al. (2014), a measure of change in intensity was produced. Because Gilbert et al. hypothesized that vignette manipulations would decrease level of intensity, those researchers calculated a percent reduction score by dividing intensity from the second APT by intensity from the first APT and subtracting this quotient from one (Equation 14):

$$\%Reduction = 1 - (\frac{Intensity_2}{Intensity_1}) \tag{14}$$

Instead of calculating a percent reduction, change in demand intensity in the current experiments was calculated by subtracting the first APT intensity from the second APT intensity, dividing this difference by the first APT intensity, and multiplying by 100 (Equation 15). Intuitively, positive values correspond with an increased change and negative values correspond with a decreased change, while noting that both change score equations (14 and 15) are mathematically identical with the only difference being the interpretation of the sign (i.e., positive, negative). For experiment 2 only, a multiple linear regression with covariates was used to compare differences in change in intensity across framing groups and happy hour state status.

$$\%Change = \frac{Intensity_2 - Intensity_1}{Intensity_1} \times 100 \tag{15}$$

In addition to intensity, percent change scores were calculated for (empirical) O_{max} and (derived) EV. Distributions of the residuals were examined for normality (Shapiro-Wilk) and heterogeneity between groups (Brown-Forsythe-Levene test; Brown & Forsythe, 1974). When only heterogeneity was present, a Welch's ANOVA (Welch, 1951) and Holm-Bonferroni (Abdi, 2010; Holm, 1979) adjusted pairwise t-tests were conducted to test differences in group means. When only non-normality was present, a Kruskal-Wallis one-way ANOVA (Kruskal & Wallis, 1952) and Holm-Bonferroni adjusted pairwise Mann-Whitney (Mann & Whitney, 1947; Wilcoxon, 1945) tests were used. Under circumstances where neither normality nor homogeneity were present, parametric and non-parametric pairwise comparisons were conducted and consistency among the test results were compared. Given differences in the price sequence between the standard and modified APTs, comparisons of breakpoint (BP_1) and (empirical) P_{max} were conducted between the discount price groups at time 1 and time 2 using parametric and non-parametric independent two-group tests. At the group level, the Extra Sum-of-Squares F test was conducted to determine if α values, derived from the aggregate demand curves, were statistically significantly different across the three groups. A global significant result was followed up by Holm-Bonferroni pairwise comparisons. Finally, a mixed ANOVA evaluated differences in consumption across time and group at prices common among the three groups.

Results

Experiment 1

Demographics and typical alcohol consumption. A total of 165 participants provided complete datasets for analysis. Table 5 shows detailed information related to participant demographics. Group sizes (56, 55, 54 for the control, BOGO, and HP groups, respectively) and demographic variables were similar across the three groups. According to the Kruskal-Wallis, age was the only variable significantly different among the groups ($p = 0.038$). The median (25th, 75th percentile) ages for the control, BOGO, and HP groups were 31 (27, 38), 33 (28,42), and 29 (25,35). Histograms (with overlaid density curves) of age by group are shown in Figure 5. Median duration to complete the task took 8.78 (6.29,11.54), 10.02

(7.32,12.93), and 9.30 (7.38,12.75) minutes for the control, BOGO, and HP groups, respectively. Gender was slightly unbalanced but did not meet statistical significance ($p = 0.107$).

The median number of binge drinking episodes during the past 30 days was 1 ($IQR = 3.00$), 1 ($IQR = 2.00$), and 1 ($IQR = 2.75$) for the control, BOGO, and HP groups, respectively. The median number of total drinks consumed in a typical week during the past 30 days was 5 ($IQR = 9.25$), 6 ($IQR = 10.00$), and 5 ($IQR = 9.50$) for the control, BOGO, and HP groups, respectively. Finally the median number of total hours spent drinking in a typical week during the past 30 days was 5.5 ($IQR = 8.250$), 7.0 ($IQR = 7.000$), and 5.5 ($IQR = 7.125$) for the control, BOGO, and HP groups, respectively. Parametric ANOVAs were conducted predicting each of the three DDQ outcomes as a function of group. Examination of the models' residuals indicated substantial positive skew and they were examined using Levene's test. Results for the number of binge episodes ($F[2,162] = 0.20, p = 0.821$), total number of drinks consumed ($F[2,162] = 0.45, p = 0.636$), and total number of hours spent drinking ($F[2,162] = 0.47, p = 0.627$) indicated that the variances between the groups were not unequal. Therefore, a Kruskal-Wallis one-way ANOVA was conducted to test whether there were differences in the three DDQ measures across the three groups. Results for the number of binge episodes ($\chi^2[2] = 0.63, p = 0.730$), total number of drinks consumed ($\chi^2[2] = 1.07, p = 0.585$), and total number of hours spent drinking ($\chi^2[2] = 1.29, p = 0.524$) revealed no statistically significant differences across the three groups.

Alcohol purchase task.

Consumption. As is typically observed in the demand curve literature, reported consumption decreased as price increased. Across all prices and all participants, a total of 9 outlying values (7 unique participants; ids: 43, 49, 51, 92, 123, 137, and 148) were replaced in the time 1 APT. At time 2, a total of 10 (2, 6, and 2 for control, BOGO, and HP conditions, respectively) outlying values were replaced (5 unique participants; ids: 51, 118, 148, 155, and 157). Figures 6 and 7 display box plots of consumption at each price for time 1 and time 2, respectively, after recoding.

Systematic responding. Table 6 displays the number of participants within each group at each time point that passed all three criteria proposed by Stein et al. (2015). Similar numbers of participants, both across condition and time period, passed all criteria. A total of 27 (~16.4%) and 25 (~15.2%) participants for time 1 and time 2, respectively, failed at least one criteria and a total of 32 (~19.4%) unique participants failed at least one criteria at either time point (ids: 8, 26, 28, 30, 31, 32, 42, 43, 49, 54, 63, 64, 79, 80, 82, 84, 92, 103, 110, 117, 118, 119, 121, 124, 127, 129, 130, 140, 147, 148, 155, and 165). Thus, after excluding these participants, 133 datasets were retained for subsequent analyses.

Demand measures. Outliers that were greater/less than $\pm 3.29 SDs$ above/below the mean were recoded as the next highest non-outlying value. Across the empirical measures of intensity, BP_1, O_{max}, and P_{max}, 5 values each were replaced for time 1 (ids: 51, 99, 123, 137, and 157) and time 2 (ids: 51, 62, 133, 136, and 137). One value of EV was replaced at each time point (time 1 id: 100; time 2 id: 116). Results from the Shapiro-Wilk normality test were statistically significant ($p < 0.05$) for all five untransformed demand measures across both time points. Measures were transformed using logarithmic and square-root methods, however only the square root transformation resulted in a statistically nonsignificant result for EV at times 1 and 2 and O_{max} at time 2 (see Figures 8 through 17 for sample histograms). Given these measures were to be used for subsequent calculation of percent change, they remained unaltered. Tables 7 and 8 provide descriptive statistics from the model fitting for time 1 and 2, respectively. At this point of the analysis, a total of 10 participants' data (out of 133 that passed all three systematic criteria; 7.5%) were recoded to some degree or another (consumption or demand measures).

Percent change.

Intensity. Figure 18 displays histograms (with overlaid density curves) of the percent change in intensity across the three groups. From left to right, the columns reflect unaltered, logarithmic transformed, and square root transformed values. The peaks represent 0% change.

A one-way ANOVA was fit to the unaltered data. Results of the Shapiro-Wilk test on the model residuals were statistically significant ($W = 0.85, p < 0.001$), as were the results of Levene's test, $F(2,129) = 53.20, p < 0.001$. Adjusted pairwise t-tests indicated the BOGO group ($M = 44.09\%, SD = 43.13\%$) was statistically significantly different from both the control ($M = -0.33\%, SD = 6.68\%$), $t(44.98) = -6.75, p < 0.001$, 95% CI $[-57.67, -31.17]$, $d = -1.42$, and HP groups ($M = 5.87\%, SD = 17.76\%$), $t(57.71) = 5.41, p < 0.001$, 95% CI $[24.08, 52.34], d = 1.17$. The control and HP groups were not statistically significantly different, $t(51.51) = -2.13, p = 0.29$, 95% CI $[-12.05, -0.36], d = -0.45$, from one another. Results of the adjusted pairwise Mann-Whitney tests also confirmed that the BOGO ($Mdn = 33.33\%$) group was statistically significantly different from both the control ($Mdn = 0\%$), $U = 338.5, p < 0.001, r = 0.65$, and HP groups ($Mdn = 0\%$), $U = 1431.5, p < 0.001, r = 0.51$. However, it also indicated differences between the control and HP groups, $U = 777, p = 0.011, r = 0.27$. Figure 19 displays box plots of percent change in intensity by group. Visual inspection of the box plots confirm the finding that the BOGO group was different than the other two groups. Differences between the control and HP groups do not look compelling, although there appears to be a number of points that fall above 0% relative to the control group.

O_{max}. Figure 20 displays histograms of the percent change in O_{max} across the three groups. Similar to before, the columns represent the unaltered data and transformations. A one-way ANOVA was fit to the unaltered data. Results of the Shapiro-Wilk test on the model residuals were statistically significant ($W = 0.90, p < 0.001$), as were the results of Levene's test, $F(2,126) = 5.20, p = 0.007$. As such adjusted parametric and non-parametric tests were used to compare the three groups, but neither family of tests indicated statistically significant differences in percent change between the three groups. The control group had a mean change of 17.62% ($SD = 41.10\%$, $Mdn = 0\%$). The BOGO group had a mean change of 25.64% ($SD = 63.89\%$, $Mdn = 16.67\%$). Finally, the HP group had a mean change of 5.48% ($SD = 38.86\%$, $Mdn = 0\%$). Figure 21 displays box plots of percent change in O_{max} by group.

EV. Figure 22 displays histograms of the percent change in *EV* across the three groups. A one-way ANOVA was fit to the unaltered data. Results of the Shapiro-Wilk test on the model residuals were statistically significant ($W = 0.75, p < 0.001$), however results of Levene's test indicated relative homogeneity, $F(2,111) = 2.01, p = 0.14$. The results of both Welch's ANOVA, $F(2,68.18) = 0.25, p = 0.78$, and the Kruskal Wallis, $\chi^2(2) = 0.61, p = 0.737$, did not indicate a main effect of APT framing on percent change in *EV* across the three groups. Figure 23 displays box plots of percent change in *EV* by group. As displayed in the figure, the control group had a mean change of 26.11% ($SD = 55.93\%$, $Mdn = 14.32\%$), the BOGO group had a mean change of 36.21% ($SD = 72.96\%$, $Mdn = 20.29\%$), and the HP group had a mean change of 33.55% ($SD = 87.80\%$, $Mdn = 13.32\%$). This should be a somewhat expected finding as *EV* is derived from α in Equation 6, which attempts to standardize the "real" cost by weighting each price against a given individual's level of intensity. That there were significant differences in change in intensity, but not *EV*, may suggest that the value of alcohol, per se, is unaffected by the happy hour frames.

Comparisons between discount groups.

BP_1 and P_{max}. Due to the discrepancy in the price sequence between the unmodified and modified APTs, comparisons between the empirical measures BP_1 and P_{max} (which are price dependent) were conducted for the BOGO and HP groups. Results from Welch's *t*-test, $t(84.09) = -0.54, p = 0.594$, 95% CI $[-3.51, 2.02], d = -0.11$ and Mann-Whitney, $U = 880.5, p = 0.584, r = 0.06$, indicated no statistically significant differences in BP_1 between the BOGO ($M = 9.59, SD = 6.36, Mdn = 8$) and HP ($M = 10.33, SD = 6.58, Mdn = 8$) groups at time 1. At time 2, however, results were discrepant. Welch's *t*-test, $t(84.906) = -1.92, p = 0.059$, 95% CI $[-2.90, 0.05], d = -0.41$, did not meet the threshold for statistical significance, whereas the results of the Mann-Whitney indicated otherwise, $U = 724.5, p = 0.049, r = 0.21$. Figure 24 displays box plots of BP_1 for each discount group at time 1 and time 2. As seen in the figure, at time 2 the median BP_1 for the HP group is 10

($M = 7.34, SD = 3.40$), whereas the median value for the BOGO group is 5 ($M = 5.92, SD = 3.52$). Given the Mann-Whitney test "barely" met significance, and visual inspection of the box plots suggest minimal differences, it appears BP_1 was not differentially affected by the happy hour frames.

At time 1, there were no statistically significant differences in P_{max} between the BOGO ($M = 6.30, SD = 4.83, Mdn = 5$) and HP ($M = 6.49, SD = 5.49, Mdn = 5$) groups (Welch's $t[81.83] = -0.17, p = 0.866$; Mann-Whitney $U = 951, p = 0.963$). This was also the case at time 2 with both Welch's t-test, $t(84.82) = -1.15, p = 0.252$, and Mann-Whitney, $U = 782, p = 0.164$, indicating no differences between the BOGO ($M = 4.56, SD = 3.27, Mdn = 3.5$) and HP ($M = 5.36, SD = 3.19, Mdn = 4.5$) groups. Figure 25 displays box plots for P_{max} across groups and time. Visual inspection confirms that the groups look similar at both time points.

Elasticity. The Extra Sum-of-Squares F test was conducted to test whether one value of α sufficiently fit the aggregate curves from the three groups at time 1 and time 2. The Extra Sum-of-Squares F test at time 1 indicated a significant global effect, $F(2,45) = 6.16, p = 0.043$. Adjusted pairwise tests indicated one α was unlikely to fit the control and BOGO aggregate curves $F(1,30) = 13.42, p = 0.003$ and the control and HP groups $F(1,30) = 6.06, p = 0.040$. There were no statistically significant differences between the HP and BOGO groups $F(1,30) = 0.77, p = 0.388$. Figure 26 displays the aggregate demand curves at time 1 and Table 9 contains results from the curve fitting. Interestingly, at time 2, results of the Extra Sum-of-Squares F test indicated no statistically significant differences in α between all three groups, $F(1,45) = 2.58, p = 0.087$. Figure 27 displays and Table 10 contains the results of the analyses. Visual inspection appears counterintuitive to the results of the statistical test. There appears to be substantial overlap in the data points at time 1, but relative differentiation at time 2. Recall, however, that α does not describe consumption at any one price – rather, α is generated across the entire range of prices. Relative group differences in consumption at higher prices may be contributing to these findings. Consistent with Figure 27, Table 10 indicates that estimated Q_0 was higher at time 2 for the BOGO group relative to the other two groups, regardless of if α was shared or not.

Consumption by price. Consumption at each common price among the groups was examined as it related to group and time. Figure 28 displays, within each price, the mean change (and standard error of the mean) in consumption between time 1 and time 2 for all three groups. The results of a mixed ANOVA (Table 11), using the within subject factors of time and price and the between subject factor of group, revealed a statistically significant three-way interaction between all the factors ($F[7.13, 463.34] = 10.16, p < 0.001$). Thus, as illustrated in Figure 28, the BOGO group showed increased consumption at time 2, relative to time 1, at low prices. Also for the BOGO group, as price increased the difference between time 1 and time 2 consumption became smaller. Starting at $1.00, consumption at time 2 for the BOGO group began to look more similar to the other two groups. Overall, there appeared to be a slight increase in consumption at time 2 relative to time 1 for all groups. And for all groups, consumption tended to decrease with increasing costs.

Experiment 1 Discussion

Experiment 1 evaluated the effects of a framed "happy hour" special on subsequent alcohol consumption. Results were somewhat discrepant among the various measures. For example, participants in the BOGO group had a greater percent change in intensity as compared to the other two groups, but there were no statistically significant differences between any of the groups on percent change measures of O_{max} or EV. Comparisons of BP_1 and P_{max} were largely consistent with these findings as well in that the BOGO group did not differ from the HP group.

The results of the Extra Sum-of-Squares F test are intriguing for several reasons. Due to random assignment to groups, one would expect no differences in the aggregate demand curves at time 1. However, results indicated that the two discount groups were independently different from the control group, but not from one another. This finding would compromise any interpretations of differences, if there were any, at time 2. That there were differences at time

1 but not time 2 is further intriguing given that visual inspection of the graphs appear counterintuitive to these findings – participants' responding in the BOGO condition is visually distinct from the other groups at time 2, but not at time 1. Because these discrepant findings could be due to sampling error, experiment 2's larger sample size may be able to rule out this possibility.

Finally, examining prices within the mixed ANOVA revealed an interesting interaction between price, group, and time. Those participants in the BOGO group tended to have higher consumption at time 2 relative to the other two groups, but only at the lower prices (i.e., <$1.00). Overall, patterns of consumption in the HP and control groups looked similar. And for all groups, there was a trend for a slight increase in consumption associated with the second APT, except for one deviation at the $5.00 price. At this price, consumption during the second APT decreased for those participants in the discount groups while consumption for the control group followed the general slightly increasing pattern. Similar to the results of the Extra Sum-of-Squares *F* test, this discrepancy may be due to sampling error and the larger sample recruited in experiment 2 may be able to provide insight as to whether this finding will be replicated.

Experiment 2

Experiment 2 was conducted with two primary goals. The first goal was to replicate the findings from experiment 1, particularly (1) that the BOGO framing led to a greater change in intensity relative to the other two manipulations, (2) the discrepancies between the Extra Sum-of-Squares *F* test at time 1 and time 2, and (3) decreases in consumption associated with $5.00 at time 2 for the discount groups, but not the control group. The second goal was to simulate a public policy change by examining whether individuals residing in states where happy hours are banned show relatively greater change in intensity as compared to individuals residing in states where happy hours are not banned. As mentioned previously, two samples of participants were recruited from either states where happy hours are banned (i.e., Alaska, Delaware, Hawaii, Indiana, Maine, Massachusetts, North Carolina, Oklahoma, Rhode Island, Utah, Vermont) or from states where happy hours are not banned (i.e., California, Colorado, Florida, Georgia, Idaho, Iowa, Kentucky, Maryland, Minnesota, Mississippi, Missouri, Montana, Nevada, North Dakota, South Dakota, West Virginia, Wisconsin, Wyoming). The decision was made *a priori* to analyze participant data separately within each state status group (i.e., banned or not banned) given it was unknown if state status moderated responding on the APT.

Demographics and typical alcohol consumption.

Banned states. A total of 476 participants from banned states provided complete datasets for analysis. Table 12 shows detailed information related to participant demographics. The number of participants in each group (159, 158, 159 for the control BOGO, and HP groups, respectively) and their respective demographic information were similar. Unlike experiment 1, age was not statistically significantly different across the three groups. Median duration (25th, 75th percentile) to complete the task was 10.57 (8.49,13.59), 11.37 (8.75, 14.18), and 10.58 (8.70, 13.51) minutes for the control, BOGO, and HP groups, respectively. These times were similar to experiment 1. Interestingly, and unexpectedly, there were a small number of participants who reported living in states other than what was specified in the mTurk qualifications. According to Amazon's documentation, "Every Worker has a value for each system Qualification, and these values are updated as the Worker uses the system" and defines the `Worker_Locale` as, "The location of the Worker, as specified in the Worker's mailing address" (http://tinyurl.com/aws-api-reference). Whether these participants mistakenly selected a different state, lied on the survey, or live in a state that is different from the mailing address on file by mTurk is unknown. In any case, the majority of participants reported living in the states that were explicitly selected as Worker qualifications (e.g., Indiana, Maine, Massachusetts, North Carolina, Oklahoma, Rhode Island, Utah) and met criteria for banned happy hour specials.

The median number of binge drinking episodes during the past 30 days was 1 ($IQR = 2$), 1 ($IQR = 2$), and 1 ($IQR = 3$) for the control, BOGO, and HP groups, respectively. The median number of total drinks consumed in a typical week during the past 30 days was 5 ($IQR = 8.00$), 5 ($IQR = 8.75$), and 5 ($IQR = 8.00$) for the control, BOGO, and HP groups, respectively. Finally the median number of total hours spent drinking in a typical week during the past 30 days was 5 ($IQR = 7.50$), 5 ($IQR = 8.00$), and 6 ($IQR = 7.00$) for the control, BOGO, and HP groups, respectively. Measures on the DDQ as a function of group membership were estimated using parametric ANOVAs. Visual inspection of the models' residuals appeared non-normal. Levene's test confirmed homogeneity between the groups on the number of binge episodes ($F[2,473] = 0.19, p = 0.827$), total number of drinks consumed ($F[2,473] = 0.22, p = 0.802$), and total number of hours spent drinking ($F[2,473] = 0.96, p = 0.383$). Therefore, Kruskal-Wallis one-way ANOVAs were used to test differences between the groups on the DDQ measures. Results indicated number of binge episodes ($\chi^2[2] = 0.28, p = 0.871$), total number of drinks ($\chi^2[2] = 0.67, p = 0.715$), and total number of hours spent drinking ($\chi^2[2] = 0.96, p = 0.383$) were not statistically significantly different across the three groups.

Not banned states. For the not banned states, a total of 475 participants provided complete datasets for analysis. Table 13 shows demographic information related to this sample. The number of participants in each APT group (154, 160, 161 for the control, BOGO, and HP groups, respectively) were slightly more unbalanced than in the banned states. Similar, however, was that there were no significant differences in any of the demographic measures. Median duration (25th, 75th percentile) to complete the task was 9.82 (8.40, 12.62), 11.28 (8.16, 14.06), and 10.30 (8.07, 13.13) minutes for the control, BOGO, and HP groups, respectively. Duration was very similar to participants in the banned states and experiment 1. As in the banned states, some participants reported living in states other than what was specified in the mTurk qualifications. Notwithstanding, the majority of participants reported living in states that were specified in the qualifications (e.g., California, Colorado, Florida, Georgia, Missouri, Wisconsin) and met criteria for no bans on happy hour specials.

In terms of typical drinking, the median number of binge drinking episodes during the past 30 days was 1 ($IQR = 3$), 1 ($IQR = 3$), and 1 ($IQR = 3$) for the control, BOGO, and HP groups, respectively. The median number of total drinks consumed in a typical week during the past 30 days was 4.5 ($IQR = 8.00$), 6.0 ($IQR = 10.00$), and 6.0 ($IQR = 8.00$) for the control, BOGO, and HP groups, respectively. Finally the median number of total hours spent drinking in a typical week during the past 30 days was 4 ($IQR = 8.00$), 6 ($IQR = 9.25$), and 6 ($IQR = 8.00$) for the control, BOGO, and HP groups, respectively. Visual inspection of the residuals suggested substantial skew and Levene's test examined homogeneity of variances. Results for the number of binge episodes ($F[2,472] = 0.41, p = 0.662$), total number of drinks consumed ($F[2,472] = 1.39, p = 0.251$), and total number of hours spent drinking ($F[2,472] = 1.64, p = 0.194$) indicated homogeneity of variances among the groups. A series of Kruskal-Wallis tests compared the measures across the groups. Results for the number of binge episodes ($\chi^2[2] = 3.51, p = 0.173$), total number of drinks consumed ($\chi^2[2] = 1.43, p = 0.490$), and total number of hours spent drinking ($\chi^2[2] = 1.81, p = 0.405$) revealed no statistically significant differences in the measures across the three groups.

Alcohol purchase task.

Consumption.

Banned states. Levels of consumption followed the same general decreasing trend as is seen in typical demand curve research. Figures 29 (time 1) and 30 (time 2) display box plots of consumption values for each price, stratified by the three groups, after recoding. At time 1, a total of 20 outlying values were replaced (ids: 14, 25, 98, 190, 238, 400, 430, 458, and 459) and at time 2, a total of 19 (3 [ids: 164 and 400], 14 [ids: 25, 127, and 394], and 2 [ids: 359 and 430] for control, BOGO, and HP, respectively) outlying values were replaced.

Not banned states. Figures 31 and 32 display box plots of consumption, stratified by group, at each price for time 1 and time 2, respectively, after recoding. Compared to the banned states, substantially more outlying values were replaced among participants recruited from the not banned states. A total of 42 outlying values were replaced (ids: 27, 48, 62, 70, 190, 235, 322, 352, 394, and 454) at time 1 compared to a total of 61 (14 [id: 48], 28 [ids: 54, 86, 190, 250, 322, and 394], and 19 [ids: 235, 408, and 454] for control, BOGO, and HP, respectively) outlying values at time 2.

Systematic responding.

Banned states. For those recruited from the banned states, Table 14 displays the number of participants within each group and at each time point that passed all three criteria proposed by Stein et al. (2015). Similar numbers of participants, both across condition and time period, passed all criteria. A total of 56 (~11.8%) and 63 (~13%) participants for time 1 and time 2, respectively, failed at least one criteria. This resulted in 68 (~14%) unique participants (ids: 18, 20, 21, 27, 47, 50, 56, 62, 68, 98, 99, 100, 116, 125, 140, 149, 153, 158, 165, 169, 175, 177, 179, 185, 186, 188, 190, 203, 210, 214, 220, 234, 239, 245, 261, 265, 266, 270, 273, 285, 304, 308, 318, 320, 332, 336, 344, 347, 356, 368, 378, 380, 387, 389, 391, 396, 397, 402, 407, 408, 418, 425, 426, 429, 430, 432, 454, and 458) failing at least one criteria at either time point. After excluding these participants, 408 participants' data remained for subsequent analysis.

Not banned states. Table 15 displays the results of applying the systematic criteria to participants' data from the not banned states. As was found in the banned states, similar numbers of participants, both across condition and time period, passed all three criteria. However, relatively fewer participants passed all three criteria. A total of 73 (~15%) and 83 (~17%) participants for time 1 and time 2, respectively, failed at least one criteria, which resulted in a total of 87 (~18%) unique participants [ids: 6, 15, 24, 35, 42, 46, 47, 49, 61, 62, 66, 67, 68, 70, 78, 80, 89, 100, 101, 102, 107, 111, 117, 120, 124, 125, 134, 146, 147, 155, 156, 171, 173, 187, 190, 201, 209, 216, 219, 220, 222, 224, 230, 231, 238, 245, 252, 255, 261, 262, 266, 267, 271, 277, 279, 281, 287, 295, 297, 305, 313, 314, 318, 320, 327, 332, 340, 341, 345, 352, 354, 357, 365, 368, 370, 372, 380, 385, 397, 398, 411, 417, 423, 432, 441, 442, and 460] failing at least one criteria at either time point. Although less than the banned states, a sizable number of participants' data (388 participants) remained for subsequent analyses.

Demand measures.

Banned states. Empirical measures of intensity, BP_1, O_{max}, and P_{max}, and derived EV were examined for outliers. At time 1, 10 and 7 values for intensity (ids: 10, 25, 58, 66, 164, 300, 339, 343, 390, and 394) and EV (ids: 130, 219, 225, 238, 358, 440, and 464), respectively, were recoded. There were no outliers identified for the remaining measures. At time 2, 4, 14, and 8 outliers for intensity (ids: 360 and 394), O_{max} (ids: 25, 127, 238, and 394), P_{max} (ids: 67, 72, 92, 176, 189, 196, 249, 262, 331, 351, 361, 413, 423, and 471), and EV (ids: 25, 36, 127, 216, 238, 404, 440, and 468), respectively, were recoded. Values were transformed using logarithmic and square root functions and subsequently examined for departures from normality using the Shapiro-Wilk test. Test results for the untransformed and transformed were significant across both time points. As such, measures remained untransformed during subsequent analyses. Figures 33 through 42 show frequency plots of the untransformed and transformed values. In addition, Tables 16 and 17 display descriptive summaries of the model fitting for time 1 and time 2, respectively. At this point of the analysis, a total of 41 participants' data (out of 408 that passed all three systematic criteria; 10%) were recoded to some degree or another (consumption or demand measures).

Not banned states. Similar to the banned states, empirical measures of intensity, BP_1, O_{max}, and P_{max}, and derived EV were examined for outliers. Five, six, and eight outliers were identified and recoded for intensity (ids: 27, 140, 235, 257, and 394), O_{max} (ids: 48, 82, 235, 278, 322, and 454), and EV (ids: 48, 84, 235, 278, 322, 343, 435, and 454), respectively, for time 1. For time 2, 9, 4, 8, and 6 outliers were recoded for intensity (ids: 41, 54, 86, 140, 250, 302, 394, 415, and 456), O_{max} (ids: 48, 82, 322, and 394), P_{max} (ids: 60, 116, 129, 137, 170, 210, 416, and 439), and EV (ids: 48, 82, 84, 272, 322, and 454), respectively. Values were transformed using logarithmic and square root functions, but all samples at both time points were statistically significant according to the Shapiro-Wilk test. Therefore, measures were left unaltered. Figure 43 through 52 depict frequency plots of the untransformed and transformed measures. Tables 18 and 19 provide summaries of the demand indices generated from the model fits at time 1 and time 2, respectively. At this point of the analysis, a total of 30 participants' data (out of 388 that passed all three systematic criteria; 12.9%) were recoded to some degree or another (consumption or demand measures).

Percent change.

Intensity.

Banned states. Percent change in intensity was calculated using the untransformed values from time 1 and time 2. Figure 53 displays histograms of untransformed and transformed values. Data were left untransformed given the excessive number of 0s and statistically significant results of the Shapiro-Wilk test. Untransformed values were fit using a one-way ANOVA. One participant appeared to be an outlier based on visual examination of the model's diagnostic plots. S/he was excluded from this analyses because s/he answered "1" at time 1 and "15" at time 2 and, thus, resulted in a percent change of 1400%. The model was refit omitting this datapoint.

Results of both Shapiro-Wilk ($W = 0.82, p < 0.001$) and Levene's test ($F[2,404] = 87.80, p < 0.001$) on the models' residuals indicated non-normality and heterogeneity. Parametric and nonparametric pairwise comparisons with Holm's correction were performed. Post-hoc pairwise t-tests indicated the BOGO ($M = 42.73\%, SD = 47.91\%$) group was statistically significantly different from both the HP ($M = 5.92\%, SD = 18.17\%$), $t(167.93) = 8.25, p < 0.001$, 95% CI $[28.00, 45.61], d = 1.02$, and control groups ($M = 1.94\%, SD = 8.63\%$), $t(138.84) = -9.64, p < 0.001$, 95% CI $[-49.16, -32.42], d = -1.16$. The control group was not statistically significantly different from the HP group, $t(183.34) = -2.29, p = 0.27$, 95% CI $[-7.42, -0.56], d = -0.28$. Post-hoc pairwise Mann-Whitney tests demonstrated statistically significant differences between the control ($Mdn = 0\%$) and BOGO ($Mdn = 25\%$) groups, $U = 3571, p < 0.001, r = 0.61$, the control and HP ($Mdn = 0\%$) groups, $U = 8561.5, p = 0.039, r = 0.12$, and the BOGO and HP groups, $U = 13374, p < 0.001, r = 0.50$. Figure 54 displays box plots of change in intensity by group. The discrepant results between the parametric and nonparametric pairwise tests match the results from experiment 1. Indeed, the relative differences both in the locations of the means and variability look visually similar to the results of experiment 1. Overall, the BOGO group showed a greater change in intensity compared to the other two groups.

Not banned states. Figure 55 displays histograms of untransformed and transformed values of percent change in intensity for participants in the not banned states. Similar to the analyses on the banned states, untransformed values were fit using a one-way ANOVA. Visual inspection of the model's diagnostic plots suggested one outlier. S/he was omitted from this analysis because s/he answered "1" at time 1 and "10" at time 2 and, thus, resulted in a percent change of 900%. The model was refit without this datapoint.

Model residuals were not likely to be sampled from a Normal distribution ($W = 0.70, p < 0.001$) and variances between the groups displayed heterogeneity ($F[2,384] = 41.10, p < 0.001$). Post-hoc pairwise t-tests indicated statistically significant differences between the BOGO ($M = 46.55\%, SD = 60.79\%$) group and the control ($M = 1.60\%, SD = 11.10\%$) group, $t(129.53) = -8.08, p < 0.001$, 95% CI $[-55.95, -33.93], d = -1.01$, and between the BOGO and HP ($M = 9.32\%, SD = 29.28\%$) group, $t(173.23) = 6.15, p < 0.001$, 95% CI $[25.28, 49.16], d = 0.77$, but not between the control and HP groups, $t(166.13) = -2.82, p = 0.11$, 95% CI $[-13.12, -2.32], d = -0.35$. Results of the post-hoc pairwise Mann-Whitney tests indicated statistically significant differences between the control ($Mdn = 0\%$) and BOGO ($Mdn = 20.00\%$) groups, $U = 2649.5, p < 0.001, r = 0.65$, the control and HP ($Mdn = 0\%$) groups, $U = 7770.5, p = 0.008, r = 0.16$, and the BOGO and HP groups, $U = 12516, p < 0.001, r = 0.52$. Figure 56 displays the box plots across groups. Results of this analysis mimicked those found in the banned states and in experiment 1. Overwhelmingly, it appears participants in the BOGO group showed the greatest change in intensity due to the framing.

O_{max}.

Banned states. Percent change in empirical O_{max} was compared in a similar fashion to that of intensity. Figure 57 displays histograms of percent change in O_{max} under various transformations. Visual analysis of the diagnostic plots resulting from the one-way ANOVA suggested two outliers, which were subsequently omitted.

Residuals were non-normal ($W = 0.93, p < 0.001$) and variances displayed heterogeneity ($F[2,394] = 13.76, p < 0.001$). Post-hoc pairwise t-tests indicated statistically significant differences between the BOGO ($M = 9.71\%, SD = 41.13\%$) and HP ($M = -4.71\%, SD = 31.14\%$) groups, $t(234.75) = 3.15, p = 0.001$, 95% CI $[5.42, 23.43], d = 0.40$, and between the HP and control ($M = 6.11\%, SD = 22.94\%$) groups, $t(231.69) = 3.22, p = 0.013$, 95% CI $[4.20, 17.44], d = 0.39$. There were no significant differences between the BOGO and control groups, $t(192.53) = -0.87, p = 0.36$, 95% CI $[-11.74, 4.54], d = -0.11$. Post-hoc Mann-Whitney tests were in agreement with the t-tests indicating statistically significant differences between the BOGO ($Mdn = 0\%$) and HP ($Mdn = -2.38\%$) groups, $U = 9833.5, p = 0.007, r = 0.18$, and between the HP and control ($Mdn = 0\%$) groups, $U = 11615, p < 0.001, r = 0.24$. No differences were observed between the BOGO and control groups, $U = 9184.5, p = 0.790, r = 0.02$. Figure 58 visually displays the differences between the groups.

Not banned states. Figure 59 displays histograms of untransformed and transformed values of percent change in O_{max}. After fitting the untransformed values and examining the model's diagnostic plots, no outliers appeared to be present. As with the banned states, the ANOVA's residuals were non-normal ($W = 0.87, p < 0.001$) and Levene's test ($F[2,374] = 13.49, p < 0.001$) indicated heterogeneity. Both parametric and nonparametric post-hoc tests indicated no statistically significant differences across the three groups (Control: $M = 5.50\%, SD = 25.70\%, Mdn = 0\%$; BOGO: $M = 11.76\%, SD = 56.12\%, Mdn = 0\%$; HP: $M = 1.72\%, SD = 39.60\%, Mdn = 0\%$). These results are in contrast with those found among the banned states, but consistent with that was found in experiment 1.

EV.

Banned states. Percent change in EV was the final demand metric to be compared across groups. Figure 61 displays the untransformed and transformed values of percent change in *EV* across groups. Untransformed values were fit using a one-way ANOVA. No outliers appeared to be present when the model's diagnostic plots were examined. Tests on model residuals indicated non-normality ($W = 0.85, p < 0.001$) and heterogeneity between the groups ($F[2,358] = 9.61, p < 0.001$). Parametric and nonparametric post-hoc tests were conducted. Pairwise t-tests indicated statistically significant differences between the control ($M = 8.63\%, SD = 31.78\%$) and BOGO ($M = 28.67\%, SD = 57.62\%$) groups, $t(155.18) = -3.21, p = 0.003$, 95% CI $[-32.37, -7.71], d = -0.42$, as well as between the BOGO and HP ($M = 12.11\%, SD = 48.12\%$) groups, $t(205.35) = 2.34, p = 0.014$, 95% CI $[2.60, 30.52], d = 0.31$. Pairwise Mann-Whitney tests were in agreement suggesting differences between the control ($Mdn = 5.34\%$) and BOGO ($Mdn = 14.78\%$) groups, $U = 5483, p = 0.012, r = 0.19$, and between the BOGO and HP ($Mdn = 1.49\%$) groups, $U = 7817, p = 0.019, r = 0.17$. Neither the t-tests, $t(209.16) = -0.68, p = 0.548$, 95% CI $[-13.62, 6.67], d = -0.08$, nor the Mann-Whitney tests, $U = 8374, p = 0.664, r = 0.03$, indicated statistically significant differences between the HP and control groups. Figure 62 depicts box plots between the three groups. These results are in contrast with those found in experiment 1. Although post-hoc pairwise tests were not conducted in experiment 1, results from both the one-way ANOVA and Kruskal-Wallis indicated no statistically significant main effect of framing.

Not banned states. Figure 63 displays values of percent change in *EV* across the three groups. Model diagnostics of the one-way ANOVA fit to the untransformed data suggested the presence of one outlier. This outlying value was removed and the model was refit. As before, test of model residuals indicated non-normality ($W = 0.90, p < 0.001$) and heterogeneity between groups ($F[2,335] = 12.85, p < 0.001$). Both parametric and nonparametric post-hoc pairwise tests revealed no statistically significant differences between the groups (Control: $M = 10.48\%, SD = 27.89\%, Mdn = 2.45\%$; BOGO: $M = 22.45\%, SD = 51.25\%, Mdn = 10.10\%$; HP: $M = 17.56\%, SD = 48.61\%, Mdn = 9.30\%$). While these findings contrast those from the banned states, they are consistent with what was observed in experiment 1. Figure 64 depicts box plots of change in EV across groups.

Comparisons between discount groups.

BP_1 and P_{max}.

Banned states. Due to the discrepancy in the price sequence between the unmodified and modified APTs, comparisons between the empirical measures BP_1 and P_{max} (which are price dependent) were conducted for the BOGO and HP groups. For BP_1, both Welch's t-test, $t(261.38) = -1.35, p = 0.179$, 95% CI $[-2.54, 0.48], d = -0.17$, and Mann-Whitney, $U = 7591, p = 0.068, r = 0.11$, indicated no statistically significant differences between the BOGO ($M = 9.68, SD = 6.38, Mdn = 8.00$) and HP ($M = 10.71, SD = 6.08, Mdn = 9.50$) groups at time 1. At time 2, however, both tests ($t[257.04] = -5.10, p < 0.001$, 95% CI $[-2.89, -1.28], d = -0.63$; $U = 5841, p < 0.001, r = 0.30$) indicated statistically significant differences between the groups (BOGO: $M = 5.91, SD = 3.54, Mdn = 5.00$; HP: $M = 8.00, SD = 3.08, Mdn = 10.00$). Figure 65 depicts box plots of BP_1 across the groups for time 1 and time 2.

At time 1, Welch's t-test, $t(255.78) = -2.05, p = 0.041$, 95% CI $[-2.64, -0.05], d = -0.25$, but not Mann-Whitney, $U = 7560, p = 0.062, r = 0.11$, suggested statistically significant differences in P_{max} among the two discount groups (BOGO: $M = 6.28, SD = 4.89, Mdn = 6.00$; HP: $M = 7.63, SD = 5.73, Mdn = 6.00$). Results were opposite at time 2 with Welch's t-test, $t(261.75) = -1.89, p = 0.060$, 95% CI $[-1.55, 0.03], d = -0.23$, indicating no differences, while Mann-Whitney, $U = 7450.5, p = 0.040, r = 0.13$, indicating statistically significant differences (BOGO: $M = 4.79, SD = 3.32, Mdn = 4.00$; HP: $M = 5.55, SD = 3.22, Mdn = 4.50$). Figure 66 depicts box plots of P_{max} across group and time.

Not banned states. At time 1, both Welch's t-test and Mann-Whitney indicated no statistically significant differences in BP_1 between the BOGO ($M = 10.10, SD = 6.54, Mdn = 9.00$) and HP ($M = 10.10, SD = 6.39, Mdn = 10.00$) groups, $t(251.47) = 0.002, p = 0.998$, 95% CI $[-1.59, 1.60], d = 0$; $U = 8085, p = 0.950, r = 0$. Similar to what was found in the banned states, there was a significant difference between the groups (BOGO: $M = 6.08, SD = 3.66, Mdn = 5.00$; HP: $M = 7.10, SD = 3.41, Mdn = 10.00$) at time 2, $t(249.1) = -2.29, p = 0.022$, 95% CI $[-1.89, -0.14], d = -0.29$; $U = 6858, p = 0.024, r = 0.14$. Figure 67 depicts these differences via box plots.

Results of the comparisons of P_{max} were more straightforward compared to what was found among the banned states. Both parametric and nonparametric tests indicated no statistically significant differences across the BOGO ($M = 6.71, SD = 5.36, Mdn = 6.00$) and HP ($M = 7.03, SD = 5.43, Mdn = 6.00$) groups at time 1, $t(252.57) = -0.48, p = 0.633$, 95% CI $[-1.65, 1.01], d = -0.06$; $U = 7793.5, p = 0.576, r = 0.04$. No statistically significant differences were found at time 2 between the BOGO ($M = 4.52, SD = 3.25, Mdn = 3.50$) and HP ($M = 5.04, SD = 3.00, Mdn = 4.50$) groups, $t(248.39) = -1.35, p = 0.178$, 95% CI $[-1.30, 0.24], d = -0.17$; $U = 7116.5, p = 0.086, r = 0.11$. Figure 68 displays box plots of P_{max} across group and time.

Elasticity.

Banned states. Extra Sum-of-Squares F tests were conducted to test whether one value of α sufficiently fit the aggregate curves from the three groups at time 1 and time 2. At time 1, results of the F test indicated that one value of α did not sufficiently fit the three aggregate curves ($F[2, 45] = 4.79, p = 0.013$). Post-hoc pairwise tests indicated statistically significant differences in α between the control and BOGO groups, $F(1, 30) = 9.98, p = 0.011$, but not between the control and HP groups, $F(1, 30) = 2.54, p = 0.243$, or BOGO and HP groups, $F(1, 30) = 2.21, p = 0.243$. Figure 69 graphically displays the curves and Table 20 contains the derived measures from the F test. Global differences in α across groups at time 2 were also statistically significant ($F[2, 45] = 9.24, p < 0.001$). However, at time 2 the BOGO and control groups, $F(1, 30) = 11.11, p = 0.007$, and HP and control groups, $F(1, 30) = 7.43, p = 0.021$, were statistically significantly different, while the BOGO and HP groups were not, $F(1, 30) = 0.69, p = 0.412$. Figure 70 displays the aggregate demand curves by group at time 2 and derived values are shown in Table 21. Based on the results of the Extra Sum-of-Squares F

test, few conclusions can be made with respect to how the different APT manipulations manifested their effects in aggregate measures of α as there were preexisting differences between the groups at time 1. As with experiment 1, estimated Q_0 appears to be slightly higher for the BOGO group relative to the other two groups.

Not banned states. In contrast to what was found among the groups in the banned states, there were no statistically significant differences in α between the three groups in the not banned states at time 1, $F(2,45) = 2.30, p = 0.112$. No follow-up tests were conducted between the groups. Figure 71 and Table 22 display the results of the fits to the aggregate data. At time 2, no significant differences were detected, $F(2,45) = 1.99, p = 0.148$. Figure 72 and Table 23 depict the results of the analyses. Derived Q_0 appears to be greater for the BOGO group relative to the other two groups and this finding is consistent with results from analyses on the banned states and experiment 1.

Consumption by price.

Banned states. Consumption at each common price among the groups was examined as it related to group and time. Figure 73 shows changes in consumption from time 1 to time 2 across each of the three groups. The results of a mixed ANOVA (Table 24) demonstrated a statistically significant interaction between group, time, and price, $F(8.49, 1719.96) = 17.29, p < 0.001$. Consistent with the observations from experiment 1, the BOGO group showed a relatively greater change from time 1 to time 2 at the low prices, but as prices increased these differences look more similar to the other two groups. Overlap between the BOGO group and the other two groups occurs around the $1.00 price point. Also consistent with experiment 1, there appeared to be slight increases in consumption from time 1 to time 2 for all the groups.

Not banned states. Results from the mixed ANOVA (Table 25) were consistent with the findings from before. There was a statistically significant interaction between the three factors, $F(6.31, 1214.92) = 23.88, p < 0.001$. This is visually apparent in Figure 74 as well. Compared to the findings from the banned states, it appears there is a relatively greater increase from time 1 to time 2 for the BOGO group and that this increase sustains up to around $2.00.

State status as a moderator. A multiple linear regression model was constructed to determine whether state status moderated change in intensity. Predictors included state status (i.e., banned, not banned states), manipulation group (i.e., control, BOGO, HP), the interaction between state status and manipulation group, age, total number of alcoholic drinks consumed during a typical week in the past month, and gender (i.e., male, female). Two participants were excluded because they appeared to be influential cases. Two additional participants were excluded because for gender they answered "Would rather not say." The results of the model are displayed in Table 26. There were no statistically significant main effect or interactions of state status. Age appeared to be a statistically significant predictor ($\hat{\beta} = 0.232, p \leq 0.05$) such that, with all else in the model held constant, the model predicts that for every unit increase in age, percent change in intensity decreases by 0.232%. The coefficient for BOGO ($\hat{\beta} = 45.239, p \leq 0.001$) was statistically significant and suggests that, holding everything else in the model constant, being in the BOGO group results in a 45.239% increase in change in intensity. Thus, consistent with the analyses conducted within each of the different state statuses, percent change in intensity is affected greatest by being exposed to the BOGO frame.

Experiment 2 Discussion

Experiment 2 was conducted to replicate several findings from experiment 1 and to determine if state status moderated changes in intensity between the APT framing. Results of experiment 2 were consistent with those found in experiment 1 by demonstrating that the BOGO framing resulted in the greatest change in intensity relative to the other two groups. This finding was also consistent regardless of state status. Also consistent across experiments was the finding that only for the BOGO and HP groups, consumption associated with the $5.00 price per drink at time 2 decreased relative to consumption at the same price at time 1. In experiment 1, results of the Extra Sum-of-Squares F test were inconsistent across time 1 and time 2 in that there were statistically significant differences at time 1 but not at time 2. In contrast, results of experiment 2 suggested inconsistencies not across time, but across groups.

Within the banned states, there were statistically significant differences in α at both time 1 and time 2. On the other hand, within the not banned states, there were no statistically significant differences in α at either of the time points.

Discussion

The goal of the present study was to examine the effects of a hypothetical happy hour drink special on responding on an APT . Two different hypothetical drink special scenarios were constructed by slightly modifying the wording and price structure of the APT: buy one get one (BOGO) and half price (HP). The prices per drink in both drink special or discount groups were equivalent. Experiment 1 tested these vignette manipulations among a general sample of mTurk workers and experiment 2, among two samples of mTurk workers residing in states where happy hours were banned or not banned. In addition to attempting to replicate findings from experiment 1, experiment 2 examined whether living in states where happy hour legality status differed resulted in differential changes in intensity. A general finding consistent across both experiments and state status groups was that the BOGO framing resulted in greater changes in intensity. Additionally, participants in the BOGO group reported more drinks relative to the other two groups but only at the lower prices. Once prices reached approximately $1.50 per drink, levels of consumption at time 2 were nearly indistinguishable between the three groups.

Across both experiments and state status groups, the BOGO frame resulted in an approximately 50% increase in intensity from time 1. Several conclusions can be drawn from this finding. First, participants were not simply answering with the same number of purchases as they did at time 1. Recall that participants answered how many BOGO purchases they would make, not how many drinks they would consume. Rather, a column automatically populated with the number of drinks they would consume based on the number of BOGO purchases (i.e., two times their purchases in the case of BOGO, one times their purchases in all other conditions). On the average, if participants were merely responding with the same value that they did at time 1 then this would have resulted in a 100% increase (i.e., double).

Further, if participants were compensating at time 2 to match the number of drinks they reported at time 1, then this would have resulted in a 0% change, on the average. It appears participants were reporting fewer purchases on the BOGO version relative to their responses on the standard version, but not quite half as many. The current study used a mixed design, rather than a fully repeated-measures design, to reduce any carryover effects. Replicating the current study using a within-subjects design may provide insight into individual specific patterns of responding to the happy hour frames.

The results of the current study contribute to the growing literature on APT vignette manipulations. Previous research has demonstrated differential responding in the context of academic constraints (Gentile et al., 2012; Gilbert et al., 2014; Skidmore & Murphy, 2011) and driving after drinking (Teeters & Murphy, 2015). Continued examinations of vignette or other structural manipulations of the APT, and the HPT more generally (e.g., Roma et al., 2016), may be beneficial for several reasons. First, the degree to which participants' responses change in the context of vignette manipulations may provide some insight into individuals' decision making related to the commodity under study. For example, Teeters and Murphy (2015) examined the effects of a drinking after driving manipulation of the APT where college-aged participants were told, "Imagine that you were driving home at 2:00 AM at least 1 hour after you stopped drinking" (p. 898). They found that participants who self-reported driving within 2 hours after drinking 3 or more drinks during the past 3 months showed significantly smaller reductions in demand compared to participants who reported less than 3 drinks. Future research should investigate how vignette manipulations affect demand in orderly ways and associations with alcohol related measures.

Vignette manipulations may also provide insights into different patterns of responding the APT evokes. The decreasing function of alcohol consumption with increases in price shown across both experiments is no surprise and is consistent with behavioral economic demand theory (Hursh, 1980, 1984) and previous APT research. The finding that consumption at time 2 was not equivalent across the three groups, or even across the two discount groups, is interesting given work from the human operant literature (e.g., Bickel, DeGrandpre, Hughes, & Higgins, 1991; DeGrandpre, Bickel, Hughes, Layng, & Badger, 1993; Madden et al., 2000) examining unit price. It has been argued that consumption should be examined as a function of the cost-benefit ratio, or unit price; that is, the work required or spent per unit of the commodity (Hursh et al., 1988). For example, both Bickel et al. (1991) and Madden et al. (2000) found that cigarette consumption (i.e., number of puffs) was similar under identical unit prices even when the costs (response requirements) and benefits (reinforcer magnitude) of the unit price ratio were different. Differences in consumption between the groups may be due to the framing of the price sequence specifying two drinks. In the BOGO condition, an example price point read, "$1.00 per drink on sale for $1.00 per 2 drinks," whereas in the HP condition the same price read, "$1.00 per drink on sale for $0.50 per drink." In the latter scenario, unit price per drink was explicit and is more similar to the standard version that read, for example, "$1.00 per drink." Although the following comparison should be taken with caution as there are a number of differences between the studies, Madden et al. found that when smokers were given the choice of responding on alternatives with equal unit price, participants tended to favor the alternatives that resulted in more cigarette puffs (i.e., greater benefit) and required more responses (i.e., greater cost) at *low unit prices*. Preference shifted towards the alternatives that resulted in fewer puffs and required fewer responses *at higher unit prices*. They concluded that, "...when both response requirements were relatively small, the difference in reinforcer magnitude outweighed the proportionally equivalent difference in response requirement" (p. 58).

Amount (i.e., number of drinks), then, may have exerted a relatively greater influence on responding and could account for the differences observed in the percent change in intensity. For this, the three prices read, "$0.00 per drink," "$0.00 per drink on sale for $0.00 per drink," and "$0.00 per drink on sale for $0.00 per 2 drinks," for the control, HP, and BOGO versions, respectively. That participants in the BOGO condition consumed more drinks even at equivalent unit prices is consistent with the findings by Wilson, Stolarz-Fantino, and Fantino

(2013). In their study, participants made a series of repeated decisions for hypothetical drink purchases in the context of different drink menus, one of which contained a bundle. Bundling is defined as the "sale of two or more separate products in one package" (Stremersch & Tellis, 2002). In one condition, the menu contained three soda sizes (i.e., 16 oz, 24 oz, 32 oz) associated with three different prices (i.e., $1.59, $1.79, $1.99). In another condition, the menu contained the same prices except two of the soda options were bundled (i.e., 16 oz, 2 12 oz, 2 16 oz). In the third condition, the menu contained only the 16 oz option. Even though unit price was held constant across the three different drink sizes, the bundled menu resulted in participants buying significantly more ounces of soda compared to the unbundled condition and the condition with only the 16 oz option. These results are also generally consistent with consumer's perceptions of quality and value of products associated with promotions.

Both the bundling and the buy one get something free promotions are considered "value added" and consumers generally tend to favor these types of promotions over other promotions (e.g., discounts; e.g., Hardesty & Bearden, 2003; Krishna, Briesch, Lehmann, & Yuan, 2002; Raghubir, 2004). Although they did not evaluate bundles per se, Darke and Chung (2005) compared participants' perceptions of a product (i.e., headphones) under different promotional conditions using a between-subjects design. Two of the conditions specified a set price of the product (control conditions; i.e., $39.99, $59.99) and in the other two conditions, product offers were either a standard discount offer (i.e., was $59.99, now $39.99) or a free-gift offer ($59.99, plus free $20 gift). Participants in the free-gift offer not only rated the product as higher quality, they also rated the value of the deal higher. Participants in the standard discount offer group rated quality the lowest, and there were no differences in ratings of value compared to the control conditions. Further support for general preferences for BOGO promotions come from a non peer-reviewed report based on a proprietary shopping panel (http://www.ala-national.org/assets/research_center/Hot_Topic_BOGO_freeFINAL.pdf). Out of 673 respondents, they report 93% of them have taken advantage of a BOGO offer and 66% of them preferred BOGO promotions over other promotions. Pulling from psychology's “behavioral economic” literature, individuals tend to respond in seemingly “irrational” ways when something is marketed as “free” (Ariely, 2008). For example, Shampanier, Mazar, and Ariely (2007) asked participants to make hypothetical purchases between two types of chocolates at different prices. In three conditions, a Hershey’s kiss cost $0.00, $0.01, and $0.02 and a Ferrero Rocher (a more exotic, pricy chocolate) cost $0.25, $0.26, and $0.27. When the Hershey’s kiss cost $0.01 or $0.02 (and the Ferrero Rocher cost $0.26 or $0.27), 40% of participants chose the Ferrero and 40-45% chose the Hershey’s. However, once each product was discounted by a cent (or two) such that the Hershey’s and Ferrero cost $0.00 and $0.25, respectively, 90% chose the Hershey’s and only 10% chose the Ferrero. Shampanier et al. found consistent results (an increase in purchases of the free alternative) in a follow-up experiment when participants made actual purchases.

Given the construction of the BOGO-framed APT, it is not possible to disentangle whether the increased consumption in that condition was attributable to the framing of getting another drink for free (as was displayed in the vignette) or to the price structure that specified two drinks rather than one. Future studies may attempt to investigate the relative contributions of these two variables on APT responding. For example, instead of specifying that one drink is free, a vignette could simply indicate either a bundled version or a “two-for-one” version. Likewise, another version would omit the quantity aspect and instead specify a BOGO purchase (e.g., $1.00 per drink on sale for $1.00 buy-one-get-one-free).

Although the results of the multiple linear regression did not indicate statistically significant effects of state status on changes in intensity, there may be some value for informing public policy as it relates to restricting certain types of alcohol promotions. Recall that BOGO consumption was greater than the other two groups, but only up to prices around ~$1.50 per drink. From a policy perspective, the relative increases associated with a BOGO promotion may be offset by requiring a minimum price at which the drinks can be offered. Currently, 11 states completely ban happy hours, 9 states have restrictions on times, 9 states restrict the amount of the discount, 6 states only ban unlimited drinks, and 18 states do not ban or restrict any type of happy hour. Given these state differences, the APT could serve as a tool to investigate changes in different policies, such as the timing or duration of happy hour, as they relate to hypothetical alcohol consumption and purchasing of other restricted commodities (e.g., cigarettes, marijuana).

Further research should be aimed at examining the structural characteristics of the APT (and HPT in general), including the medium by which it is administered. Across both experiments, participants in the happy hour discount groups reported relatively lower consumption at the $5.00 unit price at time 2 relative to the control group. This was unexpected given the "equivalent" unit prices. However, notice the relative positioning of the three different prices in Figure 75. For the discount groups, $5.00 unit price is the second price from the bottom, whereas for the control group the price is nearly in the middle of the sequence. No direct comparisons can be made using the results from Reed et al. (2014) and Roma et al. (2016) given they did not compare relative consumption at a price-by-price level. Amlung and MacKillop (2012), however, did examine price-level differences between sequential and randomized orders of prices in an APT (25 prices used, $0-30 per drink). They found self-reported consumption at each price tended to be similar, except for the $6.00, $9.00, $16.00, $18.00, and $25.00 prices. Interestingly, nearly all of these prices were located in the *second* half of the sequential progression, yet all of them were located in the *first* half of the randomized progression. Further, I know of no study that has explicitly compared responses on the APT when prices are displayed on individual pages vs. all at once. In my literature review, I identified only one study (i.e., Kiselica & Borders, 2013) that explicitly reported displaying prices on separate pages. It may be that when participants are able to see the entire price sequence, their responding is partly under the control of (1) their previous responses, (2) the number of prices that are left in the sequence, or (3) the highest price in the sequence. Additional research will need to be conducted to examine these possibilities.

The current study has several strengths. First, much of the prior APT research (see Table 1; 71.1% of the articles reviewed) and research examining drink specials and alcohol consumption (e.g., Baldwin et al., 2014; Kuo et al., 2003; Thombs et al., 2008) have used college or undergraduate participant samples. Although still a convenience sample, participants in the current study were demographically diverse and reflective of the mTurk workforce (e.g., Paolacci et al., 2010). Within each experiment, except for age in experiment 1, participants in each of the three groups were similar on all of the demographic variables and there were no group differences in typical alcohol consumption as measured by the DDQ.

Even though groups were similar demographically, there were three instances in which there were statistically significant differences in demand measures across the groups at time 1. First, in experiment 1 the Extra Sum-of-Squares F test indicated statistically significant differences in α between the BOGO and control groups and between the HP and control groups. These preexisting differences did not allow for any definitive conclusions to be made when the results of the Extra Sum-of-Squares F test indicated no statistically significant differences at time 2. Second, within the banned states in experiment 2 the Extra Sum-of-Squares F test indicated differences between the BOGO and control groups at time 1, which also precluded any inferences related to the effects of the happy hour frames on aggregate demand. Although the results of the F tests suggest that we reject the null hypothesis (i.e., that the α values are not different), from a scientific judgement perspective the α values in tables 9, 20, and 21 appear very similar. For example, in experiment 1 time 1 the shared $\alpha = 0.0059$, whereas independently fit $\alpha s = 0.0054, 0.0062$, and 0.0060 for the control, BOGO, and HP groups, respectively. And for experiment 2 time 1 the shared $\alpha = 0.0040$, whereas the independently fit $\alpha s = 0.0038, 0.0043$, and 0.0040 for the control, BOGO, and HP groups, respectively. Third, within the banned states in experiment 2 comparisons of P_{max} between the two discount groups at time 1 showed mixed results with Welch's t-test, but not Mann-Whitney, indicating statistically significant differences. For both tests, however, p values were on the so-called threshold of significance (i.e., 0.05; 0.041 and 0.062 for t-test and Mann-Whitney, respectively). Results were opposite at time 2 (0.060 and 0.040 for t-test and Mann-Whitney, respectively).

These observations bring up the broader topic of the difference between the two varieties of "significance" (Cumming, 2013). As quoted in Ellis (2010, p. 4):

> A statistically significant result is one that is unlikely to be the result of chance. But a practically significant result is meaningful in the real world. It is quite possible, and unfortunately quite common, for a result to be statistically significant and trivial. It is also possible for a result to be statistically nonsignificant and important. Yet scholars, from PhD candidates to old professors, rarely distinguish between the statistical and the practical significance of their results. Or worse, results that are found to be statistically significant are interpreted as if they were practically meaningful. This happens when a researcher interprets a statistically significant result as being "significant" or "highly significant".

It may certainly be the case that the differences in α (resulting from the Extra Sum-of-Squares F-tests) are not only statistically significant but are also practically significant, especially if the differences manifest themselves in some impactful way at a population level. Experiments that explicitly set out to investigate how differences such as these reflect behaviors in the real world would be of interest to policy makers, doctors, and researchers alike.

Another strength of the current study was the use of various open-source softwares. The `R` programming language, along with a number of different packages (Johnson & Kite, 2016; Johnson, 2016; Kaplan, 2016; Lawrence, 2016; R Core Team, 2016; Re, 2013; Wickham, 2009, 2016; Wickham & Francois, 2016; Yoshida & Bohn, 2015), served as the backbone for all analyses and visualizations. There are numerous advantages of using an open-source programming language such as `R`, and notwithstanding its rising popularity in academia (Tippmann, 2014) it provides cross-platform compatibility (OSX, Unix, Windows) and a high degree of customizability. Take for example the `MTurkR` package (Leeper, 2016), which was used to automate recruitment in a consistent and efficient manner. This package allows direct access to mTurk's application program interface (API). After HIT templates were created in mTurk's requester user interface, an `R` script connected to mTurk's API and launched a HIT with the specified number of assignments. While running, the script would periodically "check-in" to determine whether all the assignments for a given HIT were completed. If so, Worker IDs were extracted and those Workers were assigned a qualification that restricted them from completing the HIT again. As long as the number of completed assignments was less than the total specified, another HIT was launched and the script would wait some time to check-in again. Given the increasing popularity and use of mTurk, future research projects may benefit from a consistent and automated recruitment process in a similar fashion. Furthermore, version control software (i.e., Git) was used to keep a record and “history” of this study, including analyses and write-up (i.e., this document). Utilizing version control software may not only keep researchers accountable (e.g., show the results are correct), but may also improve aspects of reproducibility (Ram, 2013). This study has attempted to take a step forward in that direction.

Notwithstanding some strengths, one limitation of the current study was the relative price sequences used in the standard and modified APTs. The price sequence (i.e., price per drink) used in the standard version of the APT was the same as what has been used in previous APT research (e.g., Amlung, Yurasek, et al., 2015; Murphy et al., 2013; Tripp et al., 2015), while the prices in the modified versions were half the standard sequence. And while the number of prices used was in line with recommendations by Roma et al. (2016), analytical issues arose when comparing relative changes (% change) in demand metrics that are price dependent (e.g., BP_1, P_{max}). For example, a participant could have had a BP_1 value of $20.00 in the standard APT and $10.00 in the modified APT, yet this would have reflected a 50% decrease. Had the upper price limit for the modified APT been higher, this might have captured differences (or similarities) across these measures. Future studies examining framing effects or other APT manipulations should ensure price sequences have equivalent upper bounds.

The APT used in the current preparation differed from previous forms in that participants responded with how many purchases they would make and a separate column automatically populated with the number of drinks they would consume. Previous research using the APT typically describe the question as, “How many drinks would you purchase and consume if they were $__?” or “How many drinks would you consume if they were $__?”. Automatic calculation of drinks consumed was kept constant across all versions of the APT.

Unfortunately, Qualtrics does not record data on whether participants changed their responses after seeing the automatically calculated value. Future research may examine if information in terms of drinks consumed affects participant responses. With that noted, the current study did integrate attending questions, which may have increased responding to relevant stimuli. Specifically, participants were required to correctly identify assumptions specified in the vignette (e.g., the happy hour special). Future research could investigate whether attending questions result in a greater proportion of systematic responding or increase the likelihood of responses being under the control of relevant stimuli (e.g., cue-reactivity paradigms).

Another limitation is that the BOGO drink special was the only option available to participants in that group. As a result, drink consumption was necessarily calculated in multiple of 2's. This type of scenario, where only one drink special is available, may not be reflective of what is actually encountered in the real world. If participants were given the opportunity to distribute responses among BOGO and regularly priced drinks, total drink consumption may not have increased to the extent observed. It would also be interesting to provide concurrently available alternatives with equivalent unit price (e.g. half price and BOGO), akin to that of Madden et al. (2000).

As with much of the APT research, the current study relied solely on self-report measures. However, past research suggests consistency between responses on the APT with hypothetical outcomes and with experienced outcomes (Amlung & MacKillop, 2015; Amlung et al., 2012) and various validity and reliability measures have been established (see Validity and Reliability sections at the beginning of this paper). Further demonstrations of consistency between responses on hypothetical and experiential versions of the APT would add value to the literature, especially in the context of vignette manipulations. That is, when participants are required to spend money, would their response patterns look similar to the ones observed in the current study?

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Table 1
Demographic Characteristics of Articles

Authors (year)	Sample Description	N	Age (SD)	Compensation	Other Measures
Acker, Amlung, Stojek, Murphy, and MacKillop (2012)	From community, Caucasian heavy drinkers (~28 drinks/week for males, ~20 drinks/week for females) in their mid-twenties of average intellectual functioning, modest income, and who were hazardous drinkers based on the AUDIT	61	23.8 (5.4)	Monetary; ($30 for 2 hr session)	TLFB; AUDIT; PACS; UPPS; MCQ; SILS
Amlung, Acker, Stojek, Murphy, and MacKillop (2012)	From community, heavy drinkers (14+/7+ drinks/week for men/women)	41	22.8 (3.0)	Monetary; ($15/hour; total = $105)	TLFB; AUDIT
Amlung et al. (2013)	Undergraduates; monthly alcohol use	273	20 (1.7)	Research/extra credit	DDQ; AUDIT; UPPS-P; MCQ
Amlung and MacKillop (2012)	Undergraduates monthly alcohol use	91	20.7 (2.1)	Research/extra credit	DDQ
Amlung and MacKillop (2014)	From community, heavy drinkers (14+/7+ drinks/week for men/women)	84	22.10 (2.42); 22.38 (2.06); 22.24 (2.24)	Monetary; ($40 plus up to $15)	TBFL; AUDIT; ICCMCP; DD
Amlung and MacKillop (2015)	From university and community; male heavy drinkers (21+ drinks/week)	19	22.84 (2.89)	N/A; ($15/hour as per MacKillop et al., 2014)	TLFB

Authors (year)	Sample Description	N	Age (SD)	Compensation	Other Measures
Amlung, McCarty, et al. (2015)	From university and community; 2/week and ~3-4 drinks/drinking day	85	22.94 (3.41)	Monetary; ($12/hour)	Past-month quantity/frequency alcohol use; YAACQ; Craving (VAS; how much do you want a drink right now?)
Amlung, Yurasek, et al. (2015)	College students; >=1 heavy drinking episodes (5/4+ drinks/occasion) in past month	207	19.5 (1.99)	Course credit/monetary payment	DDQ; AUDIT
Bertholet et al. (2015)	Swiss men approaching army recruitment	4790	21.2 (1.2)	None; army recruitment	Alcohol demographics; adapted SSAGA/DSM-5
Bujarski et al. (2012)	Heavy (>=8 AUDIT) drinkers of East Asian Ethnicity	32	22.3 (1.98)	N/A	AUDIT
Dennhardt, Yurasek, and Murphy (2015)	Undergraduates; heavy drinking (4/5+ drinks female/male)	97	20.10 (2.23)	N/A	DDQ; YAACQ; MPS; DDT; ARSS-SUV
Gentile et al. (2012)	Undergraduates; (at least one alcoholic drink during past month)	164	19.88 (1.53)	Research/extra credit	DDQ
Gentile et al. (2012)	Undergraduates; (at least one alcoholic drink during past month)	59	19.2 (1.15)	Research/extra credit	DDQ

Authors (year)	Sample Description	N	Age (SD)	Compensation	Other Measures
Gilbert et al. (2014)	Undergraduates; >=1 heavy drinking episode past 30 days (see Murphy et al., 2012 for more details)	80	18.5 (.69)	N/A	DDQ; YAACQ
Gray and MacKillop (2014)	From parent study (MacKillop et al., 2012); any alcohol use in past year	720	29.7 (12.0)	N/A	AUDIT; UPPS; FTND
Herschl, McChargue, MacKillop, Stoltenberg, and Highland (2012)	College students (self-reported binge drinking >4/5 drinks per night)	297	19.88 (1.92)	None; volunteers	AUDIT; RAPI; CEOA
Kiselica and Borders (2013)	Undergraduates; consumed alcohol in past 6 months	202	19.48 (1.42)	Course/extra credit	UPPS; DDQ; YAACQ
MacKillop et al. (2014)	Heavy (21+ drinks/week) drinking males from the community	24	22.58 (2.62)	Monetary; ($15/hour)	TLFB
MacKillop, Miranda, et al. (2010)	From community; regular drinkers (18-60/14-53 drinks/week for men/women)	61	42.4 (13.1)	N/A	TLFB; SCID; MCQ; PACS
MacKillop et al. (2009)	Weekly drinking undergraduates	267	20.11 (0.1.51 [sic])	Research credit	DDQ; RAPI
MacKillop and Murphy (2007)	Undergraduate drinkers (upper 20% of weekly drinking distribution for their gender)	54 (initial); 51 (follow-up)	20 (1.22)	Extra credit; ($15 for follow-up)	DDQ; ARSS

Authors (year)	Sample Description	N	Age (SD)	Compensation	Other Measures
MacKillop, O'Hagen, et al. (2010)	Undergraduate heavy drinkers (21+/14+ drinks/week for men/women)	92	18.9	N/A	AUQ; PANAS
Miller and Droste (2013)	Undergraduates from Australian Universities who've used some drug or alcohol	485	20.31 (2.46)	N/A	Not clear
Murphy et al. (2015)	Secondary analysis to Murphy et al., 2010; first year undergrads, 18+, >=1 heavy drinking episode (5/4 drinks one occasion for male/female)	133	18.6 (1.2)	N/A	DDQ; YAACQ; RDEA; Proportionate alcohol-related reinforcement
Murphy et al. (2009)	Undergraduates with history of past month heavy drinking or drug use	38 (time 1); 17 (time 2)	19.92 (1.68)	Monetary; ($40-60)	TLFB; YAAPST; ARSS-SUV
Murphy and MacKillop (2006)	Undergraduates weekly drinkers	267	20.11 (SE = 0.09)	Extra credit	DDQ; RAPI
Murphy et al. (2013)	Undergraduates >= 1 heavy drinking (5+/4+ drinks/occasion male/female) episode past month	133	N/A	N/A	DDQ
Murphy et al. (2014)	Undergraduates >= 1 heavy drinking (5+/4+ drinks/occasion male/female) episode past month (see Murphy et al. 2010)	133 (family history); 74 (no family history)	19.5 (5.04)	Extra credit or monetary	DDQ; YAACQ; Family history drinking problems

Authors (year)	Sample Description	N	Age (SD)	Compensation	Other Measures
Owens, Murphy, and MacKillop (2015)	Heavy drinkers from community (>14 std drinks/week men; >7 std drinks/week women), >7 on AUDIT, 21-29 yrs	84	23.43 (1.76)	Monetary; ($30 for 2.5 hr session)	Alcohol craving
Owens, Ray, and MacKillop (2015)	Non-treatment heavy drinkers >= 8 on AUDIT	62	20.76 (2.55)	N/A	AUQ
Skidmore, Murphy, and Martens (2014)	College students; >=1 heavy drinking episode (5/4 single occasion for male/female); non treatment seeking	207	19.5 (1.99)	Extra credit or monetary	ARSS-SUV; RDEA; DDQ; YAACQ; PBSS; BSSS-4
Skidmore and Murphy (2011)	Heavy-drinking college students	207	19.5 (1.99)	Extra credit or monetary	DDQ; BSSS-4
Smith et al. (2010)	Undergraduates >1 drink during past 30 days	255	20.55 (4.3)	Course credit	UPPS; DDQ; YAACQ
Teeters and Murphy (2015)	College students; past month alcohol use	419	20.37 (2.56)	Course credit	DDQ; Driving after drinking; DRD; UPPS
Teeters et al. (2014)	Undergraduate students reporting >=1 heavy drinking episode (5+/4+ drinks/occasion for male/female) during past 30 days	207	19.5 (1.99)	N/A	DDQ; DAD (single item from YAACQ); BSSS-4
Tripp et al. (2015)	Undergraduate students; past-month alcohol use	264	21.7 (5)	Course credit	DDQ; YAACQ; PACS

Authors (year)	Sample Description	N	Age (SD)	Compensation	Other Measures
Wahlstrom, McChargue, and MacKillop (2012)	Undergraduates; self-reported >=5 drinks on drinking occasions	120	19.88 (1.83)	N/A	AUDIT; RAPI
Yurasek, Murphy, Clawson, Dennhardt, and MacKillop (2013)	Undergraduate students reporting >=1 heavy drinking episode (5+/4+ drinks/occasion for male/female) during past 30 days	207	19.5 (5.04)	N/A	DDQ; YAACQ; FTND
Yurasek et al. (2011)	College students drinking alcohol >=1 day in past 30 days	215	20.65 (4.14)	Course credit	DMQ-R; DDQ; YAACQ

Table 2
Structural Characteristics of APTs

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Acker, Amlung, Stojek, Murphy, and MacKillop (2012)	Computer (MediaLab V2008)	25	0, .02, .05, .13, .25, .50, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100	"Please respond to these questions honestly, as if you were actually in this situation. Imagine that you are drinking in a TYPICAL SITUATION when you drink. The following questions ask how many drinks you would consume if they cost various amounts of money. The available drinks are standard size domestic beer (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 are making these decisions, and will not have an opportunity to drink elsewhere after making these decisions. In addition, assume that you would consume every drink you request; that is, you cannot stockpile drinks for a later date or bring drinks home with you." (pg. 426)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Amlung, Acker, Stojek, Murphy, and MacKillop (2012)	Computer	24	0, .02, .05, .10, .15, .20, .25, .50, .75, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15	Instructions: "(i) each person had a $15 "bar tab" for purchasing alcohol during the study's 1-hour self-administration period; (ii) the alcohol available was their typical alcoholic beverage; (iii) a maximum of 8 "mini-drinks," approximately half the size of standard drinks, were available for purchase; (iv) the total amount of alcohol available would be sufficient to raise their blood alcohol level to 0.07%; (v) the drinks they received could only be consumed during the self-administration period and could not be stockpiled for a later time; and (vi) a 3-hour recovery period was required, regardless of choice outcomes (i.e., choosing fewer drinks would not speed up the session)" Vignette: "This version is hypothetical. This means the questions ask you to make your best estimates of how much you would spend AS IF you would actually receive the drinks and money, but in reality you will not." (pg. 718)
Amlung et al. (2013)	Paper & pencil (90 min group testing)	21	0-10	"Participants were given similar instructions as previous APT studies (i.e., assume a typical drinking situation, their current income level, no stockpiling of drinks for later consumption, and no access to other alcohol)" (pg. 471)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Amlung and MacKillop (2012)	Paper & pencil (shown on Power-Point)	25	0, .02, .10, .25, .50, .75, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, 22.50, 25, 27.50, 30 (also shown a randomized order)	"Participants were asked to estimate how much of a hypothetical $30 'bar tab' they would allocate to purchasing their typical alcoholic beverage at 25 prices ... participants were instructed that each drink was approximately half the size of a standard drink, the maximum number of drinks available was eight, and the total volume would be sufficient to raise their blood alcohol level to 0.07% ... [and] that they would have 1 h to consume the drinks and that they could not take any leftover drinks with them." (pg. 2)
Amlung and MacKillop (2014)	N/A	18	.01, .10, .50, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 (randomized order)	"...based on previous state-based purchase task assessments (Amlung et al., 2012; MacKillop et al., 2010b)." (pg. 1782)
Amlung and MacKillop (2015)	Computer	22	0.01-15.00 (randomized order)	"Participants were given a $15 'bar tab' to be allocated to drink purchases or kept by the participant. Drinks available were the participants' typical alcoholic beverages, and the maximum number of drinks available was 8 'mini-drinks,' each approximately half the size of standard drinks (e.g., Drobes et al., 2003). For the hypothetical version, participants were told that they would not receive any alcohol or money from their choices, but were instructed to make decisions as if the alcohol and money were real (Amlung et al., 2012)." (pg. 188)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Amlung, McCarty, et al. (2015)	Computer	21	0-30	"Participants were given standard instructions based on previous studies using APTs (e.g. assume a typical drinking situation, no opportunity for drinking elsewhere, no stockpiling drinks for later consumption)." (pg. 1423)
Amlung, Yurasek, et al. (2015)	N/A	17	0, 0.25, 0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20	"Participants reported the number of standard-sized drinks (e.g., 12 oz. of beer, 5-oz. glass of wine, or a mixed drink containing 1.5 oz. of liquor) they would purchase and consume in a typical drinking situation if the drinks cost 17 different prices." (pg. 171)
Bertholet et al. (2015)	Paper & pencil / online	11	0, 50cts, 1, 2, 3, 4, 6, 8, 10, 15, 20 Swiss Francs	"Imagine you are in a situation you usually drink alcohol (at a bar, at a party, at home, etc.). You did not drink alcohol before nor will you go have a drink elsewhere afterwards. How many drinks would you have if each drink was:" (pg. 41)
Bujarski et al. (2012)	N/A	16	0-1120	"The APT is a hypothetical alcohol purchase task wherein participants report how many standard drinks they would consume in a typical drinking situation at 16 price points ranging from free ($0) to $1,120 per drink." (pg. 184)
Dennhardt et al. (2015)	N/A	19	0-20	"Participants report the number of standard drinks (domestic beers (12 oz.), wine (5 oz.), shots of hard liquor (1.5 oz.), or mixed drinks containing one shot of liquor) they would purchase and consume during a specified time frame (5 hr) at 19 price increments ranging zero (free) to $20 per drink." (pg. 129)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Gentile et al. (2012)	Computer (online, but in an on-campus lab)	14	5, .25, 7, 10, .50, 3, 1, 0, 4, .75, 8, 2, 6, 9 (randomized order)	Standard condition: “Imagine that you and your friends are at a bar from 9 p.m. to 2 a.m. The following questions ask how many drinks you would purchase at various prices. The available drinks are a standard size beer (12 oz.), a glass of wine (5 oz.), a shot of hard liquor (1.5 oz.), or a mixed drink with one shot of liquor. Assume that you did not drink alcohol before you went to the bar and will not go out after.” Academic constraint condition: “Imagine that you and your friends are at a bar from 9 p.m. to 2 a.m., but you have a class at [8:30 a.m./10:30 a.m./12:30 p.m.] the next day. The class is an upper-level seminar within your major and there are 12 students in the class. The following questions ask how many drinks you would purchase at various prices. The available drinks are a standard size beer (12 oz.), a glass of wine (5 oz.), a shot of hard liquor (1.5 oz.), or a mixed drink with one shot of liquor. Assume that you did not drink alcohol before you went to the bar and will not go out after.” (pg. 392)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Gentile et al. (2012)	Computer (online, but in an on-campus lab)	19	5, .25, 7, 13, 10, .5, 3, 15, 1, 0, 4, 12, .75, 8, 2, 11, 6, 9, 14 (randomized order)	"Imagine that you and your friends are at a bar from 9 p.m. to 2 a.m., and you have a(n) [exam/class] at [8:30 a.m./12:30 p.m.] the following day. The following questions ask how many drinks you would purchase at various prices. The available drinks are a standard size beer (12 oz.), a glass of wine (5 oz.), a shot of hard liquor (1.5 oz.), or a mixed drink with one shot of liquor. Assume that you did not drink alcohol before you went to the bar and will not go out after." (pg. 395)
Gilbert et al. (2014)	N/A	1	0	"Participants completed a hypothetical alcohol consumption task in which they were asked to indicate how many drinks they would consume during the evening preceding each of nine next-day responsibilities: no next-day responsibilities, a college class at 9:00 a.m., class at 10:00 a.m., class at 11:00 a.m., class at noon, an internship, extracurricular activity, volunteering, and paid employment (each at 9:00 a.m.). Participants were first given definitions of standard drinks and then asked to imagine that they would consume the drink(s) at a party that began at 9:00 p.m. They were told that they could leave whenever they wanted and that the drinks were free. Each next-day responsibility item was phrased, 'How many drinks would you have at this party if you had [class] the next morning at 9:00 a.m.?'" (pg. 1244)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Gray and MacKillop (2014)	N/A	26 (only 21 analyzed; excluded $70-$1120 b/c lack of variability)	0, .02, .05, .13, .25, .5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 70, 140, 280, 560, 1120	N/A
Herschl et al. (2012)	Paper & pencil	14	0, .25, .50, 1, 1.50, 2, 2.50, 3, 4, 5, 6, 7, 8, 9	"How many drinks would you consume if they were ____ each?" (pg. 687)
Kiselica and Borders (2013)	Paper & pencil	19	5, .25, 7, 13, 10, .5, 3, 15, 1, 0, 4, 12, .75, 8, 2, 11, 6, 9, 14 (randomized order; shown on separate pages)	"Imagine that you and your friends are at a bar from 9 P.M. to 2 A.M. The following questions ask how many drinks you would purchase at various prices. The available drinks are a standard-size beer (12 oz.), a glass of wine (5 oz.), a shot of distilled spirits (1.5 oz.), or a mixed drink with one shot of distilled spirits. Assume that you did not drink alcohol before you went to the bar and will not go out after." (pg. 492)
MacKillop et al. (2014)	Computer	22	0.01, 1.00, 8.00, 0.75, 7.00, 15.00, 2.00, 0.25, 14.00, 0.05, 9.00, 3.00, 12.00, 0.50, 6.00, 11.00, 5.00, 0.10, 4.00, 13.00, 0.02, 10.00 (one of four randomized sequences)	N/A

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
MacKillop, Miranda, et al. (2010)	N/A	16	0-1120	“Please respond to these questions honestly, as if you were actually in this situation. Imagine that you are drinking in a TYPICAL SITUATION when you drink. The following questions ask how many drinks you would consume if they cost various amounts of money. The available drinks are standard size domestic beer (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 are making these decisions, and will not have an opportunity to drink elsewhere after making these decisions. In addition, assume that you would consume every drink you request; that is, you cannot stockpile drinks for a later date or bring drinks home with you.” (pg. 109)
MacKillop et al. (2009)	Paper & pencil	14	0, .25, .5, 1,1.50, 2, 2.50, 3, 4, 5, 6, 7, 8, 9	“Imagine that you and your friends are at a bar from 9 P.M. to 2 A.M. to see a band. The following questions ask how many drinks you would purchase at various prices. The available drinks are standard size beer (12 oz), wine (5 oz), shots of hard liquor (1.5 oz), or mixed drinks with one shot of liquor. Assume that you did not drink alcohol before you went to the bar and will not go out after.” (pg. 35)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
MacKillop and Murphy (2007)	Paper & pencil	14	0, .25, .5, 1,1.50, 2, 2.50, 3, 4, 5, 6, 7, 8, 9	"Imagine that you and your friends are at a bar from 9pm to 2am to see a band. The following questions ask how many drinks you would purchase at various prices. The available drinks are standard size beer (12oz), wine (5oz), shots of hard liquor (1.5oz), or mixed drinks with one shot of liquor. Assume that you did not drink alcohol before you went to the bar and will not go out after." (pg. 228-229)
MacKillop, O'Hagen, et al. (2010)	Paper & pencil	19	0, .01, .05, .13, .25, .5, 1, 2, 3, 4, 5, 6, 11, 35, 70, 140, 280, 560, 1120	"Please respond to these questions honestly. Imagine that you could drink RIGHT NOW. The following questions ask how many drinks you would consume if they cost various amounts of money. The available drinks are standard size domestic beer (12 oz.), wine (5 oz.), shots of hard liquor (1.5 oz.), or mixed drinks containing one shot of liquor. Assume that you would consume every drink you request; that is, you cannot stockpile drinks for a later date or bring drinks home with you." (pg. 1601)
Miller and Droste (2013)	Computer (online)	N/A	N/A	N/A
Murphy et al. (2015)	N/A	17	0-20	"Participants report the number of standard drinks they would purchase and consume during a specified time frame (5 hr) at 17 price increments ranging from free ($0) to $20 per drink." (pg. 1036)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Murphy et al. (2009)	N/A	14	0-9; 0-3 by .5 increments; 3-9 by 1 increments	"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 party on a weekend night from 9:00 p.m. until 2:00 a.m. 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 or use drugs before you went to the party, and that you will not drink or use drugs after leaving the party. You cannot bring your own alcohol or drugs to the party. Also, assume that the alcohol you are about to purchase is for your consumption only. In other words, you can't sell the drinks or give them to anyone else. You also can't bring the drinks home. Everything you buy is, therefore, for your own personal use within the 5 hour period that you are at the party. Please respond to these questions honestly, as if you were actually in this situation." (pg. 398)
Murphy and MacKillop (2006)	N/A	14	0, .25, .5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 9	"Imagine that you and your friends are at a bar from 9 p.m. to 2 a.m. to see a band. The following questions ask how many drinks you would purchase at various prices. The available drinks are standard size beer (12 oz), wine (5 oz), shots of hard liquor (1.5 oz), or mixed drinks with one shot of liquor. Assume that you did not drink alcohol before you went to the bar and will not go out after." (pg. 222)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Murphy et al. (2013)	Paper & pencil	17	0-20; 0-3 by .50 increments; 3-10 by 1 increments; 10-20 by 5 increments	"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 party on a weekend night from 9:00 p.m. until 2:00 a.m. to see a band. Imagine that you do not have any obligations the next day (i.e., no work or classes). 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 or use drugs before you went to the party, and that you will not drink or use drugs after leaving the party. You cannot bring your own alcohol or drugs to the party. Also, assume that the alcohol you are about to purchase is for your consumption only. In other words, you can't sell the drinks or give them to anyone else. You also can't bring the drinks home. Everything you buy is, therefore, for your own personal use within the 5 hour period that you are at the party. Please respond to these questions honestly, as if you were actually in this situation." (pg. 131)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Murphy et al. (2014)	Paper & pencil	17	0-20; 0-3 by .50 increments; 3-10 by 1 increments; 10-20 by 5 increments	Standard condition: “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 party on a Thursday night from 9:00 P.M. until 2:00 A.M. to see a band. Imagine that you do not have any obligations the next day (i.e., no work or classes). 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 distilled spirits (1.5 oz.), or mixed drinks containing one shot of distilled spirits. Assume that you did not drink alcohol or use other drugs before you went to the party and that you will not drink or use other drugs after leaving the party. Also, assume that the alcohol you are about to purchase is for your consumption only during the party (you can’t sell or bring drinks home). Please respond to these questions honestly, as if you were actually in this situation.” Next day test condition: “The only difference from the last scenario is that we now ask that you imagine that you have a test (worth 25% of your course grade) for a college class the next morning at 10:00 A.M.” (pg. 656)
Owens, Murphy, and MacKillop (2015)	N/A	N/A	N/A	N/A; 1. If drinks were free, how many would you have?; 2. What is maximum total amount you would spend on drinking?; 3. What is maximum you would pay for single drink?

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Owens, Ray, and MacKillop (2015)	Paper & pencil	16	0, .01, .05, .13, .25, .5, 1, 3, 6, 11, 35, 70, 140, 280, 560, 1120 (only up to 70)	"Please respond to these questions honestly. Imagine that you could drink RIGHT NOW. The following questions ask how many drinks you would consume if they cost various amounts of money. The available drinks are standard size domestic beer (12 oz.), wine (5 oz.), shots of hard liquor (1.5 oz.), or mixed drinks containing one shot of liquor. Assume that you would consume every drink you request; that is, you cannot stockpile drinks for a later date or bring drinks home with you." (pg. 79)
Skidmore et al. (2014)	N/A	17	0-20	"Participants were asked to read the description of a hypothetical drinking scenario and report the number of standard drinks they would purchase and consume at 17 different prices, ranging from free to $20 per drink." (pg. 204)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Skidmore and Murphy (2011)	Paper & pencil	17	0-20	No-responsibility condition: “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 party on a Thursday night from 9:00 PM until 2:00 AM to see a band. Imagine that you do not have any obligations the next day (i.e., no work or classes). 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 that contain one shot of liquor. Assume that you did not drink alcohol or use drugs before you went to the party and that you will not drink or use drugs after leaving the party. Also, assume that the alcohol you are about to purchase is for your consumption only during the party (you can’t sell or bring drinks home). Please respond to these questions honestly, as if you were actually in this situation.” Next-day test condition: “The only difference from the last scenario is that we now ask that you imagine that you have a test (worth 25% of your course grade) for a college class the next morning at 10:00 AM.” Next-day class condition: “The only difference from the last scenario is that we now ask that you imagine that you have a college class the next morning at 10:00 AM, but there is no test and the teacher does not take attendance.” (pg. 61)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Smith et al. (2010)	N/A	17	0-20; 0-3 by .5 increments, 3-10 by 1 increments, 10-20 by 5 increments	"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 party on a Thursday night from 9:00 p.m. until 2:00 a.m. to see a band. Imagine that you do not have any obligations the next day (i.e., no work or classes). 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 or use drugs before you went to the party and that you will not drink or use drugs after leaving the party. Also, assume that the alcohol you are about to purchase is for your consumption only during the party (you can't sell or bring drinks home). Please respond to these questions honestly, as if you were actually in this situation." (pg. 523)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Teeters and Murphy (2015)	Computer (online)	17	0-20	Standard condition: “In the questions that follow we would like you to make decisions about how many drinks you would have in various situations. The available drinks are standard size domestic beers (12 oz.), wine (5 oz.), shots of hard liquor (1.5 oz.), or mixed drinks containing 1 shot of liquor. Please respond to these questions honestly, as if you were actually in this situation. Please imagine that you and your friends are at a party from 9:00 PM until 1:00 AM. Assume that you did not drink alcohol or use drugs before you went to the party, and that you will not drink or use drugs after leaving the party.” Driving condition (last sentence added): “Imagine that you were driving home at 2:00 AM at least 1 hour after you stopped drinking.” (pg. 898)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Teeters et al. (2014)	N/A	17	0-20	"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 party on a Thursday night from 9:00 PM until 2:00 AM to see a band. Imagine that you do not have any obligations the next day (i.e., no work or classes). 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 1 shot of liquor. Assume that you did not drink alcohol or use drugs before you went to the party, and that you will not drink or use drugs after leaving the party. Also, assume that the alcohol you are about to purchase is for your consumption only during the party (you can't sell or bring the drinks home). Please respond to these questions honestly, as if you were actually in this situation." (pg. 2068)
Tripp et al. (2015)	Computer (online)	17	0, .25, .5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20	"...participants are instructed to imagine that they are at a party with friends from 9:00 p.m. until 1:00 a.m. and that they will not consume any alcohol prior to or after the party. They are told that 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." (pg. 326)
Wahlstrom et al. (2012)	N/A	14	0, .25, .5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 9	N/A

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Yurasek et al. (2013)	N/A	17	0-20; 0-3 by .5 increments, 3-10 by 1 increments, 10-20 by 5 increments	"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 party on a Thursday night from 9:00 P.M. until 2:00 A.M. to see a band. Imagine that you do not have any obligations the next day (i.e., no work or classes). 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 distilled spirits (1.5 oz.), or mixed drinks containing one shot of distilled spirits. Assume that you did not drink alcohol or use other drugs before you went to the party and that you will not drink or use other drugs after leaving the party. Also, assume that the alcohol you are about to purchase is for your consumption only during the party (you can't sell or bring drinks home). Please respond to these questions honestly, as if you were actually in this situation." (pg. 628)

Authors (year)	Response Medium	Number of Prices	Prices Specified ($USD/Drink)	Vignette
Yurasek et al. (2011)	N/A	17	0-20; 0-3 by .5 increments, 3-10 by 1 increments, 10-20 by 5 increments	"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 party on a Thursday night from 9:00 P.M. until 2:00 A.M. to see a band. Imagine that you do not have any obligations the next day (i.e., no work or classes). 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 distilled spirits (1.5 oz.), or mixed drinks containing one shot of distilled spirits. Assume that you did not drink alcohol or use drugs before you went to the party and that you will not drink or use drugs after leaving the party. Also, assume that the alcohol you are about to purchase is for your consumption only during the party (you can't sell or bring drinks home). Please respond to these questions honestly, as if you were actually in this situation." (pg. 993)

Table 3
Characteristics of Data Analyses

Authors (year)	Software Used	Changes to 0s	*k* (method of obtaining)	Use Equation 6?
Acker, Amlung, Stojek, Murphy, and MacKillop (2012)	GraphPad Prism; SPSS 18.0	N/A	2.9 (best-fitting *k* from overall mean performance)	Yes
Amlung, Acker, Stojek, Murphy, and MacKillop (2012)	GraphPad Prism; SPSS 18.0	N/A	4 (best-fitting *k* from overall mean performance)	Yes
Amlung et al. (2013)	N/A	N/A	4 (best-fitting *k* from overall mean performance)	Yes
Amlung and MacKillop (2012)	N/A	N/A	N/A	Yes
Amlung and MacKillop (2014)	N/A	N/A	3 (N/A)	Yes
Amlung and MacKillop (2015)	GraphPad Prism 6; IBR template	N/A	4.0 (best-fitting *k* from overall mean performance)	Yes
Amlung, McCarty, et al. (2015)	SAS 9.4	N/A	N/A	No
Amlung, Yurasek, et al. (2015)	GraphPad Prism 6; IBR template	Removed	2.6 (best-fitting *k* from overall mean performance)	Yes
Bertholet et al. (2015)	Calculator from IBR website	0 -> .01	3.5 (N/A)	Yes
Bujarski et al. (2012)	SAS 9.2	N/A	N/A	Yes

Dennhardt et al. (2015)	N/A; (used Prism macro for DD)	N/A	N/A	Yes
Gentile et al. (2012)	Prism	$0 -> $.01	1.482 (IBR's iterative solver and added .5)	Yes
Gentile et al. (2012)	Prism	N/A	1.822 (IBR's iterative solver)	Yes
Gilbert et al. (2014)	N/A	N/A	N/A	No
Gray and MacKillop (2014)	N/A	N/A	3.0 (best-fitting *k* from overall mean performance)	Yes
Herschl et al. (2012)	Calculator from IBR website	N/A	1 (N/A)	Yes
Kiselica and Borders (2013)	Mplus 5.0	N/A	N/A	Yes
MacKillop et al. (2014)	N/A	N/A	N/A	No
MacKillop, Miranda, et al. (2010)	SPSS 16.0	Intensity -> .001; 0 -> .001	N/A	No
MacKillop et al. (2009)	N/A	N/A	N/A	No
MacKillop and Murphy (2007)	N/A	0 -> 0.01	N/A	No
MacKillop, O'Hagen, et al. (2010)	SPSS 16.0	0 -> .01; $0.00 -> $.001	N/A	No
Miller and Droste (2013)	N/A	N/A	N/A	No
Murphy et al. (2015)	N/A	N/A	N/A	No
Murphy et al. (2009)	Used IBR template	0 -> 0.01	3.8 (N/A)	Yes
Murphy and MacKillop (2006)	SPSS 11.5	0 -> 0.01	N/A	No

Murphy et al. (2013)	Calculator from IBR website	0 -> 0.01	2.834 (derived from sample mean)	Yes
Murphy et al. (2014)	N/A	N/A	N/A	No
Owens, Murphy, and MacKillop (2015)	SPSS 21.0; Compre-hensive Meta-Analysis 2.0	N/A	N/A	No
Owens, Ray, and MacKillop (2015)	N/A	N/A	3 (N/A; "denotes range of consumption values across individuals")	Yes
Skidmore et al. (2014)	Excel from IBR	Removed	2.834 (best-fitting *k* from sample mean)	Yes
Skidmore and Murphy (2011)	Calculator from IBR	0 -> 0.01	2.834 (based on average)	Yes
Smith et al. (2010)	N/A	N/A	N/A	No
Teeters and Murphy (2015)	GraphPad Prism 5.0.4; IBR template	Removed	2.6 (N/A)	Yes
Teeters et al. (2014)	GraphPad Prism 5.0.4; IBR template	Removed	2.6 (N/A)	Yes
Tripp et al. (2015)	GraphPad Prism 5.0.4; IBR template	Removed	2.6 (N/A)	Yes
Wahlstrom et al. (2012)	Calculator from IBR website	No BP -> $9	1 (N/A; "constant across individuals that denotes range of consumption values in log powers of ten")	Yes

Yurasek et al. (2013)	N/A	N/A	N/A	Yes
Yurasek et al. (2011)	AMOS?	N/A	N/A	No

Table 4
Happy Hour Laws By State

State	Ban?	Restrict?	Details	Citation	Text
Alabama	No	Yes	May not reduce price between 9 PM & 10 AM	Ala. Admin. Code r. 20-X-6-.13	(1) It shall be unlawful for any ABC Board licensee to: (a) Serve multiple drinks for a single price. (b) Establish a single retail price based upon the required purchase of two or more drinks. (c) Sell or otherwise furnish drinks before 10 a.m. or after 9 p.m. at a price which is reduced from the usual customary or established retail price charged for such drinks. (2) Nothing herein contained shall be construed to prohibit the dispensing of drinks customarily sold in pitchers, provided such pitchers shall be available at all times the licensee is open for business. The usual, customary or established retail price thereof shall not be reduced before 10 a.m. or after 9 p.m. (3) The term "drink" or "drinks" is defined herein to mean any beverage containing any quantity of alcohol. "Multiple drinks" is defined to mean two or more drinks containing any quantity of alcohol or a single container which contains more than the normal quantity of alcohol for an individual drink in accordance with ABC Board Regulation 20-X-6-.04(2). The term "pitcher" is defined to mean any receptacle containing a minimum of sixty (60) fluid ounces of beverages. (4) This regulation shall not apply to legitimate, prearranged private parties, functions, or events where guests thereof are served in a room or rooms so designated and used exclusively therefor.

State	Ban?	Restrict?	Details	Citation	Text
Alaska	Yes	n/a		Alaska Stat. Â§ 04.16.015	(a) On premises where alcoholic beverages are sold by the drink, a licensee or a licensee's agent or employee may not (1) offer or deliver, as a marketing device to the general public, free alcoholic beverages to a patron; (2) deliver an alcoholic beverage to a person already possessing two or more; (3) sell, offer to sell, or deliver alcoholic beverages to a person or group of persons at a price less than the price regularly charged for the beverages during the same calendar week, except at private functions not open to the general public; (4) sell, offer to sell, or deliver an unlimited number of alcoholic beverages to a person or group of persons during a set period of time for a fixed price; (5) sell, offer to sell, or deliver alcoholic beverages to a person or group of persons on any one day at prices less than those charged the general public on that day, except at private functions not open to the general public; (6) encourage or permit an organized game or contest on the licensed premises that involves drinking alcoholic beverages or the awarding of alcoholic beverages as prizes. (b) A licensee or a licensee's agent or employee may not advertise or promote in any way, either on or off the premises, a practice prohibited under (a) of this section. (c) This section may not be construed as prohibiting a licensee or a licensee's agent or employee from offering free food or entertainment at any time, from serving wine by the bottle or carafe or beer by the pitcher with or without meals, or from including an alcoholic beverage as part of a meal package. (d) Notwithstanding (a) and (b) of this section, a licensee or a licensee's agent or employee when acting as a caterer may offer or deliver free alcoholic beverages to a political, charitable, or educational group or organization.

State	Ban?	Restrict?	Details	Citation	Text
Arizona	No	Yes	Unlimited drinks prohibited, nothing about reducing price	A.R.S. Â§ 4-244	23. For an on-sale retailer or employee to conduct drinking contests, to sell or deliver to a person an unlimited number of spirituous liquor beverages during any set period of time for a fixed price, to deliver more than forty ounces of beer, one liter of wine or four ounces of distilled spirits in any spirituous liquor drink to one person at one time for that person's consumption or to advertise any practice prohibited by this paragraph. The provisions of this paragraph do not prohibit an on-sale retailer or employee from selling and delivering an opened, original container of distilled spirits if: (a) Service or pouring of the spirituous liquor is provided by an employee of the on-sale retailer. (b) The employee of the on-sale retailer monitors consumption to ensure compliance with this paragraph. Locking devices may be used, but are not required.

State	Ban?	Restrict?	Details	Citation	Text
Arkansas	No	Yes	Unlimited & two-for-one drinks prohibited, nothing about smaller price reduction	006 02 CARR 001	SUBTITLE G. . . Section 1.79 Prohibited Activities; Grounds for Cancellation, Suspension, Revocation, or Placing of Monetary Fine Against Any Permit. In addition to the violation or failure to comply with any of these Regulations or any alcoholic beverage control law of the State of Arkansas, any permit issued pursuant to any alcoholic beverage control law of the State of Arkansas may be cancelled, suspended, revoked, or assessed a monetary fine for any of the following prohibited activities committed by the permittee or any employee, agent or servant of the permittee:. . . . (28) Advertising, Selling or Dispensing Alcoholic Beverages on a Two or More for the Price of One Basis. The permittee advertised, sold, dispensed, or served any alcoholic beverages for on premises consumption on the basis of two or more drinks for the price of one. Further, the permittee advertised, sold, dispensed, or served alcoholic beverages without a limit to any person on the basis of a flat fee or cover charge. Further, distilled spirits may not be sold by the bottle to patrons for self pouring at on premises consumption permitted outlets. Provided, a fee charged for wine tastings, where such tastings are served in containers of two (2) ounces or less and each patron is limited to a maximum of four (4) servings per charge, shall not be deemed in violation of this Regulation; (Amended 8-17-05)
California	No	No			
Colorado	No	No			

State	Ban?	Restrict?	Details	Citation	Text
Connecticut	No	Yes	Unlimited drinks prohibited, nothing about reducing price	Regs., Conn. State Agencies, 30-6-A24B	(b) Restrictions. No permittee, backer, or employee or agent of same, at any on-premises consumption place of business, shall: (1) sell, offer, or deliver more than one drink to any one person for his/her own consumption at any one time. A second serving may be allowed only after the first serving has been substantially disposed of or consumed; (2) sell, offer or deliver drinks by the pitcher or other vessel containing more than one drink except to two or more persons, excluding minors as defined by the Liquor Control Act, at any one time. A second serving may be allowed only after the first serving has been substantially disposed of or consumed; (3) sell, offer or deliver to any person an unlimited number of drinks during any set period of time for a fixed price; (4) encourage or permit, on the licensed premises, any game or contest which involves drinking or the awarding of drinks as prizes. (c) Private Functions and Hotel Guest Bars. The provisions of this section shall not apply to private functions held in a room or rooms at any on-premises consumption place of business or to hotel guest bars. (d) Nothing in this section shall be construed as an exception to any other provision of the Liquor Control Act or Regulations of Connecticut State Agencies, especially those respecting hours and days of sale, the sale of alcoholic liquor to minors or intoxicated persons.

State	Ban?	Restrict?	Details	Citation	Text
Delaware	Yes	n/a		CDR 4-002	IV. Prohibited Practices. A. Retail Licensees 1. On-Premise License No establishment licensed to sell alcoholic beverages for consumption on the premises where sold shall engage in any trade practice which can reasonably be expected to cause, encourage, or induce a consumer to purchase, receive, or consume alcoholic beverages in excessive amounts or at an unduly rapid rate and shall include, but not be limited to, the following: a. Giving alcoholic beverages in any form, either directly or indirectly, to any individual, organization, group or other entity. b. Giving any form of cash (medium of exchange), either directly or indirectly, to any individual, organization, group, or other entity, except for bona fide contributions to not for profit entities and provided that such contribution is in no way conditional upon the purchase and/or consumption of alcoholic beverages. c. Selling alcoholic beverages at a price which is less than the seller's cost. d. Promoting, sponsoring, conducting, or participating in any event that is in any way conditional upon or involves consumption of alcoholic beverages. e. Offering or selling two (2) or more drinks for the regular price of one. f. Extending credit except as provided in Rule 56. g. Unlimited consumption of alcoholic beverages for a set price. However, caterers, as defined in 4 Del. C., Â§ 101 (8), and private functions in which the host/hostess pays a set price and which are conducted by invitation on a licensed premises are excluded from this prohibition.

State	Ban?	Restrict?	Details	Citation	Text
Delaware	Yes	n/a		CDR 4-002	h. Delivering alcoholic beverages to any person who is or who appears to be intoxicated. i. Soliciting or receiving any items which an importer licensee is prohibited under Section IV-B-1-a or IV-B-1-b from giving to a retailer. j. Open bars are generally not permitted pursuant to the provisions of IV-A-1-g above; however, the Commissioner may grant a variance to this section provided that the licensee meets the criteria that follows. . .
District of Columbia	No	No			
Florida	No	No			
Georgia	No	No			
Hawaii	Yes	n/a		HRS Â§ 281-78.5	(a) No person licensed to sell liquor for consumption on the premises shall engage in practices which promote excessive consumption of liquor. (b) The liquor commission shall adopt rules pursuant to chapter 91 to prohibit specific liquor promotion practices which promote excessive consumption of liquor. (c) Any person who violates this section or any rule adopted by the commission pursuant to this chapter shall be guilty of a violation for each separate offense. Each date of violation shall constitute a separate offense.
Idaho	No	No			

State	Ban?	Restrict?	Details	Citation	Text
Illinois[a]	Yes	n/a		235 ILCS 5/6-28	Sec. 6-28. Happy hours prohibited. (a) All retail licensees shall maintain a schedule of the prices charged for all drinks of alcoholic liquor to be served and consumed on the licensed premises or in any room or part thereof. Whenever a hotel or multi-use establishment which holds a valid retailer's license operates on its premises more than one establishment at which drinks of alcoholic liquor are sold at retail, the hotel or multi-use establishment shall maintain at each such establishment a separate schedule of the prices charged for such drinks at that establishment. (b) No retail licensee or employee or agent of such licensee shall: (1) serve 2 or more drinks of alcoholic liquor at one time to one person for consumption by that one person, except conducting product sampling pursuant to Section 6-31 or selling or delivering wine by the bottle or carafe; (2) sell, offer to sell or serve to any person an unlimited number of drinks of alcoholic liquor during any set period of time for a fixed price, except at private functions not open to the general public; (3) sell, offer to sell or serve any drink of alcoholic liquor to any person on any one date at a reduced price other than that charged other purchasers of drinks on that day where such reduced price is a promotion to encourage consumption of alcoholic liquor, except as authorized in paragraph (7) of subsection (c); (4) increase the volume of alcoholic liquor contained in a drink, or the size of a drink of alcoholic liquor, without increasing proportionately the price regularly charged for the drink on that day; (5) encourage or permit, on the licensed premises, any game or contest which involves drinking alcoholic liquor or the awarding of drinks of

State	Ban?	Restrict?	Details	Citation	Text
Illinois[a]	Yes	n/a		235 ILCS 5/6-28	alcoholic liquor as prizes for such game or contest on the licensed premises; or (6) advertise or promote in any way, whether on or off the licensed premises, any of the practices prohibited under paragraphs (1) through (5). (c) Nothing in subsection (b) shall be construed to prohibit a licensee from: (1) offering free food or entertainment at any time; (2) including drinks of alcoholic liquor as part of a meal package; (3) including drinks of alcoholic liquor as part of a hotel package; (4) negotiating drinks of alcoholic liquor as part of a contract between a hotel or multi-use establishment and another group for the holding of any function, meeting, convention or trade show; (5) providing room service to persons renting rooms at a hotel; (6) selling pitchers (or the equivalent, including but not limited to buckets), carafes, or bottles of alcoholic liquor which are customarily sold in such manner, or selling bottles of spirits, and delivered to 2 or more persons at one time; (7) increasing prices of drinks of alcoholic liquor in lieu of, in whole or in part, a cover charge to offset the cost of special entertainment not regularly scheduled; or (8) including drinks of alcoholic liquor as part of an entertainment package where the licensee is separately licensed by a municipal ordinance that (A) restricts dates of operation to dates during which there is an event at an adjacent stadium, (B) restricts hours of serving alcoholic liquor to 2 hours before the event and one hour after the event, (C) restricts alcoholic liquor sales to beer and wine, (D) requires tickets for admission to the establishment, and (E) prohibits sale of admission tickets on the day of an event and permits the sale of admission tickets for single events only. (d) A violation of this Act shall be grounds for suspension or revocation of the retailer's license as provided by this Act.

State	Ban?	Restrict?	Details	Citation	Text
Indiana	Yes	n/a		Burns Ind. Code Ann. Â§ 7.1-5-10-20	(a) It is unlawful for a holder of a retailer's permit to do any of the following: (1) Sell alcoholic beverages during a portion of the day at a price that is reduced from the usual, customary, or established price that the permittee charges during the remainder of that day. (2) Furnish two (2) or more servings of an alcoholic beverage upon the placing of an order for one (1) serving to one (1) person for that person's personal consumption. (3) Charge a single price for the required purchase of two (2) or more servings of an alcoholic beverage. (b) Subsection (a) applies to private clubs but does not apply to private functions that are not open to the public. (c) Notwithstanding subsection (a)(1), it is lawful for a holder of a retailer's permit to sell alcoholic beverages during a portion of the day at a price that is increased from the usual, customary, or established price that the permittee charges during the remainder of that day as long as the price increase is charged when the permittee provides paid live entertainment not incidental to the services customarily provided. (d) Notwithstanding subsection (a), section 12 [IC 7.1-5-10-12] of this chapter, and IC 7.1-5-5-7, it is lawful for a hotel, in an area of the hotel in which alcoholic beverages are not sold, to make available to its registered guests and their guests alcoholic beverages at no additional charge beyond what is to be paid by the registered guests as the room rate.
Iowa	No	No			

State	Ban?	Restrict?	Details	Citation	Text
Kansas	No	Yes	Unlimited drinks prohibited, drinks for less than cost prohibited, nothing about reducing price less than that	K.S.A. Â§ 41-2640; see also K.S.A. Â§ 41-2722	(a) No club, drinking establishment, caterer or holder of a temporary permit, nor any person acting as an employee or agent thereof, shall: (1) Offer or serve any free cereal malt beverage or alcoholic liquor in any form to any person; (2) offer or serve to any person an individual drink at a price that is less than the acquisition cost of the individual drink to the licensee or permit holder; (3) sell, offer to sell or serve to any person an unlimited number of individual drinks during any set period of time for a fixed price, except at private functions not open to the general public or to the general membership of a club; (4) encourage or permit, on the licensed premises, any game or contest which involves drinking alcoholic liquor or cereal malt beverage or the awarding of individual drinks as prizes; or (5) advertise or promote in any way, whether on or off the licensed premises, any of the practices prohibited under subsections (a)(1) through (4).
Kentucky	No	No			
Louisiana	No	Yes	"All you can drink" only prohibited after 10 PM	La. R.S. 26:90; see also La. R.S. 26:286(A)(15)	A. No person holding a retail dealer's permit and no agent, associate, employee, representative, or servant of any such person shall do or permit any of the following acts to be done on or about the licensed premises: (15) Sell or serve any alcoholic beverages at a price fixed on an "all you can drink" basis after the hour of 10:00 p.m.

State	Ban?	Restrict?	Details	Citation	Text
Maine	Yes	n/a		28-A M.R.S. Â§ 709	1. CERTAIN PRACTICES PROHIBITED. The following practices are prohibited. A. No licensee or employee or agent of a licensee may: 1) Offer or deliver any free liquor to any person or group of persons; 2) Deliver more than 2 drinks containing spirits, a carafe containing more than one liter or 33.8 ounces of wine, or any serving or pitcher containing more than one liter or 33.8 ounces of malt liquor, to one person at one time; 3) Sell, offer to sell or deliver to any person or group of persons an unlimited number of drinks for a fixed price, except at private functions not open to the public; 4) Encourage or permit, on the licensed premises, any game or contest that involves drinking or the awarding of drinks as prizes; or 5) Any other practice the specific purpose of which is to encourage customers of the licensee to drink to excess; and B. No licensee may advertise or promote in any way, whether within or without the licensed premises, any of the practices prohibited under paragraph A. 2. EXCEPTIONS. Subsection 1 does not prohibit the following practices: A. Licensees offering free food or entertainment either with or without the purchase of one drink; B. Licensees increasing the prices for drinks when entertainment is provided; C. Licensees including a drink as part of a meal package; D. The sale or delivery of wine, malt liquor or mixed drinks by the bottle, carafe or pitcher when sold with meals or to more than one person; E. Those licensed under sections 1052-B or 1052-C offering free samples or tastings; F. Those licensed as bona fide hotels offering room services to registered guests; G. Licensees offering reduced prices for prearranged private parties on the premises of the licensee;

State	Ban?	Restrict?	Details	Citation	Text
Maine	Yes	n/a		28-A M.R.S. Â§ 709	H. Licensees whose licensed premises include more than one room charging different prices for the same drink served in the different rooms; I. Conducting taste testing under section 460, 1051, 1205, 1207 or 1355-A; J. Providing samples authorized under section 1355-A, 1402, 1402-A or 1504; or K. Donations authorized under section 708-B.
Maryland	No	No			
Mas-sachusetts	Yes	n/a		204 CMR 4.03	(1) No licensee or employee or agent of a licensee shall: (a) offer or deliver any free drinks to any person or group of persons; (b) deliver more than two drinks to one person at one time; (c) sell, offer to sell or deliver to any person or group of persons any drinks at a price less than the price regularly charged for such drinks during the same calendar week, except at private functions not open to the public; (d) sell, offer to sell or deliver to any person an unlimited number of drinks during any set period of time for a fixed price, except at private functions not open to the public; (e) sell, offer to sell or deliver drinks to any person or group of persons on any one day at prices less than those charged the general public on that day, except at private functions not open to the public; (f) sell, offer to sell or deliver malt beverages or mixed drinks by the pitcher except to two or more persons at any one time; (g) increase the volume of alcoholic beverages contained in a drink without increasing proportionately the price regularly charged for such drink during the same calendar week; (h) encourage or permit, on the licensed premises, any game or contest which involves drinking or the awarding of drinks as prizes. (2) No licensee shall advertise or promote in any way, whether within or without the licensed premises, any of the practices prohibited under 204 CMR 4.03.

State	Ban?	Restrict?	Details	Citation	Text
Michigan	No	Yes	Unlimited drinks prohibited, nothing about reducing price	MICH. ADMIN. CODE R 436.1438	Rule 38. (1) An on-premises licensee shall not sell, offer to sell, or advertise the sale of, an unlimited quantity of alcoholic liquor at a specific price. (2) No licensee shall sell, offer to sell, or advertise the sale of, 2 or more identical drinks containing alcoholic liquor to a person for that person's consumption for 1 price. When 2 or more identical drinks containing alcoholic liquor are served to a person at 1 time, the price charged for the second and each additional identical drink shall be the same as the price charged for the first drink.
Minnesota	No	No			
Mississippi	No	No			
Missouri	No	No			
Montana	No	No			
Nebraska	No	Yes	Unlimited drinks prohibited, nothing about reducing price	Nebraska Admin. Code Title 237, Ch. 6	019.01U MULTIPLE DRINKS 019.01U1 No licensee shall sell, or serve for on-premises consumption, an unlimited quantity of beer, wine, or spirits at a specific price. 019.01U2 No licensee shall sell or serve two or more drinks containing beer, wine, or spirits to a person for that person's consumption on the licensed premises for one price. A pitcher shall not be considered a drink, however, no licensee shall sell two or more pitchers for one price. 019.01U3 Nothing in this rule shall limit, or in any way restrict, the price which may be charged by any licensee for a single drink containing beer, wine, or spirits to be consumed on the licensed premises.
Nevada	No	No			

State	Ban?	Restrict?	Details	Citation	Text
New Hampshire	No	Yes	No free drinks	NH RSA 179:44	I. No licensee shall give away free drinks to customers, patrons, members or guests, in any manner. II. Notwithstanding the above, beverage manufacturers, beverage vendors, brew pubs, wholesale distributors and their liquor or wine vendors, their liquor and wine representatives, domestic wine manufacturers, and on-premises and off-premises licensees may conduct beverage, liquor, or wine tasting, as applicable, on licensed premises. Liquor, beverage, or wine tasting shall be conducted only during such hours as are authorized by the commission for the sale of the product on the premises. III. Liquor, beverage, or wine samples shall be consumed on the premises, and, except for wine samples provided by wine manufacturers, liquor or wine for this purpose shall be purchased from the commission under conditions prescribed by this title. Beverage samples for a tasting shall only be obtained as prescribed by this title.

State	Ban?	Restrict?	Details	Citation	Text
New Jersey	No	Yes	Unlimited drinks prohibited (except for New Year's Eve), nothing about reduced price	N.J.A.C. 13:2-23.16	(a) Except for consumer alcoholic beverage tasting events conducted in accordance with N.J.A.C. 13:2-37, and promotions permitted in this section, no licensee, permittee or brand registrant shall, directly or indirectly, allow, permit or suffer any practice or promotion that: 1. Offers unlimited availability of any alcoholic beverage for consumption on a licensed premises, for a set price, except for: i. Private parties, not sponsored by the licensee, such as wedding and birthday parties, and events held by social affair permittees; or ii. New Year's Eve parties sponsored by a licensee where a set price for attendance includes an open bar; 2. Offers to a patron or consumer a free drink, gift, prize or anything of value, conditioned upon the purchase of an alcoholic beverage or product, except for: i. Branded or unique glassware or souvenirs in connection with a single purchase; ii. Consumer mail-in rebates offered in accordance with N.J.A.C. 13:2-24.11; iii. Manufacturer's sweepstakes and contests, not prohibited by law, where entry or opportunity to win is open to the public without a requirement that a purchase be made; iv. Discounts offered by retailers to consumers on the purchase of alcoholic beverages for off premises consumption; v. Offers of not more than one free drink per patron, as a gesture of good will, in a 24 hour period, by an on-premise consumption licensee; vi. Offers of not more than one free drink coupon, ticket, or token redeemable by a patron, once in a 24 hour period; vii. Offers of a set price for a meal that includes a single alcoholic beverage drink; or viii. Offers of a single bottle of wine or champagne to guests staying at a licensed hotel or motel, as part of a specialty package, provided that the primary guests are of legal drinking age;

State	Ban?	Restrict?	Details	Citation	Text
New Jersey	No	Yes	Unlimited drinks prohibited (except for New Year's Eve), nothing about reduced price	N.J.A.C. 13:2-23.16	3. Requires or allows a consumer to prepurchase more than one drink or product at a time via tickets, tokens, admission fees, or the like, as a condition for entry into a licensed premises or as a requirement for service or entertainment thereon; 4. Offers any prize, gift or award which consists of alcoholic beverages or coupons or gift certificates which may be redeemed for alcoholic beverages, such as two for one, and the like, except for a prize consisting of alcoholic beverages in sealed containers offered in a raffle licensed pursuant to N.J.S.A. 5:8-50. A coupon or gift certificate, other than a certificate purchased by a consumer for an amount equal to the dollar value of the certificate, shall expressly state that the certificate shall not be applied toward the purchase or consumption of alcoholic beverages; or 5. Contains an instant win coupon, ticket, cap, game card or the like. (b) No prize or promotion shall be given to, nor shall any contest for consumers be open to, any person under the legal age to purchase or consume alcoholic beverage, any supplier, wholesaler, distributor or retailer; or affiliates, employees or members of the immediate family or household of any such persons or entities.

State	Ban?	Restrict?	Details	Citation	Text
New Mexico	No	Yes	Unlimited drinks prohibited, more than half price discount prohibited, nothing about smaller discount	15.10.51.11 NMAC	C. The following practices are prohibited on a licensed premises: (1) games or contests that involve drinking alcoholic beverages or the awarding of alcoholic beverage drinks as prizes; (2) the sale or delivery to a person of an unlimited number of alcoholic beverage drinks during any set period of time for a fixed price; (3) the sale or delivery of two or more alcoholic beverage drinks for the price of one; (4) allowing any person to have more than two unconsumed alcoholic beverage drinks at any one time; (5) the sale or delivery of alcoholic beverages by the drink for less than half the usual, customary, or established price for a drink of that type on the licensed premises; (6) the sale or delivery of alcoholic beverages by the drink for less than cost; or (7) the advertising of the practices prohibited by this regulation. D. Nothing contained in this regulation shall prohibit a licensee from: (1) including one alcoholic beverage drink per person as part of a meal package when approved by the director in writing; (2) selling wine by the bottle or carafe, or beer in a pitcher, when sold with a meal; (3) selling wine by the bottle or carafe, or beer in a pitcher, to more than one person; (4) offering free samples or tastes of alcoholic beverages in quantities of 1.5 ounce or less if the product is wine, beer, or a beverage containing alcohol and at least one other ingredient, or .5 ounce or less if the product is undiluted spiritous liquors, when done to promote a product; (5) offering free alcoholic beverage drinks to registered guests in its hotel when approved by the director in writing;

State	Ban?	Restrict?	Details	Citation	Text
New Mexico	No	Yes	Unlimited drinks prohibited, more than half price discount prohibited, nothing about smaller discount	15.10.51.11 NMAC	or (6) utilizing a "free drink coupon" which is limited to one drink per day per patron or giving a patron a free drink as a gesture of good will or friendship; free drinks as a gesture of good will or friendship may not be advertised and may not be given at any established interval or based on the purchases by the customer; (7) offering to customers product promotions such as sweepstakes, rebates on non-alcoholic beverage items, or goods that are not or do not include alcoholic beverages.
New York	No	Yes	Unlimited drinks prohibited, can't attempt to circumvent this section, price reductions (if reasonable) seem permissible	NY CLS Al Bev Â§ 117-a	1. No licensee, acting individually or in conjunction with one or more licensees, shall: (a) offer, sell, serve, or deliver to any person or persons an unlimited number of drinks during any set period of time for a fixed price. (b) allow a person, agent, party organizer, or promoter, as such terms shall be defined by the authority in rule and regulation, to offer, sell, serve, or deliver to any person or persons an unlimited number of drinks during any set period of time for a fixed price. (c) advertise, promote, or charge a price for drinks that in the judgment of the authority creates an offering of alcoholic beverages in violation of the purposes and intent of this section, or which in the judgment of the authority is an attempt to circumvent the intent and purposes of this section, such as, but not limited to, offerings of free drinks, or multiple drinks for free or for the price of a single drink, or for a low initial price followed by a price increment per hour or other period of time, or for such a minor amount that in the judgment of the authority the pricing would constitute an attempt to circumvent the intent and purposes of this section.

State	Ban?	Restrict?	Details	Citation	Text
New York	No	Yes	Unlimited drinks prohibited, can't attempt to circumvent this section, price reductions (if reasonable) seem permissible	NY CLS Al Bev Â§ 117-a	2. As used in this section, licensee means and includes the licensee, and any employees, or agents of such licensee. 3. With respect to an individual licensee, this section shall not apply to private functions not opened to the public, such as weddings, banquets, or receptions, or other similar functions, or to a package of food and beverages where the service of alcoholic beverages is incidental to the event or function. 4. The authority shall investigate any documented allegation of a violation of this section upon a complaint by any person. 5. The authority shall promulgate rules and regulations necessary to implement the provisions of this section. 6. The provisions of this section shall not apply to the holder of a temporary permit under subdivision two of section one hundred five-a of this article.

State	Ban?	Restrict?	Details	Citation	Text
North Carolina	Yes	n/a		4 N.C.A.C. 2S.0232	(a) An on-premise permittee or his agent shall not: (1) sell more than one drink to a patron for a single price;(2) establish a single price based upon the required purchase of more than one drink; or (3) deliver more than one drink at one time to a patron for his consumption. This Rule does not prohibit the sale of pitchers of alcoholic beverages to two or more patrons. This Rule also does not prohibit serving a single carafe or bottle of wine to a single patron. (b) An on-premise permittee or his agent shall not give away a drink or sell one at a price that is different from the usual or established price charged for the drink for any period of time less than one full business day. Free or reduced drinks under this provision shall be offered to all customers, not just a segment of the population. (c) For purposes of this Rule, a "drink" contains the amount of alcoholic beverages usually and customarily served to a single patron as a single serving by the permittee. A "drink" may also include two different alcoholic beverages served separately at the same time to a single patron if such "drink" is a customary combination, such as a shot of spirituous liquor with a malt beverage. (d) An on-premise permittee may include alcoholic beverages in a package offering that includes a meal or entertainment. (e) The offer of a meal and alcoholic beverage at a single total price is not a violation of this Rule so long as the total price reflects the actual price of the alcoholic beverages and not a reduced price.
North Dakota	No	No			

State	Ban?	Restrict?	Details	Citation	Text
Ohio	No	Yes	Unlimited drinks prohibited, price reductions prohibited after 9 PM	OAC Ann. 4301:1-1-50	(A) No liquor permit holder, and no agent or employee of a liquor permit holder, shall: (1) Offer to sell, furnish, or deliver to any person or group of persons: (a) Two or more servings of an alcoholic beverage upon the placing of an order for an individual serving of an alcoholic beverage; (b) An unlimited number of servings of alcoholic beverages during any set period of time for a fixed price; (c) Any alcoholic beverage after nine p.m. at a price less than the regularly-charged price, as established by the schedule of prices required in paragraph (B) of this rule. (2) Encourage or allow any game or contest that involves the drinking of alcoholic beverages or the awarding of alcoholic beverages as a prize. (3) Increase the volume of alcoholic beverages contained in a serving without increasing proportionately the price charged for such serving.(B) All permit holders authorized to sell for on-premises consumption shall maintain on their permit premises a schedule of prices for all drinks of alcoholic beverages to be sold, furnished, delivered, or consumed thereon. Scheduled prices shall be effective for not less than one calendar month, dating from twelve p.m. on the first day of each month. Prior to nine p.m., permit holders may sell, furnish, deliver, or allow the consumption of any alcoholic beverage at a price less than the regularly-charged price, as established by the aforementioned schedule of prices. Permit holders who do so may designate this time as happy hour periods.

State	Ban?	Restrict?	Details	Citation	Text
Oklahoma	Yes	n/a		37 Okl. St. Â§ 537	B. No licensee of the ABLE Commission shall: 4. Advertise or offer "happy hours" or any other means or inducements to stimulate the consumption of alcoholic beverages including: a. deliver more than two drinks to one person at one time, b. sell or offer to sell to any person or group of persons any drinks at a price less than the price regularly charged for such drinks during the same calendar week, except at private functions not open to the public, c. sell or offer to sell to any person an unlimited number of drinks during any set period of time for a fixed price, except at private functions not open to the public, d. sell or offer to sell drinks to any person or group of persons on any one day at prices less than those charged the general public on that day, except at private functions not open to the public, e. increase the volume of alcoholic beverages contained in a drink without increasing proportionately the price regularly charged for such drink during the same calendar week, or f. encourage or permit, on the licensed premises, any game or contest which involves drinking or the awarding of drinks as prizes.

State	Ban?	Restrict?	Details	Citation	Text
Oregon	No	Yes	Unlimited drinks prohibited, price reductions prohibited from midnight - 2:30 AM	Or. Admin. R. 845-006-0345	(10) Promotions. (a) The following practices are prohibited: (A) The sale, offer or service to any person of an unlimited number of alcoholic beverage(s) during any set period of time for a fixed price; (B) The sale, offer or service of alcoholic beverages by the drink for a price per drink that is less than the licensee's cost for the alcohol to any person paying a fixed "buy in" price, entry fee, cover or door charge; (C) Price reductions on alcoholic beverages by the drink from 12:00 midnight until 2:30 a.m. A price reduction is a lower price as compared to the usual, customary, or established non-discounted price the licensee charges for a drink of that type on the licensed premises; (D) The sale, offer or service of distilled spirits by the bottle for consumption on the premises, except as allowed in OAR 845-006-0433 (Minibars in Hotel Guest Rooms) and 845-006-0434 (Minibars in Arena Suites). This subsection does not prohibit a Full On-Premises Public Location Sales Licensee (F-PL) or Full On-Premises Catering Sales Licensee (F-Cat) from charging clients by the bottle for distilled spirits that are served by the drink at hotel suites, banquets, receptions or catered events where the reasonably projected attendance is at least 20 patrons; (E) Operating, encouraging or permitting games of chance or skill, contests, exhibitions, or competitions of any kind on the licensed premises that involve drinking alcoholic beverages, (e.g., beer pong, "21 for 21");

State	Ban?	Restrict?	Details	Citation	Text
Pennsylvania	No	Yes	Unlimited drinks prohibited, price reductions permitted for two hours per day (but not from midnight to closing time)	40 Pa. Code 13.102	(a) General. Retail licensees may discount the price of alcoholic beverages for a consecutive period of time not to exceed 2 hours in a business day, but may not engage in discount pricing practices between 12 midnight and the legal closing hour. Retail licensees may not engage in the following discount pricing practices unless specifically excepted in subsection (b): (1) The sale or serving, or both, of more than one drink of liquor, wine, or malt or brewed beverages at any one time to any one person, for the price of one drink. (2) The sale or serving, or both, of an increased volume of one drink of liquor, wine, or malt or brewed beverages without a corresponding and proportionate increase in the price for the drink. (3) The sale or serving, or both, of an unlimited or indefinite amount of liquor, wine, or malt or brewed beverages for a set price. (4) The pricing of alcoholic beverages in a manner which permits the price to change within the 2-hour period. (b) Exceptions. Nothing in subsection (a) prohibits: (1) The sale or serving, or both, of an unlimited or indefinite amount of liquor, wine or malt or brewed beverages for a fixed price for catered events which have been arranged at least 24 hours in advance. (2) The offering for sale of one specific type of alcoholic beverage or drink per day or a portion thereof at a reduced price, if the offering does not violate subsection (a). For purposes of this section, a specific type of alcoholic beverage means either a specific registered brand of malt or brewed beverages, a type of wine, a type of distilled spirits or a mixed drink. Examples of permissible drink discounts are found in Board Advisory Notice 16.

State	Ban?	Restrict?	Details	Citation	Text
Rhode Island	Yes	n/a		R.I. Gen. Laws Â§ 3-7-26	(a) No licensee, employee or agent of any licensee who operates under a license to sell alcoholic beverages shall: (1) Cause or require any person or persons to buy more than one drink at a time by reducing the price of that drink; (2) Increase the volume of alcohol contained in any alcoholic beverage without proportionately increasing the price; (3) Sell, propose to sell or deliver to any person or persons an unlimited number of drinks during a certain period of time for a fixed price; or (4) Allow or encourage any game or promotion on the premises which involves the drinking of alcoholic beverages or the awarding of alcoholic beverages as prizes for consumption on the premises. (b) (1) No licensee shall advertise or promote in any manner, or in any medium, happy hours, open bars, two-for-one nights and/or free drink specials. (2) Any licensee is prohibited from knowingly allowing the use of its premises as part of an organized pub crawl, so-called. A pub crawl shall be defined as an organized event intended to promote the organized, commercial travel of significantly large groups of individuals between licensed premises for the primary purpose of consuming alcoholic beverages at more than one premise. Evidence of a pub crawl shall include, but not be limited by: (i) The existence of advertising, flyers, tickets or other printed or electronic material promoting or describing a planned pub crawl; (ii) Organized, commercial transportation intended to move a total of fifty (50) or more individuals from one premise to another in an organized fashion; and

State	Ban?	Restrict?	Details	Citation	Text
Rhode Island	Yes	n/a		R.I. Gen. Laws Â§ 3-7-26	(iii) Evidence of compensation paid to an organizer by participants in a pub crawl. The department of business regulation is authorized to promulgate rules and regulations consistent with this section. (c) Nothing in this section shall be construed to prohibit a licensee from offering free food or entertainment at any time; or to prohibit licensees from including an alcoholic beverage as part of a meal package; or to prohibit the sale or delivery of wine by the bottle or carafe when sold with meals or to more than one person; or to prohibit free wine tastings. Except as otherwise limited by this section, nothing contained in this section shall limit or may restrict the price which may be charged by any licensee for any size alcoholic beverage to be consumed on the licensed premises.

State	Ban?	Restrict?	Details	Citation	Text
South Carolina	No	Yes	Unlimited drinks prohibited, price reductions of more than half prohibited, but price reductions permitted from 4 PM to 8 PM	S.C. Code Ann. Â§ 61-4-160; see also 61-6-4550	No person who holds a biennial permit to sell beer or wine for on-premises consumption may advertise, sell, or dispense these beverages for free, at a price less than one-half of the price regularly charged, or on a two or more for the price of one basis. Beer or wine may be sold at a price less than the price regularly charged from four o'clock p.m. until eight o'clock p.m. only. The prohibition against dispensing the beverages for free does not apply to dispensing to a customer on an individual basis, to a fraternal organization in the course of its fund-raising activities, to a person attending a private function on premises for which a biennial permit has been issued, or to a customer attending a function sponsored by the person who holds a biennial permit. However, no more than two functions may be sponsored each year, and must be authorized by the department. A person who violates this section is guilty of a misdemeanor and, upon conviction, must be fined not less than one hundred dollars or imprisoned not less than three months, in the discretion of the court. A person found guilty of a violation of Section 61-6-4550 and this section may not be sentenced under both sections for the same offense.
South Dakota	No	No			
Tennessee	No	Yes	Discounts below cost prohibited	Tenn. Code Ann. 57-4-203	(m) Discounts. Nothing in this chapter shall prohibit a licensee from offering a discount in such manner as the licensee deems appropriate as long as the discount being offered is not below the cost paid by the licensee to purchase the alcoholic beverages from the retailer.

State	Ban?	Restrict?	Details	Citation	Text
Texas	No	Yes	Unlimited drinks prohibited, price reductions permitted until 11 PM	16 TAC 45.103	(c) Retail licensees and permittees may not: (1) serve, sell, or offer to serve or sell, two or more open containers of alcoholic beverages at a price less than the number of containers actually sold or served; (2) increase the volume of alcohol contained in a drink without increasing proportionally the price thereof; (3) serve or offer to serve more than one free alcoholic beverage to any identifiable segment of the population during the course of one business day. Licensees and permittees may, however, without prior advertising, give one free alcoholic beverage to individual consumers in celebration of birthdays, anniversaries or similar events; (4) sell, serve, or offer to sell or serve an undetermined quantity of alcoholic beverages for a fixed price or "all you can drink" basis; (5) sell, serve, or offer to sell or serve, alcoholic beverages at a reduced price to those consumers paying a fixed "buy in" price; (6) sell, serve, or offer to sell or serve, alcoholic beverages at a price contingent on the amount of alcoholic beverages consumed by an individual; (7) reduce drink prices after 11:00 p.m.; (8) sell, serve or offer to sell or serve more than two drinks to a single consumer at one time; (9) impose an entry fee, cover or door charge for the purpose of recovering financial losses incurred by the licensee or permittee because of reduced or low drink prices; (10) conduct, sponsor or participate in, or allow any person on the licensed premises to conduct, sponsor or participate in, any game or contest to be determined by the quantity of alcoholic beverages consumed by an individual or group, or where alcoholic beverages or reduced price alcoholic beverages are awarded as prizes;

State	Ban?	Restrict?	Details	Citation	Text
Texas	No	Yes	Unlimited drinks prohibited, price reductions permitted until 11 PM	16 TAC 45.103	(11) engage in any practice, whether listed in this rule or not, that is reasonably calculated to induce consumers to drink alcoholic beverages to excess, or that would impair the ability of the licensee or permittee to monitor or control the consumption of alcoholic beverages by consumers. (d) The provisions of subsections (c)(1) through (c)(7) do not apply where: (1) the permittee or licensee has entered into an agreement under the terms of which all or a portion of the licensed premises are utilized for a private party or a meeting of a particular organization; or (2) a caterer's or other temporary permit or license is used for a private party or a meeting of a particular organization. (e) Notwithstanding the provisions of (c)(1) through (c)(7) of this rule, licensees and permittees may: (1) offer free or reduced-price food or entertainment at any time, provided the offer is not based on the purchase of an alcoholic beverage; (2) include alcoholic beverages as part of a meal or hotel/motel package; (3) sell, serve or deliver wine by the bottle to individual consumers during the sale or service of a meal to the consumer; (4) sell, serve or deliver alcoholic beverages in pitchers, carafes, buckets or similar containers to two or more consumers at one time.

State	Ban?	Restrict?	Details	Citation	Text
Utah	Yes	n/a		Utah Code Ann. Â§ 32B-5-305	(1) (a) A retail licensee may sell, offer for sale, or furnish liquor only at a price fixed by the commission. (b) A retail licensee may not sell an alcoholic product at a discount price on any date or at any time. (2) (a) A retail licensee may not sell, offer for sale, or furnish an alcoholic product at less than the cost of the alcoholic product to the retail licensee. (b) A retail licensee may not sell, offer for sale, or furnish an alcoholic product at a special or reduced price that encourages over consumption or intoxication. (c) A retail licensee may not sell, offer for sale, or furnish an alcoholic product at a special or reduced price for only certain hours of the retail licensee's business day, such as a "happy hour." (d) A retail licensee may not sell, offer for sale, or furnish more than one alcoholic product for the price of a single alcoholic product. (e) A retail licensee may not sell, offer for sale, or furnish an indefinite or unlimited number of alcoholic products during a set period for a fixed price. (f) A retail licensee may not engage in a promotion involving or offering a free alcoholic product to the general public.
Vermont	Yes	n/a		CVR 26-020-001	49. First class or first and third class licensees shall not offer alcohol beverages at reduced prices for any period of time during daily legal hours. This shall not be construed to regulate prices charged for group events to its attendees only, such as banquets, nor to prohibit cover charges or price adjustments during times when live entertainment is presented on the licensed premises, nor to preclude lower alcohol beverage prices for a full day. a. Licensees or their employees shall not offer or permit games, contests, or promotions, which encourage the consumption of alcohol beverages nor shall they furnish alcoholic beverages to anyone for no charge.

State	Ban?	Restrict?	Details	Citation	Text
Virginia	No	Yes	Unlimited drinks prohibited, two-for-one specials prohibited, reduced prices okay (so long as they're not under cost) when it's not 9 PM to 2 AM	3 VAC 5-50-160	A. Definitions: 1. "Happy Hour." A specified period of time during which alcoholic beverages are sold at prices reduced from the customary price established by a retail licensee. 2. "Drink." Any beverage containing the amount of alcoholic beverages customarily served to a patron as a single serving by a retail licensee. B. No retail licensee shall engage in any of the following practices: 1. Conducting a happy hour between 9 p.m. of each day and 2 a.m. of the following day; 2. Allowing a person to possess more than two drinks at any one time during a happy hour; 3. Increasing the volume of alcoholic beverages contained in a drink without increasing proportionately the customary or established retail price charged for such drink; 4. Selling two or more drinks for one price, such as "two for one" or "three for one"; 5. Selling pitchers of mixed beverages; 6. Giving away drinks; 7. Selling an unlimited number of drinks for one price, such as "all you can drink for $ 5.00"; 8. Advertising happy hour anywhere other than within the interior of the licensed premises, except that a licensee may use the term "Happy Hour" or "Drink Specials" and the time period within which alcoholic beverages are being sold at reduced prices in any otherwise lawful advertisement; or 9. Establishing a customary retail price for any drink at a markup over cost significantly less than that applied to other beverages of similar type, quality, or volume. C. This regulation shall not apply to prearranged private parties, functions, or events, not open to the public, where the guests thereof are served in a room or rooms designated and used exclusively for private parties, functions or events.

State	Ban?	Restrict?	Details	Citation	Text
Washington	No	Yes	Unlimited drinks prohibited, two-for-one specials prohibited, nothing prohibiting reduced prices on single drinks	WAC 314-52-110	(2) No retail licensee shall offer for sale any liquor for on premises consumption under advertising slogans where the expressed or implied meaning is that a customer, in order to receive a reduced price, would be required to purchase more than one drink at a time, such as "two for the price of one," "buy one – get one free," or "two for $ ______."
West Virginia	No	No			
Wisconsin	No	No			
Wyoming	No	No			

[a] Repealed on July 15, 2015. Public Act 99-0046 allows discounted drinks for up to 4 hours per day and not more than 15 hours per week. Notice of drink specials must be displayed at least 7 days prior to promotion period. Unlimited drinks are not allowed. Of special note is that establishments (a) can serve two or more drinks to the same customer; (b) cannot sell two or more drinks for the price of one; and (c) must increase the price of a drink proportional to the increase in the volume of the same drink. Information obtained from https://www.illinois.gov/ilcc/All

Table 5
Experiment 1 Participant Demographics

	Control	BOGO	HP	p-value†
n	56	55	54	
Age (Years; Median [IQR])	31.00 [27.00, 38.00]	33.00 [28.00, 42.00]	29.00 [25.00, 35.00]	0.038
Gender = Male (%)	23 (41.1)	27 (49.1)	33 (61.1)	0.107
Smoking Status (%)				0.337
Current smoker	11 (19.6)	12 (21.8)	15 (27.8)	
Previous smoker	11 (19.6)	17 (30.9)	10 (18.5)	
Never smoker	31 (55.4)	26 (47.3)	28 (51.9)	
I don't smoke but use another form of tobacco (specify):	3 (5.4)	0 (0.0)	1 (1.9)	
State of Residence (%)				0.602
Alabama	4 (7.1)	0 (0.0)	0 (0.0)	
Arizona	2 (3.6)	2 (3.6)	2 (3.7)	
Arkansas	1 (1.8)	1 (1.8)	0 (0.0)	
California	8 (14.3)	9 (16.4)	10 (18.5)	
Colorado	1 (1.8)	0 (0.0)	0 (0.0)	
Florida	10 (17.9)	0 (0.0)	5 (9.3)	
Georgia	2 (3.6)	2 (3.6)	1 (1.9)	
Idaho	0 (0.0)	1 (1.8)	1 (1.9)	
Illinois	1 (1.8)	1 (1.8)	4 (7.4)	
Indiana	2 (3.6)	1 (1.8)	2 (3.7)	
Iowa	1 (1.8)	1 (1.8)	0 (0.0)	
Kentucky	1 (1.8)	1 (1.8)	0 (0.0)	

	Control	BOGO	HP	p-value
Louisiana	0 (0.0)	1 (1.8)	1 (1.9)	
Maryland	2 (3.6)	1 (1.8)	2 (3.7)	
Massachusetts	0 (0.0)	1 (1.8)	1 (1.9)	
Michigan	0 (0.0)	1 (1.8)	2 (3.7)	
Mississippi	1 (1.8)	0 (0.0)	0 (0.0)	
Missouri	0 (0.0)	1 (1.8)	0 (0.0)	
Nevada	1 (1.8)	1 (1.8)	0 (0.0)	
New Jersey	2 (3.6)	1 (1.8)	1 (1.9)	
New Mexico	2 (3.6)	0 (0.0)	0 (0.0)	
New York	3 (5.4)	3 (5.5)	6 (11.1)	
North Carolina	1 (1.8)	2 (3.6)	2 (3.7)	
Ohio	1 (1.8)	2 (3.6)	2 (3.7)	
Oklahoma	0 (0.0)	0 (0.0)	1 (1.9)	
Oregon	2 (3.6)	1 (1.8)	1 (1.9)	
Pennsylvania	1 (1.8)	5 (9.1)	2 (3.7)	
South Carolina	0 (0.0)	2 (3.6)	0 (0.0)	
Tennessee	0 (0.0)	0 (0.0)	1 (1.9)	
Texas	4 (7.1)	6 (10.9)	4 (7.4)	
Virginia	1 (1.8)	3 (5.5)	1 (1.9)	
Washington	1 (1.8)	1 (1.8)	1 (1.9)	
West Virginia	1 (1.8)	1 (1.8)	0 (0.0)	
Wisconsin	0 (0.0)	3 (5.5)	1 (1.9)	
Marital Status (%)				0.453
Divorced	5 (8.9)	2 (3.6)	2 (3.7)	
Living with another	5 (8.9)	3 (5.5)	2 (3.7)	

	Control	BOGO	HP	p-value
Married	20 (35.7)	24 (43.6)	18 (33.3)	
Not married but in a relationship	11 (19.6)	10 (18.2)	9 (16.7)	
Separated	0 (0.0)	0 (0.0)	2 (3.7)	
Single	15 (26.8)	15 (27.3)	21 (38.9)	
Widowed	0 (0.0)	1 (1.8)	0 (0.0)	
Income Range (%)				0.389
< $20,000	11 (19.6)	9 (16.4)	14 (25.9)	
$20,000 - $29,999	11 (19.6)	11 (20.0)	7 (13.0)	
$30,000 - $39,999	3 (5.4)	6 (10.9)	8 (14.8)	
$40,000 - $49,999	6 (10.7)	2 (3.6)	8 (14.8)	
$50,000 - $74,999	17 (30.4)	18 (32.7)	8 (14.8)	
$75,000 - $99,999	4 (7.1)	6 (10.9)	5 (9.3)	
> $100,000	4 (7.1)	3 (5.5)	3 (5.6)	
Did Not Say	0 (0.0)	0 (0.0)	1 (1.9)	
Highest Level of Education (%)				0.752
Less than High School	0 (0.0)	1 (1.8)	0 (0.0)	
High School/GED	7 (12.5)	3 (5.5)	7 (13.0)	
Some College	14 (25.0)	10 (18.2)	12 (22.2)	
2-Year College Degree (Associates)	7 (12.5)	11 (20.0)	6 (11.1)	
4-Year College Degree (BA, BS)	22 (39.3)	24 (43.6)	20 (37.0)	
Master's Degree	3 (5.4)	4 (7.3)	6 (11.1)	
Doctorate (PhD, DSc, EdD, DFA)	1 (1.8)	0 (0.0)	2 (3.7)	
Professional Degree (MD, JD, DDS, DVM, PsyD)	2 (3.6)	2 (3.6)	1 (1.9)	
Employment Status (%)				0.245

	Control	BOGO	HP	p-value
Employed	39 (69.6)	46 (83.6)	44 (81.5)	
Retired	4 (7.1)	1 (1.8)	4 (7.4)	
Unemployed	13 (23.2)	8 (14.5)	6 (11.1)	
Profession or Field of Study (%)				0.684
Arts and Entertainment	2 (3.6)	4 (7.3)	2 (3.7)	
Biology	1 (1.8)	0 (0.0)	0 (0.0)	
Business/ Marketing/ Accounting	8 (14.3)	7 (12.7)	10 (18.5)	
Communications/ Media	1 (1.8)	3 (5.5)	3 (5.6)	
Computer Science/Technology	7 (12.5)	8 (14.5)	4 (7.4)	
Culinary Arts	2 (3.6)	0 (0.0)	1 (1.9)	
Education	6 (10.7)	8 (14.5)	5 (9.3)	
Engineering	2 (3.6)	3 (5.5)	0 (0.0)	
English Language and Literature	1 (1.8)	0 (0.0)	0 (0.0)	
First Responder (police, fire, EMT)	0 (0.0)	1 (1.8)	0 (0.0)	
Food Service	2 (3.6)	1 (1.8)	6 (11.1)	
Health Sciences/ Medicine/ Nursing	6 (10.7)	3 (5.5)	6 (11.1)	
History	1 (1.8)	2 (3.6)	0 (0.0)	
Hospitality/Tourism	3 (5.4)	1 (1.8)	1 (1.9)	
Law	1 (1.8)	2 (3.6)	0 (0.0)	
Physics	0 (0.0)	1 (1.8)	1 (1.9)	
Political Science/Government	1 (1.8)	1 (1.8)	1 (1.9)	
Psychology - Clinical	1 (1.8)	1 (1.8)	0 (0.0)	
Psychology - Research	1 (1.8)	0 (0.0)	1 (1.9)	
Retail	6 (10.7)	3 (5.5)	6 (11.1)	

	Control	BOGO	HP	p-value
Skilled Trade (construction, plumbing, artisan, etc.)	0 (0.0)	3 (5.5)	5 (9.3)	
Sociology	0 (0.0)	1 (1.8)	1 (1.9)	
Student	4 (7.1)	2 (3.6)	1 (1.9)	
Duration to Complete (Minutes; Median [IQR])	8.78 [6.29, 11.54]	10.02 [7.32, 12.93]	9.30 [7.38, 12.75]	0.242

† p-values for categorical and continuous data derived from Fisher's exact test and Kruskal-Wallis, respectively

Table 6

Experiment 1 Systematic Responding by Group and Time

Condition	Time	N Passing 3 Criteria
Control (n=56)	1	47
	2	49
BOGO (n=55)	1	47
	2	46
HP (n=54)	1	44
	2	45

Table 7
Experiment 1 Descriptive Results from Model Fitting Time 1

	N	Mean	SD	0%	25%	50%	75%	100%
Control								
Intensity	46	7.11	3.50	2	4	7.5	10	15
BP_0	33	8.11	5.41	0.25	5.00	7.00	10.00	20.00
BP_1	46	10.12	7.05	0.00	4.25	8.00	20.00	20.00
Empirical O_{max}	46	18.72	13.35	0.00	8.50	16.00	29.50	50.00
Empirical P_{max}	46	7.01	5.69	0.00	3.00	5.50	8.75	20.00
Q_0	42	8.32	3.93	1.86	4.72	8.23	11.52	15.79
k	42	1.84	0.00	1.84	1.84	1.84	1.84	1.84
α	42	0.01	0.01	0.002	0.004	0.01	0.01	0.06
EV	42	0.71	0.51	0.02	0.34	0.56	0.96	1.97
Derived O_{max}	42	17.76	12.69	0.54	8.48	14.04	23.97	49.35
Derived P_{max}	42	7.60	5.50	0.55	3.82	5.78	9.83	23.98
R^2	42	0.86	0.11	0.56	0.79	0.90	0.95	0.98
BOGO								
Intensity	45	6.18	3.37	1	4	5	8	15
BP_0	36	8.78	5.50	1.50	5.00	8.00	10.00	20.00
BP_1	45	9.59	6.36	1.00	5.00	8.00	15.00	20.00
Empirical O_{max}	45	17.59	11.23	1.00	9.00	16.00	28.00	42.00
Empirical P_{max}	45	6.30	4.83	1.00	3.00	5.00	7.00	20.00
Q_0	42	7.32	4.44	2.09	4.65	6.05	9.34	20.90
k	42	1.84	0.00	1.84	1.84	1.84	1.84	1.84
α	42	0.01	0.01	0.001	0.005	0.01	0.01	0.06
EV	42	0.65	0.43	0.06	0.35	0.53	0.87	1.97
Derived O_{max}	42	16.37	10.65	1.55	8.76	13.36	21.81	49.35
Derived P_{max}	42	8.01	5.07	1.43	5.15	6.74	9.51	23.98
R^2	42	0.81	0.19	0.17	0.78	0.86	0.93	0.98

	N	Mean	SD	0%	25%	50%	75%	100%
HP								
Intensity	42	6.33	3.34	1	5	5	8	15
BP_0	31	8.73	5.04	0.25	6.00	8.00	10.00	20.00
BP_1	42	10.33	6.58	0.00	5.50	8.00	18.75	20.00
Empirical O_{max}	42	17.30	11.11	0.00	10.00	17.00	24.00	40.00
Empirical P_{max}	42	6.49	5.49	0.00	3.00	5.00	7.00	20.00
Q_0	38	7.65	3.93	2.44	5.06	6.38	9.71	18.25
k	38	1.84	0.00	1.84	1.84	1.84	1.84	1.84
α	38	0.01	0.01	0.003	0.005	0.01	0.01	0.03
EV	38	0.62	0.34	0.15	0.34	0.54	0.86	1.42
Derived O_{max}	38	15.59	8.57	3.86	8.40	13.41	21.43	35.46
Derived P_{max}	38	7.36	4.42	2.03	4.26	5.82	10.27	20.67
R^2	38	0.86	0.11	0.56	0.81	0.89	0.94	0.99

Note: Lower N for derived measures are due to nonconverged model fits

Table 8

Experiment 1 Descriptive Results from Model Fitting Time 2

	N	Mean	SD	0%	25%	50%	75%	100%
Control								
Intensity	46	7.04	3.47	2	4	6.5	10	15
BP_0	32	8.36	5.44	0.25	4.75	8.00	11.25	20.00
BP_1	46	10.58	7.08	0.00	5.25	8.50	20.00	20.00
Empirical O_{max}	46	20.77	15.42	0.00	8.50	20.00	30.00	60.00
Empirical P_{max}	46	7.30	6.15	0.00	3.00	5.50	8.00	20.00
Q_0	42	8.49	4.20	2.24	5.02	8.13	11.70	18.20
k	42	1.68	0.00	1.68	1.68	1.68	1.68	1.68
α	42	0.01	0.01	0.002	0.004	0.01	0.01	0.05
EV	42	0.85	0.69	0.09	0.36	0.67	1.07	3.04
Derived O_{max}	42	20.62	16.73	2.30	8.65	16.29	26.02	74.05
Derived P_{max}	42	8.66	6.65	1.77	4.27	7.17	11.18	33.21
R^2	42	0.83	0.14	0.18	0.78	0.87	0.93	0.98
BOGO								
Intensity	45	8.98	5.44	2	4	8	12	22
BP_0	29	4.67	2.99	0.50	2.50	4.50	7.50	10.00
BP_1	45	5.92	3.52	0.25	3.50	5.00	10.00	10.00
Empirical O_{max}	45	21.01	14.23	0.50	12.00	20.00	27.00	60.00
Empirical P_{max}	45	4.56	3.27	0.13	2.00	3.50	7.50	10.00
Q_0	35	10.93	6.19	3.50	6.67	9.24	13.04	24.25
k	35	1.68	0.00	1.68	1.68	1.68	1.68	1.68
α	35	0.01	0.02	0.002	0.004	0.01	0.01	0.07
EV	35	0.90	0.60	0.02	0.48	0.70	1.21	2.35
Derived O_{max}	35	21.80	14.54	0.56	11.58	17.00	29.37	57.16
Derived P_{max}	35	7.92	6.65	0.11	3.58	6.03	10.46	29.13
R^2	35	0.79	0.13	0.51	0.67	0.85	0.88	1.00

	N	Mean	SD	0%	25%	50%	75%	100%
HP								
Intensity	42	6.76	4.05	1	5	6	8	20
BP_0	18	4.92	2.98	0.13	3.12	4.75	7.50	10.00
BP_1	42	7.35	3.40	0.00	4.50	10.00	10.00	10.00
Empirical O_{max}	42	17.75	11.42	0.00	8.50	16.00	24.00	40.50
Empirical P_{max}	42	5.36	3.19	0.00	3.00	4.50	7.50	10.00
Q_0	39	7.85	4.30	3.05	5.10	6.24	9.38	22.46
k	39	1.86	0.00	1.86	1.86	1.86	1.86	1.86
α	39	0.01	0.01	0.001	0.004	0.01	0.01	0.07
EV	39	0.79	0.62	0.03	0.32	0.69	1.03	3.04
Derived O_{max}	39	19.85	15.27	0.83	8.06	17.45	25.88	74.05
Derived P_{max}	39	9.30	8.29	0.45	4.11	7.33	10.33	36.17
R^2	39	0.81	0.15	0.37	0.76	0.87	0.90	1.00

Note: Lower N for derived measures are due to nonconverged model fits

Table 9
Experiment 1 Extra Sum-of-Squares F Test Results Time 1

	Derived Measures						
	Q_0	α	$k^\dagger$	R^2	EV	O_{max}	P_{max}
Shared							
Control	7.21						5.05
BOGO	7.74	0.0059	2.52	0.99	0.42	11.87	4.70
HP	7.06						5.16
Not Shared							
Control	7.63	0.0054		0.99	0.46	12.79	5.14
BOGO	7.38	0.0062	2.52	0.99	0.40	11.24	4.67
HP	6.96	0.0060		0.98	0.42	11.65	5.14

$F(2,45) = 6.16, p = 0.004$

$^\dagger k$ fixed to the best-fit value

Table 10
Experiment 1 Extra Sum-of-Squares F Test Results Time 2

	Derived Measures						
	Q_0	α	$k^\dagger$	R^2	EV	O_{max}	P_{max}
Shared							
Control	7.75						5.51
BOGO	10.48	0.0067	2.01	0.98	0.52	13.47	4.07
HP	7.11						6.01
Not Shared							
Control	7.87	0.0064		0.98	0.54	13.99	5.63
BOGO	10.47	0.0070	2.01	0.98	0.50	12.88	3.89
HP	7.12	0.0068		0.98	0.52	13.33	5.93

$F(2,45) = 2.58, p = 0.087$

$^\dagger k$ fixed to the best-fit value

Table 11
Experiment 1 Mixed ANOVA

	DF	*SS*	*MSE*	*F*	*p*	η_G^2
Between						
Group	2	196.46	98.23	0.52	0.59	0.006
Residuals	130	24684.29	189.88			
Within						
Time	1	302.60	302.63	24.70	< 0.001	0.008
Price	1.75	10240.00	1024.00	167.02	< 0.001	0.223
Group x Time	2	246.50	123.23	10.06	< 0.001	0.007
Group x Price	3.50	180.00	9.00	1.47	0.22	0.005
Price x Time	3.56	99.40	9.94	10.68	< 0.001	0.003
Group x Time x Price	7.13	189.20	9.46	10.16	< 0.001	0.005
Residuals	1300	1210.00	0.93			

Note: DF = Degrees of Freedom, *SS* = Sum of Squares, *MSE* = Mean Square Error, η_G^2 = Generalized Eta Square

Table 12

Experiment 2 Participant Demographics (Banned States)

	Control	BOGO	Half Price	p-value†
n	159	158	159	
Age (Years; Median [IQR])	33.00 [28.00, 43.00]	33.00 [27.00, 45.00]	34.00 [27.00, 43.00]	0.979
Gender (%)				0.278
Female	89 (56.0)	103 (65.2)	97 (61.0)	
Male	70 (44.0)	54 (34.2)	62 (39.0)	
Would rather not say	0 (0.0)	1 (0.6)	0 (0.0)	
Smoking Status (%)				0.231
Current smoker	30 (18.9)	30 (19.0)	45 (28.3)	
Previous smoker	32 (20.1)	38 (24.1)	34 (21.4)	
Never smoker	95 (59.7)	89 (56.3)	80 (50.3)	
I don't smoke but use another form of tobacco (specify):	2 (1.3)	1 (0.6)	0 (0.0)	
State of Residence (%)				0.845
Alabama	0 (0.0)	0 (0.0)	1 (0.6)	
Alaska	1 (0.6)	4 (2.5)	3 (1.9)	
California	1 (0.6)	1 (0.6)	1 (0.6)	
Colorado	0 (0.0)	0 (0.0)	1 (0.6)	
Connecticut	0 (0.0)	0 (0.0)	1 (0.6)	
Delaware	3 (1.9)	2 (1.3)	5 (3.1)	
District of Columbia	0 (0.0)	1 (0.6)	0 (0.0)	
Florida	3 (1.9)	1 (0.6)	1 (0.6)	
Georgia	1 (0.6)	1 (0.6)	0 (0.0)	

	Control	BOGO	Half Price	p-value
Hawaii	2 (1.3)	2 (1.3)	2 (1.3)	
Indiana	26 (16.4)	23 (14.6)	28 (17.6)	
Kansas	0 (0.0)	1 (0.6)	0 (0.0)	
Kentucky	1 (0.6)	0 (0.0)	0 (0.0)	
Maine	5 (3.1)	3 (1.9)	11 (6.9)	
Maryland	0 (0.0)	2 (1.3)	1 (0.6)	
Massachusetts	25 (15.7)	22 (13.9)	30 (18.9)	
New Hampshire	1 (0.6)	1 (0.6)	0 (0.0)	
New Jersey	0 (0.0)	1 (0.6)	0 (0.0)	
New York	0 (0.0)	2 (1.3)	0 (0.0)	
North Carolina	55 (34.6)	48 (30.4)	44 (27.7)	
Oklahoma	13 (8.2)	12 (7.6)	12 (7.5)	
Oregon	0 (0.0)	1 (0.6)	1 (0.6)	
Pennsylvania	1 (0.6)	1 (0.6)	1 (0.6)	
Rhode Island	4 (2.5)	7 (4.4)	4 (2.5)	
South Carolina	1 (0.6)	0 (0.0)	0 (0.0)	
Texas	1 (0.6)	2 (1.3)	1 (0.6)	
Utah	11 (6.9)	11 (7.0)	6 (3.8)	
Vermont	4 (2.5)	8 (5.1)	5 (3.1)	
Virginia	0 (0.0)	1 (0.6)	0 (0.0)	
Marital Status (%)				0.499
Divorced	4 (2.5)	13 (8.2)	9 (5.7)	
Living with another	15 (9.4)	20 (12.7)	19 (11.9)	
Married	74 (46.5)	72 (45.6)	77 (48.4)	
Not married but in a relationship	21 (13.2)	22 (13.9)	16 (10.1)	

	Control	BOGO	Half Price	p-value
Separated	2 (1.3)	2 (1.3)	2 (1.3)	
Single	43 (27.0)	27 (17.1)	35 (22.0)	
Widowed	0 (0.0)	1 (0.6)	1 (0.6)	
Would rather not say	0 (0.0)	1 (0.6)	0 (0.0)	
Income Range (%)				0.902
< $20,000	28 (17.6)	28 (17.7)	30 (18.9)	
$20,000 - $29,999	17 (10.7)	21 (13.3)	21 (13.2)	
$30,000 - $39,999	19 (11.9)	24 (15.2)	21 (13.2)	
$40,000 - $49,999	16 (10.1)	14 (8.9)	17 (10.7)	
$50,000 - $74,999	41 (25.8)	38 (24.1)	27 (17.0)	
$75,000 - $99,999	20 (12.6)	17 (10.8)	21 (13.2)	
> $100,000	18 (11.3)	15 (9.5)	20 (12.6)	
Did Not Say	0 (0.0)	1 (0.6)	2 (1.3)	
Highest Level of Education (%)				0.627
Less than High School	1 (0.6)	2 (1.3)	1 (0.6)	
High School/GED	21 (13.2)	12 (7.6)	11 (6.9)	
Some College	37 (23.3)	34 (21.5)	38 (23.9)	
2-Year College Degree (Associates)	19 (11.9)	18 (11.4)	21 (13.2)	
4-Year College Degree (BA, BS)	56 (35.2)	71 (44.9)	67 (42.1)	
Master's Degree	19 (11.9)	20 (12.7)	18 (11.3)	
Doctorate (PhD, DSc, EdD, DFA)	1 (0.6)	0 (0.0)	0 (0.0)	
Professional Degree (MD, JD, DDS, DVM, PsyD)	5 (3.1)	1 (0.6)	3 (1.9)	
Employment Status (%)				0.55
Employed	126 (79.2)	117 (74.1)	125 (78.6)	

	Control	BOGO	Half Price	p-value
Retired	3 (1.9)	8 (5.1)	6 (3.8)	
Unemployed	30 (18.9)	33 (20.9)	28 (17.6)	
Profession or Field of Study (%)				0.609
Arts and Entertainment	8 (5.0)	10 (6.3)	9 (5.7)	
Biology	0 (0.0)	4 (2.5)	4 (2.5)	
Business/Marketing/Accounting	16 (10.1)	22 (13.9)	21 (13.2)	
Chemistry	1 (0.6)	2 (1.3)	1 (0.6)	
Communications/Media	4 (2.5)	4 (2.5)	7 (4.4)	
Computer Science/Technology	18 (11.3)	21 (13.3)	21 (13.2)	
Culinary Arts	2 (1.3)	0 (0.0)	0 (0.0)	
Education	25 (15.7)	27 (17.1)	17 (10.7)	
Engineering	4 (2.5)	4 (2.5)	5 (3.1)	
English Language and Literature	2 (1.3)	1 (0.6)	2 (1.3)	
First Responder (police, fire, EMT)	0 (0.0)	0 (0.0)	2 (1.3)	
Food Service	11 (6.9)	7 (4.4)	6 (3.8)	
Health Sciences/Medicine/Nursing	16 (10.1)	15 (9.5)	19 (11.9)	
Hospitality/Tourism	3 (1.9)	6 (3.8)	5 (3.1)	
Law	4 (2.5)	1 (0.6)	1 (0.6)	
Mathematics/Statistics	2 (1.3)	1 (0.6)	1 (0.6)	
Military/Armed Forces	2 (1.3)	0 (0.0)	0 (0.0)	
Philosophy/Religion	1 (0.6)	0 (0.0)	0 (0.0)	
Political Science/Government	5 (3.1)	2 (1.3)	3 (1.9)	
Psychology - Clinical	0 (0.0)	0 (0.0)	2 (1.3)	
Psychology - Research	2 (1.3)	2 (1.3)	1 (0.6)	
Retail	17 (10.7)	11 (7.0)	13 (8.2)	

	Control	BOGO	Half Price	p-value
Skilled Trade (construction, plumbing, artisan, etc.)	11 (6.9)	5 (3.2)	11 (6.9)	
Sociology	1 (0.6)	2 (1.3)	1 (0.6)	
Student	4 (2.5)	11 (7.0)	7 (4.4)	
Duration to Complete (Minutes; Median [IQR])	10.57 [8.49, 13.59]	11.37 [8.75, 14.18]	10.58 [8.70, 13.51]	0.18

† p-values for categorical and continuous data derived from Fisher's exact test and Kruskal-Wallis, respectively

Table 13

Experiment 2 Participant Demographics (Not Banned States)

	Control	BOGO	Half Price	p-value†
n	154	160	161	
Age (Years; Median [IQR])	34.00 [27.00, 41.00]	32.50 [27.00, 43.25]	32.00 [27.00, 41.00]	0.849
Gender (%)				0.715
Female	85 (55.2)	88 (55.0)	88 (54.7)	
Male	68 (44.2)	72 (45.0)	73 (45.3)	
Would rather not say	1 (0.6)	0 (0.0)	0 (0.0)	
Smoking Status (%)				0.957
Current smoker	30 (19.5)	35 (21.9)	30 (18.6)	
Previous smoker	39 (25.3)	39 (24.4)	46 (28.6)	
Never smoker	84 (54.5)	84 (52.5)	83 (51.6)	
I don't smoke but use another form of tobacco (specify):	1 (0.6)	2 (1.2)	2 (1.2)	
State of Residence (%)				0.496
Arizona	0 (0.0)	0 (0.0)	1 (0.6)	
California	40 (26.0)	39 (24.4)	37 (23.0)	
Colorado	7 (4.5)	5 (3.1)	7 (4.3)	
Florida	30 (19.5)	39 (24.4)	41 (25.5)	
Georgia	12 (7.8)	10 (6.2)	15 (9.3)	
Idaho	1 (0.6)	2 (1.2)	1 (0.6)	
Illinois	1 (0.6)	1 (0.6)	0 (0.0)	
Indiana	0 (0.0)	2 (1.2)	0 (0.0)	
Iowa	3 (1.9)	4 (2.5)	5 (3.1)	

	Control	BOGO	Half Price	p-value
Kansas	0 (0.0)	0 (0.0)	1 (0.6)	
Kentucky	2 (1.3)	5 (3.1)	3 (1.9)	
Louisiana	0 (0.0)	0 (0.0)	1 (0.6)	
Maryland	8 (5.2)	6 (3.8)	4 (2.5)	
Massachusetts	0 (0.0)	0 (0.0)	1 (0.6)	
Minnesota	8 (5.2)	8 (5.0)	7 (4.3)	
Mississippi	8 (5.2)	3 (1.9)	2 (1.2)	
Missouri	9 (5.8)	11 (6.9)	16 (9.9)	
Montana	0 (0.0)	1 (0.6)	1 (0.6)	
Nevada	4 (2.6)	3 (1.9)	5 (3.1)	
New Mexico	0 (0.0)	0 (0.0)	1 (0.6)	
New York	2 (1.3)	0 (0.0)	0 (0.0)	
North Carolina	1 (0.6)	0 (0.0)	1 (0.6)	
Oregon	0 (0.0)	1 (0.6)	0 (0.0)	
South Dakota	1 (0.6)	0 (0.0)	3 (1.9)	
Texas	0 (0.0)	0 (0.0)	1 (0.6)	
Virginia	0 (0.0)	1 (0.6)	0 (0.0)	
Washington	2 (1.3)	2 (1.2)	2 (1.2)	
West Virginia	2 (1.3)	7 (4.4)	1 (0.6)	
Wisconsin	12 (7.8)	10 (6.2)	3 (1.9)	
Wyoming	1 (0.6)	0 (0.0)	1 (0.6)	
Marital Status (%)				0.773
Divorced	8 (5.2)	11 (6.9)	12 (7.5)	
Living with another	12 (7.8)	18 (11.2)	19 (11.8)	
Married	69 (44.8)	63 (39.4)	63 (39.1)	

	Control	BOGO	Half Price	p-value
Not married but in a relationship	13 (8.4)	24 (15.0)	20 (12.4)	
Separated	1 (0.6)	3 (1.9)	1 (0.6)	
Single	49 (31.8)	39 (24.4)	45 (28.0)	
Widowed	1 (0.6)	1 (0.6)	1 (0.6)	
Would rather not say	1 (0.6)	1 (0.6)	0 (0.0)	
Income Range (%)				0.496
< $20,000	25 (16.2)	29 (18.1)	24 (14.9)	
$20,000 - $29,999	21 (13.6)	16 (10.0)	18 (11.2)	
$30,000 - $39,999	18 (11.7)	27 (16.9)	30 (18.6)	
$40,000 - $49,999	14 (9.1)	28 (17.5)	18 (11.2)	
$50,000 - $74,999	34 (22.1)	25 (15.6)	32 (19.9)	
$75,000 - $99,999	18 (11.7)	14 (8.8)	21 (13.0)	
> $100,000	20 (13.0)	18 (11.2)	16 (9.9)	
Did Not Say	4 (2.6)	3 (1.9)	2 (1.2)	
Highest Level of Education (%)				0.467
Less than High School	0 (0.0)	2 (1.2)	1 (0.6)	
High School/GED	16 (10.4)	17 (10.6)	21 (13.0)	
Some College	42 (27.3)	46 (28.7)	49 (30.4)	
2-Year College Degree (Associates)	18 (11.7)	21 (13.1)	15 (9.3)	
4-Year College Degree (BA, BS)	63 (40.9)	51 (31.9)	64 (39.8)	
Master's Degree	10 (6.5)	14 (8.8)	9 (5.6)	
Doctorate (PhD, DSc, EdD, DFA)	1 (0.6)	4 (2.5)	2 (1.2)	
Professional Degree (MD, JD, DDS, DVM, PsyD)	4 (2.6)	5 (3.1)	0 (0.0)	
Employment Status (%)				0.36

	Control	BOGO	Half Price	p-value
Employed	120 (77.9)	132 (82.5)	127 (78.9)	
Retired	4 (2.6)	6 (3.8)	2 (1.2)	
Unemployed	30 (19.5)	22 (13.8)	32 (19.9)	
Profession or Field of Study (%)				0.862
Arts and Entertainment	9 (5.8)	11 (6.9)	10 (6.2)	
Biology	0 (0.0)	1 (0.6)	1 (0.6)	
Business/Marketing/Accounting	23 (14.9)	20 (12.5)	19 (11.8)	
Chemistry	0 (0.0)	1 (0.6)	0 (0.0)	
Communications/Media	6 (3.9)	3 (1.9)	6 (3.7)	
Computer Science/Technology	16 (10.4)	24 (15.0)	20 (12.4)	
Culinary Arts	1 (0.6)	0 (0.0)	2 (1.2)	
Education	12 (7.8)	12 (7.5)	14 (8.7)	
Engineering	9 (5.8)	5 (3.1)	10 (6.2)	
English Language and Literature	2 (1.3)	3 (1.9)	0 (0.0)	
First Responder (police, fire, EMT)	4 (2.6)	1 (0.6)	2 (1.2)	
Food Service	7 (4.5)	4 (2.5)	3 (1.9)	
Health Sciences/Medicine/Nursing	10 (6.5)	18 (11.2)	19 (11.8)	
Hospitality/Tourism	7 (4.5)	5 (3.1)	10 (6.2)	
Law	2 (1.3)	4 (2.5)	3 (1.9)	
Mathematics/Statistics	0 (0.0)	0 (0.0)	1 (0.6)	
Military/Armed Forces	2 (1.3)	3 (1.9)	0 (0.0)	
Political Science/Government	3 (1.9)	2 (1.2)	0 (0.0)	
Psychology - Clinical	1 (0.6)	1 (0.6)	1 (0.6)	
Retail	16 (10.4)	21 (13.1)	17 (10.6)	

	Control	BOGO	Half Price	p-value
Skilled Trade (construction, plumbing, artisan, etc.)	9 (5.8)	12 (7.5)	12 (7.5)	
Sociology	2 (1.3)	1 (0.6)	3 (1.9)	
Student	13 (8.4)	8 (5.0)	8 (5.0)	
Duration to Complete (Minutes; Median [IQR])	9.82 [8.40, 12.62]	11.28 [8.16, 14.06]	10.30 [8.07, 13.13]	0.089

† p-values for categorical and continuous data derived from Fisher's exact test and Kruskal-Wallis, respectively

Table 14

Experiment 2 Systematic Responding by Group and Time (Banned States)

Condition	Time	N Passing 3 Criteria
Control (n=159)		
	1	146
	2	147
BOGO (n=158)		
	1	135
	2	133
HP (n=159)		
	1	139
	2	133

Table 15
Experiment 2 Systematic Responding by Group and Time (Not Banned States)

Condition	Time	N Passing 3 Criteria
Control (n=154)		
	1	134
	2	134
BOGO (n=160)		
	1	133
	2	127
HP (n=161)		
	1	135
	2	131

Table 16

Experiment 2 Descriptive Results from Model Fitting Time 1 (Banned States)

	N	Mean	SD	0%	25%	50%	75%	100%
Control								
Intensity	144	6.23	3.27	1	4	6	8	15
BP_0	98	9.80	5.34	0.25	6.00	9.00	15.00	20.00
BP_1	144	11.50	6.59	0.00	7.00	10.00	20.00	20.00
Empirical O_{max}	144	21.40	13.24	0.00	12.00	20.00	30.00	60.00
Empirical P_{max}	144	7.63	5.44	0.00	4.00	6.00	9.00	20.00
Q_0	133	7.53	4.15	1.54	4.78	6.46	9.96	21.12
k	133	1.80	0.00	1.80	1.80	1.80	1.80	1.80
α	133	0.01	0.01	0.001	0.004	0.01	0.01	0.07
EV	133	0.79	0.52	0.02	0.46	0.71	0.95	2.60
Derived O_{max}	133	19.77	12.90	0.49	11.49	17.66	23.73	64.62
Derived P_{max}	133	9.66	6.29	0.64	5.20	8.02	12.68	32.25
R^2	133	0.83	0.16	0.09	0.78	0.90	0.93	0.99
BOGO								
Intensity	132	6.05	3.29	1	4	5	8	15
BP_0	105	8.99	5.64	0.25	5.00	8.00	15.00	20.00
BP_1	132	9.68	6.38	0.00	5.00	8.00	15.00	20.00
Empirical O_{max}	132	19.40	15.13	0.00	8.00	16.00	25.00	64.00
Empirical P_{max}	132	6.28	4.89	0.00	3.00	6.00	8.00	20.00
Q_0	117	7.45	4.23	1.94	4.58	6.29	10.43	21.28
k	117	1.80	0.00	1.80	1.80	1.80	1.80	1.80
α	117	0.01	0.01	0.001	0.004	0.01	0.01	0.07
EV	117	0.78	0.61	0.02	0.33	0.63	0.98	2.60
Derived O_{max}	117	19.31	15.22	0.41	8.09	15.74	24.45	64.62
Derived P_{max}	117	8.96	6.82	0.51	4.61	7.58	10.97	32.25
R^2	117	0.83	0.12	0.22	0.79	0.88	0.91	0.98

	N	Mean	SD	0%	25%	50%	75%	100%
HP								
Intensity	132	6.58	3.57	1	4	5	10	15
BP_0	99	9.89	4.82	0.25	7.00	9.00	15.00	20.00
BP_1	132	10.71	6.08	0.00	7.00	9.50	16.25	20.00
Empirical O_{max}	132	20.20	13.01	0.00	10.00	20.00	25.00	60.00
Empirical P_{max}	132	7.63	5.73	0.00	4.75	6.00	8.00	20.00
Q_0	124	7.72	4.40	1.68	4.59	6.27	9.92	21.28
k	124	1.80	0.00	1.80	1.80	1.80	1.80	1.80
α	124	0.01	0.01	0.002	0.005	0.01	0.01	0.04
EV	124	0.72	0.48	0.10	0.42	0.62	0.86	2.60
Derived O_{max}	124	17.93	11.94	2.47	10.45	15.35	21.33	64.62
Derived P_{max}	124	8.55	5.41	1.24	5.11	7.53	10.45	32.25
R^2	124	0.83	0.12	0.29	0.78	0.86	0.92	0.98

Note: Lower N for derived measures are due to nonconverged model fits

Table 17

Experiment 2 Descriptive Results from Model Fitting Time 2 (Banned States)

	N	Mean	SD	0%	25%	50%	75%	100%
Control								
Intensity	144	6.53	3.78	1	4	6	8	20
BP_0	99	10.28	5.69	0.25	6.50	9.00	15.00	20.00
BP_1	144	11.62	6.55	0.00	7.00	10.00	20.00	20.00
Empirical O_{max}	144	22.36	13.55	0.00	12.38	20.00	32.00	60.00
Empirical P_{max}	144	7.02	4.15	0.00	4.00	7.00	8.00	15.00
Q_0	133	7.78	4.42	1.42	4.67	6.84	10.60	22.89
k	133	1.80	0.00	1.80	1.80	1.80	1.80	1.80
α	133	0.01	0.02	0.001	0.004	0.01	0.01	0.09
EV	133	0.82	0.52	0.02	0.52	0.73	1.00	2.81
Derived O_{max}	133	20.30	12.81	0.49	12.81	18.11	24.90	69.92
Derived P_{max}	133	9.46	6.05	0.64	5.61	8.20	12.43	34.82
R^2	133	0.83	0.14	0.30	0.77	0.89	0.92	0.99
BOGO								
Intensity	132	8.29	4.90	2	4	6	10	20
BP_0	85	4.77	3.13	0.13	3.00	4.00	7.50	10.00
BP_1	132	5.91	3.55	0.00	3.00	5.00	10.00	10.00
Empirical O_{max}	132	20.68	16.62	0.00	8.75	20.00	27.00	64.00
Empirical P_{max}	132	4.79	3.32	0.00	2.50	4.00	7.50	10.00
Q_0	107	10.15	5.56	2.35	6.44	8.71	12.67	24.50
k	107	1.65	0.00	1.65	1.65	1.65	1.65	1.65
α	107	0.01	0.01	0.001	0.004	0.01	0.01	0.09
EV	107	0.94	0.73	0.03	0.43	0.74	1.13	2.83
Derived O_{max}	107	22.84	17.82	0.76	10.36	17.85	27.35	69.92
Derived P_{max}	107	8.71	7.21	0.24	3.77	6.86	10.59	34.82
R^2	107	0.76	0.16	0.16	0.68	0.80	0.88	0.97

	N	Mean	SD	0%	25%	50%	75%	100%
HP								
Intensity	132	6.99	4.19	1	4	6	10	20
BP_0	48	6.02	3.58	0.13	3.50	7.50	10.00	10.00
BP_1	132	8.00	3.08	0.00	6.88	10.00	10.00	10.00
Empirical O_{max}	132	18.64	12.08	0.00	10.00	18.00	22.88	60.00
Empirical P_{max}	132	5.55	3.22	0.00	3.00	4.50	10.00	10.00
Q_0	124	8.17	4.96	2.23	4.43	6.73	11.17	24.50
k	124	1.82	0.00	1.82	1.82	1.82	1.82	1.82
α	124	0.01	0.01	0.001	0.004	0.01	0.01	0.09
EV	124	0.77	0.57	0.01	0.38	0.64	1.04	2.83
Derived O_{max}	124	19.31	14.07	0.33	9.37	15.89	25.91	69.92
Derived P_{max}	124	8.97	6.71	0.48	4.51	6.95	11.90	34.82
R^2	124	0.80	0.16	0.26	0.70	0.85	0.91	0.97

Note: Lower N for derived measures are due to nonconverged model fits

Table 18
Experiment 2 Descriptive Results from Model Fitting Time 1 (Not Banned States)

	N	Mean	SD	0%	25%	50%	75%	100%
Control								
Intensity	133	6.42	3.83	1	4	5	8	20
BP_0	95	9.84	5.88	0.25	5.00	9.00	15.00	20.00
BP_1	133	11.04	6.68	0.00	6.00	10.00	20.00	20.00
Empirical O_{max}	133	20.04	13.88	0.00	10.00	20.00	28.00	60.00
Empirical P_{max}	133	7.09	5.09	0.00	4.00	6.00	8.00	20.00
Q_0	120	7.48	4.31	1.42	4.16	6.35	9.71	22.17
k	120	1.88	0.00	1.88	1.88	1.88	1.88	1.88
α	120	0.01	0.01	0.001	0.004	0.01	0.01	0.08
EV	120	0.70	0.47	0.02	0.36	0.63	0.92	2.22
Derived O_{max}	120	17.76	11.92	0.52	8.96	15.78	23.08	55.99
Derived P_{max}	120	8.61	5.85	0.41	4.48	7.50	10.65	32.62
R^2	120	0.82	0.15	0.15	0.77	0.87	0.92	1.00
BOGO								
Intensity	124	6.85	4.37	1	4	5.5	10	20
BP_0	94	9.03	5.42	0.25	6.00	9.00	15.00	20.00
BP_1	124	10.10	6.54	0.00	5.00	9.00	15.00	20.00
Empirical O_{max}	124	18.71	12.73	0.00	9.50	16.00	28.50	60.00
Empirical P_{max}	124	6.71	5.36	0.00	3.00	6.00	8.00	20.00
Q_0	114	8.11	4.78	1.54	5.20	6.66	10.11	22.17
k	114	1.88	0.00	1.88	1.88	1.88	1.88	1.88
α	114	0.01	0.02	0.001	0.004	0.01	0.01	0.08
EV	114	0.69	0.47	0.03	0.37	0.59	0.95	2.22
Derived O_{max}	114	17.51	11.90	0.65	9.30	14.83	24.01	55.99
Derived P_{max}	114	8.05	5.86	0.21	4.27	6.46	9.98	28.80
R^2	114	0.86	0.13	0.19	0.81	0.90	0.94	0.98

	N	Mean	SD	0%	25%	50%	75%	100%
HP								
Intensity	131	6.76	4.36	1	4	5	10	20
BP_0	101	9.57	5.66	0.25	5.00	8.00	15.00	20.00
BP_1	131	10.10	6.39	0.00	5.00	10.00	15.00	20.00
Empirical O_{max}	131	19.61	13.05	0.00	10.00	20.00	28.00	60.00
Empirical P_{max}	131	7.03	5.43	0.00	3.00	6.00	8.00	20.00
Q_0	121	7.65	4.38	1.31	5.07	6.48	10.24	22.17
k	121	1.88	0.00	1.88	1.88	1.88	1.88	1.88
α	121	0.01	0.01	−0.02	0.004	0.01	0.01	0.08
EV	121	0.73	0.50	−0.23	0.39	0.65	0.95	2.22
Derived O_{max}	121	18.31	12.55	−5.86	9.86	16.50	23.93	55.99
Derived P_{max}	121	8.64	6.48	−5.47	5.03	7.21	10.61	33.57
R^2	121	0.82	0.17	0.07	0.77	0.88	0.92	0.98

Note: Lower N for derived measures are due to nonconverged model fits

Table 19

Experiment 2 Descriptive Results from Model Fitting Time 2 (Not Banned States)

	N	Mean	SD	0%	25%	50%	75%	100%
Control								
Intensity	133	6.50	3.89	1	4	5	8	20
BP_0	93	9.58	5.79	0.25	5.00	9.00	15.00	20.00
BP_1	133	11.06	6.79	0.00	6.00	10.00	20.00	20.00
Empirical O_{max}	133	20.83	14.66	0.00	10.00	20.00	30.00	75.00
Empirical P_{max}	133	6.61	4.11	0.00	4.00	6.00	8.00	15.00
Q_0	120	7.68	4.46	1.35	4.64	6.41	9.92	25.23
k	120	1.80	0.00	1.80	1.80	1.80	1.80	1.80
α	120	0.01	0.02	0.001	0.004	0.01	0.01	0.08
EV	120	0.77	0.59	0.03	0.35	0.69	1.00	3.72
Derived O_{max}	120	19.05	14.63	0.69	8.59	17.23	24.84	92.86
Derived P_{max}	120	8.92	6.21	0.64	5.06	7.04	11.18	32.81
R^2	120	0.82	0.17	0.08	0.76	0.87	0.93	1.00
BOGO								
Intensity	124	9.61	6.37	2	6	8	12	24
BP_0	76	4.71	3.32	0.13	1.88	4.50	7.50	10.00
BP_1	124	6.08	3.66	0.00	3.50	5.00	10.00	10.00
Empirical O_{max}	124	20.57	15.83	0.00	10.00	20.00	28.50	75.00
Empirical P_{max}	124	4.52	3.25	0.00	2.50	3.50	7.50	10.00
Q_0	103	11.85	7.82	2.83	6.76	8.88	14.98	31.56
k	103	1.88	0.00	1.88	1.88	1.88	1.88	1.88
α	103	0.01	0.01	0.0005	0.004	0.01	0.01	0.07
EV	103	0.88	0.70	0.05	0.47	0.74	0.99	3.72
Derived O_{max}	103	22.18	17.48	1.39	11.80	18.65	24.88	92.86
Derived P_{max}	103	7.38	6.37	0.73	3.88	5.76	9.25	35.32
R^2	103	0.80	0.13	0.29	0.75	0.84	0.90	0.97

	N	Mean	SD	0%	25%	50%	75%	100%
HP								
Intensity	131	7.14	4.56	1	4.5	6	10	21
BP_0	64	5.33	3.29	0.13	2.88	4.75	7.50	10.00
BP_1	131	7.10	3.41	0.00	4.50	10.00	10.00	10.00
Empirical O_{max}	131	19.65	14.08	0.00	9.00	20.00	26.00	75.00
Empirical P_{max}	131	5.04	3.00	0.00	2.50	4.50	7.50	10.00
Q_0	119	8.21	5.18	1.50	5.22	6.42	10.70	27.49
k	119	1.82	0.00	1.82	1.82	1.82	1.82	1.82
α	119	0.01	0.02	0.001	0.003	0.01	0.01	0.08
EV	119	0.89	0.73	0.02	0.42	0.71	1.21	3.72
Derived O_{max}	119	22.29	18.19	0.39	10.40	17.73	30.12	92.86
Derived P_{max}	119	10.15	8.54	0.38	4.58	7.38	11.42	35.32
R^2	119	0.78	0.18	0.07	0.67	0.84	0.90	0.99

Note: Lower N for derived measures are due to nonconverged model fits

Table 20

Experiment 2 Extra Sum-of-Squares F Test Results Time 1 (Banned States)

	Derived Measures						
	Q_0	α	$k^{\dagger}$	R^2	EV	O_{max}	P_{max}
Shared							
Control	6.82						5.93
BOGO	7.14	0.0040	3.15	0.98	0.44	13.58	5.66
HP	7.29						5.54
Not Shared							
Control	7.11	0.0038		0.99	0.47	14.45	6.05
BOGO	6.83	0.0043	3.15	0.99	0.42	12.78	5.57
HP	7.29	0.0040		0.99	0.44	13.57	5.54

$F(2,45) = 4.79, p = 0.013$

$^{\dagger}k$ fixed to the best-fit value

Table 21
Experiment 2 Extra Sum-of-Squares F Test Results Time 2 (Banned States)

	Derived Measures						
	Q_0	α	$k^\dagger$	R^2	EV	O_{max}	P_{max}
Shared							
Control	6.84						6.15
BOGO	8.56	0.0017	6.51	0.98	0.35	14.92	4.92
HP	7.21						5.83
Not Shared							
Control	7.15	0.0016		0.98	0.37	15.82	6.24
BOGO	8.53	0.0018	6.51	0.99	0.33	14.00	4.63
HP	7.25	0.0017		0.99	0.34	14.29	5.56

$F(2,45) = 9.24, p < 0.001$

$^\dagger k$ fixed to the best-fit value

Table 22

Experiment 2 Extra Sum-of-Squares F Test Results Time 1 (Not Banned States)

	Derived Measures						
	Q_0	α	$k^{\dagger}$	R^2	EV	O_{max}	P_{max}
Shared							
Control	6.77						5.90
BOGO	7.52	0.0044	2.95	0.99	0.45	13.30	5.31
HP	7.31						5.47
Not Shared							
Control	6.92	0.0043		0.99	0.46	13.75	5.97
BOGO	7.35	0.0046	2.95	0.99	0.43	12.92	5.28
HP	7.30	0.0044		0.99	0.45	13.28	5.47

$F(2,45) = 2.30, p = 0.112$

$^{\dagger}k$ fixed to the best-fit value

Table 23

Experiment 2 Extra Sum-of-Squares F Test Results Time 2 (Not Banned States)

	Derived Measures						
	Q_0	α	$k^{\dagger}$	R^2	EV	O_{max}	P_{max}
Shared							
Control	6.85						6.21
BOGO	10.30	0.0037	3.27	0.99	0.46	14.37	4.13
HP	7.49						5.69
Not Shared							
Control	6.97	0.0036		0.99	0.48	14.79	6.29
BOGO	10.26	0.0037	3.27	0.99	0.45	14.07	4.06
HP	7.51	0.0038		0.99	0.45	14.00	5.52

$F(2,45) = 1.99, p = 0.148$

$^{\dagger}k$ fixed to the best-fit value

Table 24

Experiment 2 Mixed ANOVA (Banned States)

	DF	*SS*	*MSE*	*F*	*p*	η_G^2
Between						
Group	2	16.92	8.46	0.046	0.96	0.000
Residuals	405	74270.62	183.38			
Within						
Time	1	352.59	352.60	44.67	< 0.001	0.004
Price	2.05	24633.75	2463.40	482.10	< 0.001	0.195
Group x Time	2	314.25	157.10	19.91	< 0.001	0.003
Group x Price	4.10	309.31	15.50	3.027	0.016	0.003
Price x Time	4.25	209.33	20.93	22.76	< 0.001	0.002
Group x Time x Price	8.49	318.04	15.90	17.29	< 0.001	0.003
Residuals	4050	37254.81	0.92			

Note: *DF* = Degrees of Freedom, *SS* = Sum of Squares, *MSE* = Mean Square Error, η_G^2 = Generalized Eta Square

Table 25

Experiment 2 Mixed ANOVA (Not Banned States)

	DF	*SS*	*MSE*	*F*	*p*	η_G^2
Between						
Group	2	801.58	400.80	1.79	0.167	0.006
Residuals	385	85903.00	223.10			
Within						
Time	1	653.04	653.00	46.65	< 0.001	0.006
Price	1.82	28072.34	2807.20	381.56	< 0.001	0.185
Group x Time	2	689.92	345.00	24.64	< 0.001	0.005
Group x Price	3.63	1176.52	58.80	7.99	< 0.001	0.009
Price x Time	3.16	376.13	37.61	27.09	< 0.001	0.003
Group x Time x Price	6.31	663.19	33.16	23.88	< 0.001	0.005
Residuals	3850	5346.59	1.39			

Note: DF = Degrees of Freedom, *SS* = Sum of Squares, *MSE* = Mean Square Error, η_G^2 = Generalized Eta Square

Table 26
Multiple Linear Regression Predicting Percent Change in Intensity

	Outcome: % Change Intensity	
	Estimate	(S.E.)
(Intercept)	11.182*	(5.137)
Banned States	0.710	(4.170)
BOGO	45.239***	(4.330)
HP	7.595	(4.258)
Age	-0.232*	(0.112)
Total Drinks	-0.086	(0.114)
Male	-1.659	(2.541)
Banned States x BOGO	-4.550	(6.022)
Banned States x HP	-3.789	(5.963)
N	790	
RMSE	34.445	
R^2	0.237	
adj R^2	0.229	

$*p \leq 0.05 ** p \leq 0.01 *** p \leq 0.001$

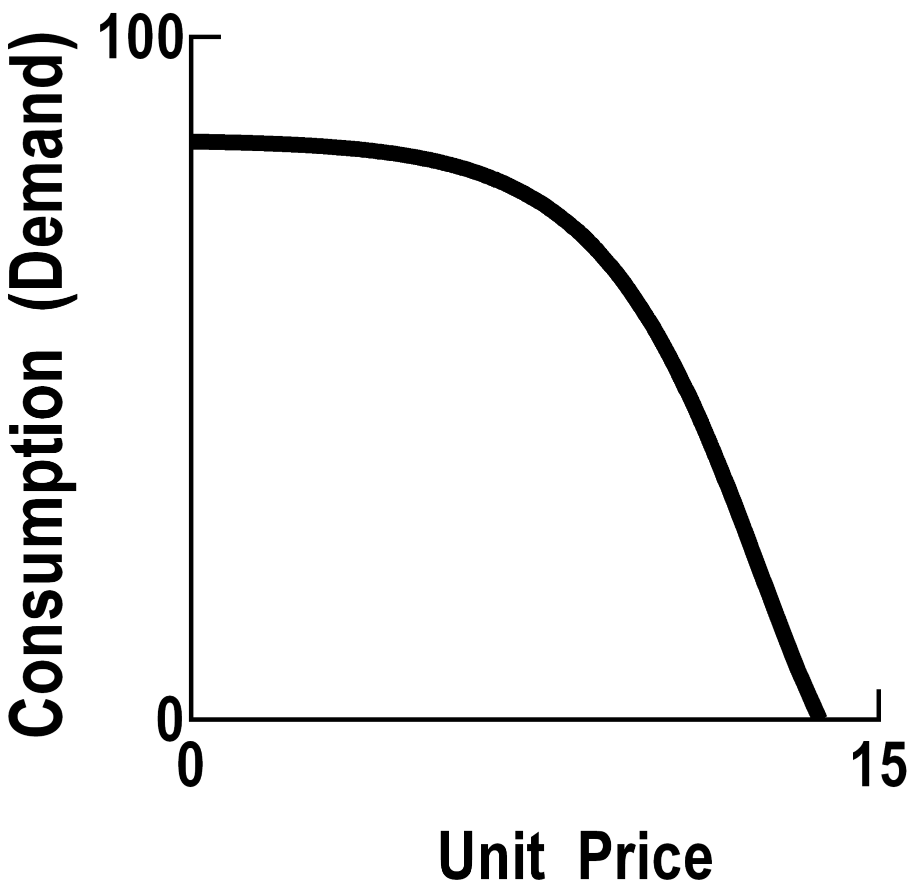


Figure 1. Prototypical demand curve. Reprinted from Autism Service Delivery (p. 282), by (Eds.) F. D. DiGennaro Reed & D. D. Reed, 2015, New York: Springer. Copyright 2015 by Springer Science+Business Media. Reprinted with permission from second author.

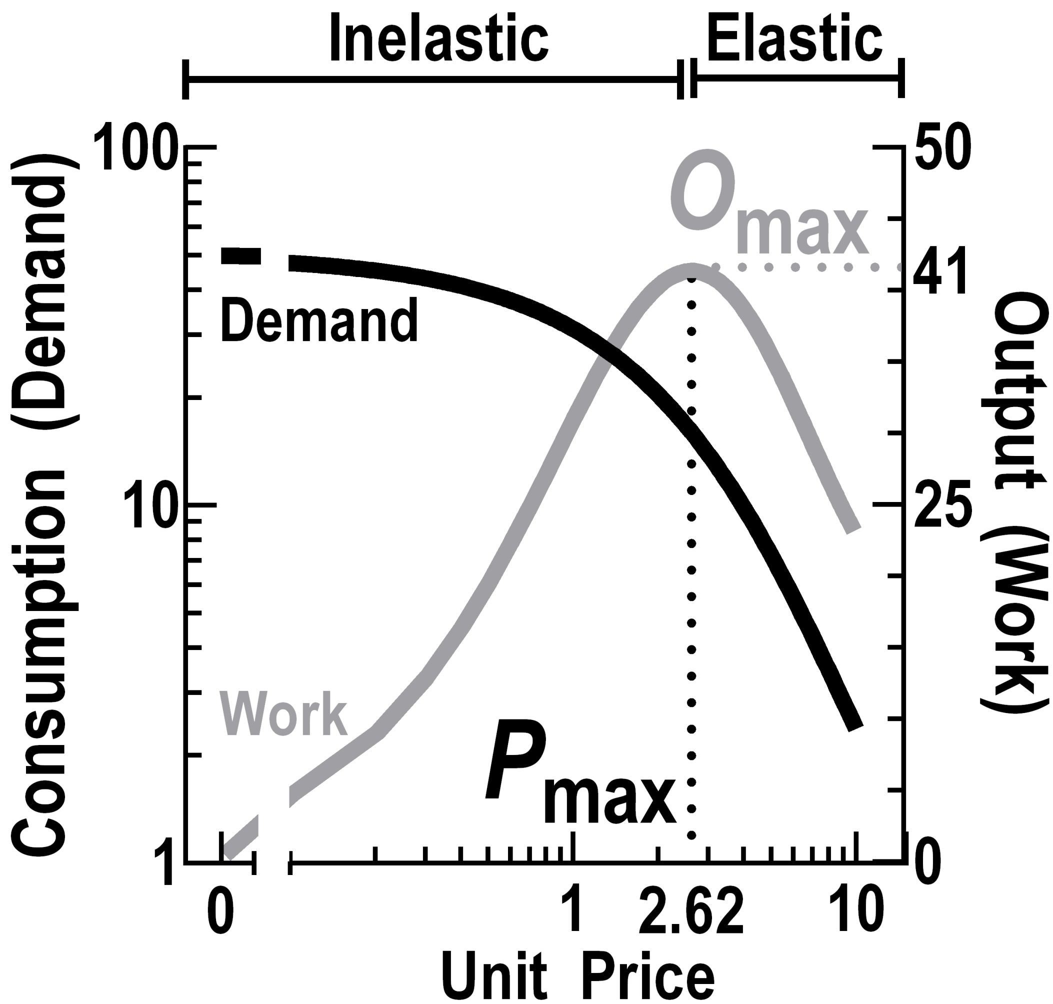


Figure 2. Aspects of the demand curve. See text for descriptions of the indices. Reprinted from Autism Service Delivery (p. 296), by (Eds.) F. D. DiGennaro Reed & D. D. Reed, 2015, New York: Springer. Copyright 2015 by Springer Science+Business Media. Reprinted with permission from second author.

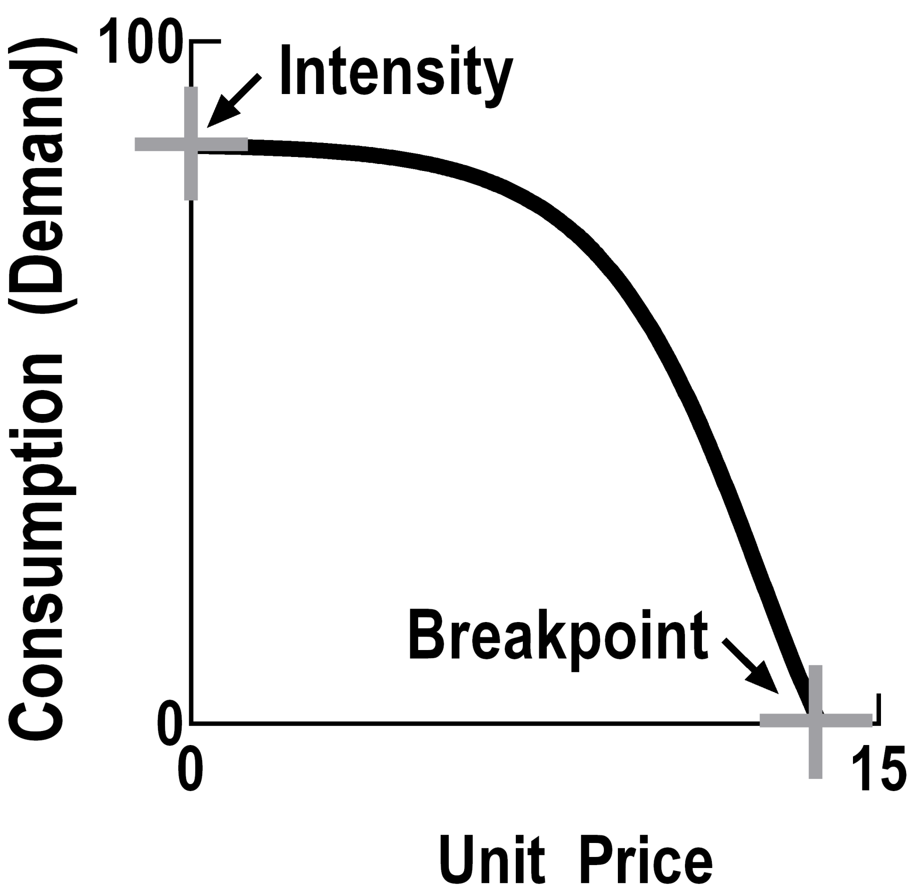


Figure 3. Demand intensity and breakpoint. Demand intensity is the amount of the consumption at free. Breakpoint is the first price at which no reinforcers are consumed. Reprinted from Autism Service Delivery (p. 285), by (Eds.) F. D. DiGennaro Reed & D. D. Reed, 2015, New York: Springer. Copyright 2015 by Springer Science+Business Media. Reprinted with permission from second author.

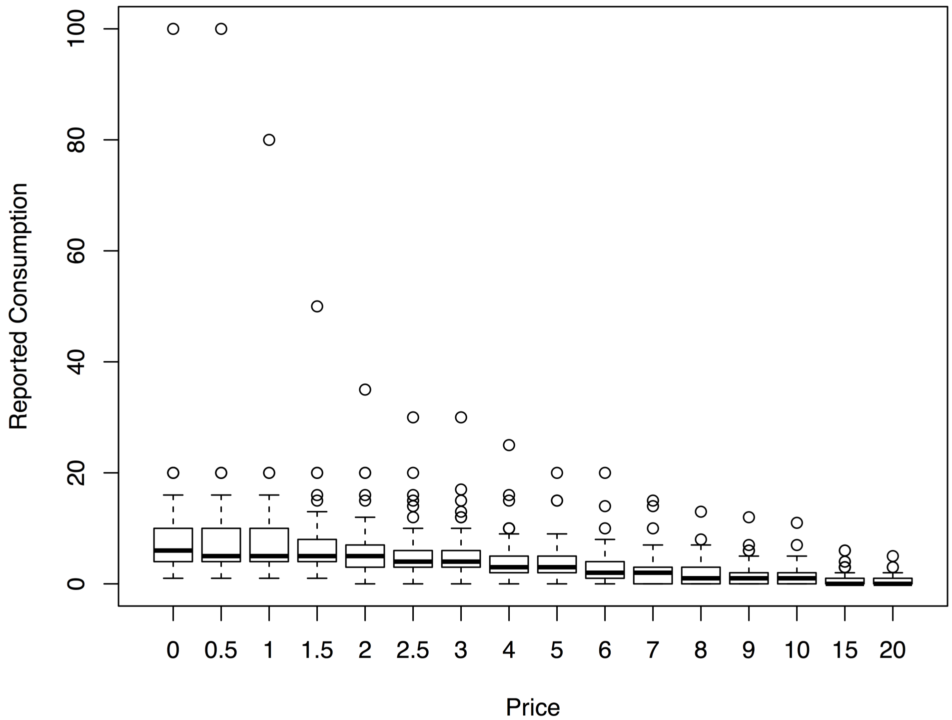


Figure 4. Example plot of distribution of consumption values. Variability in consumption as a function of price.

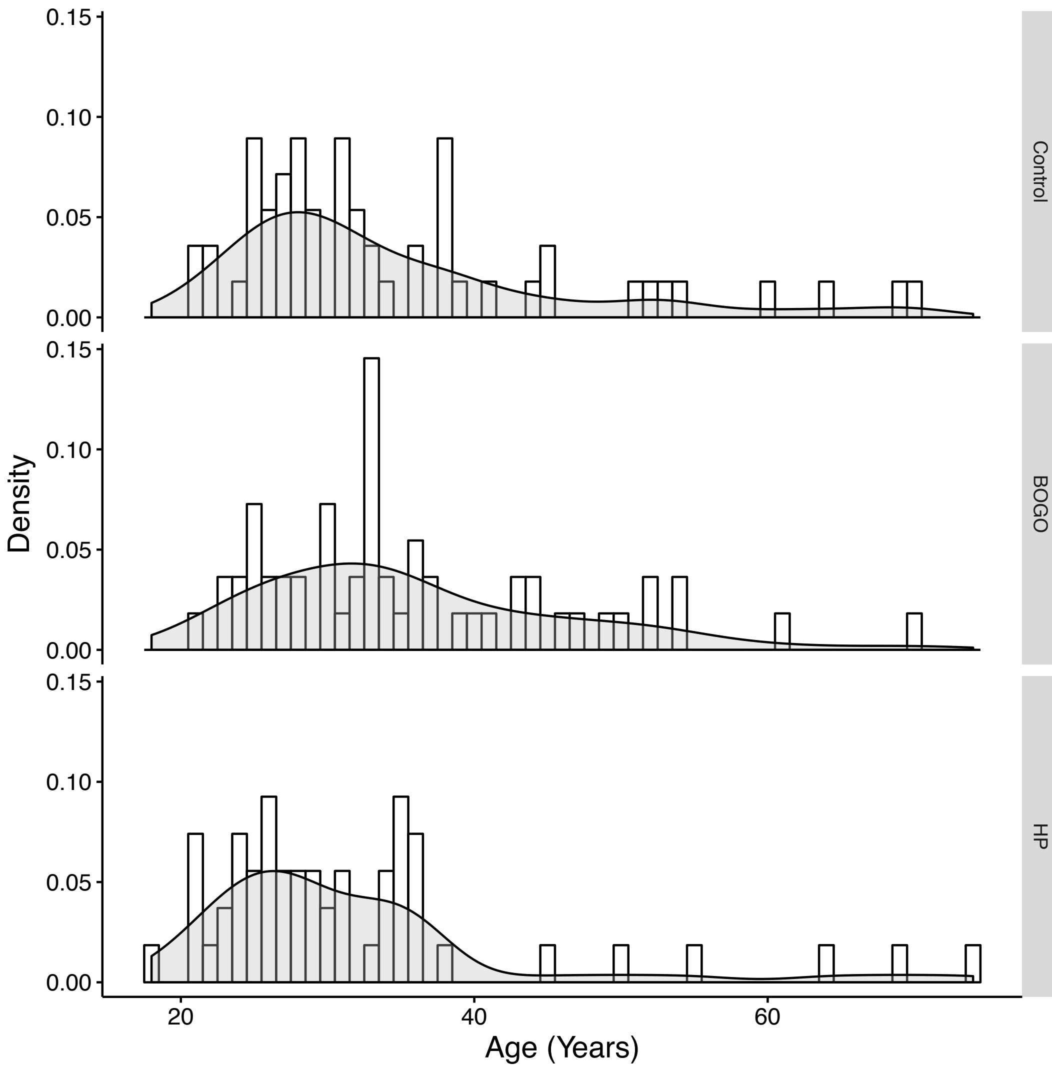


Figure 5. Experiment 1 Descriptive Summary of Age by Group

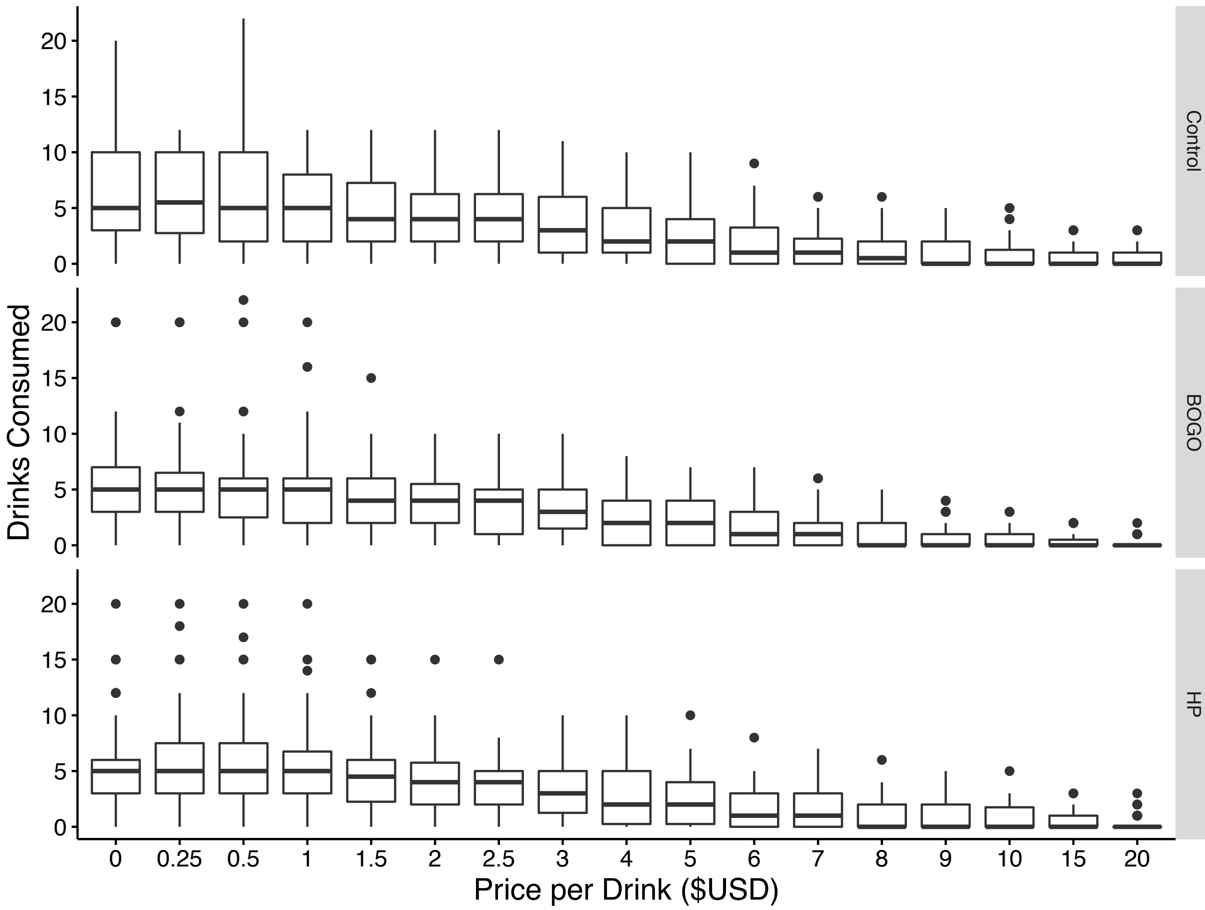


Figure 6. Experiment 1 Box Plots of Consumption by Price at Time 1

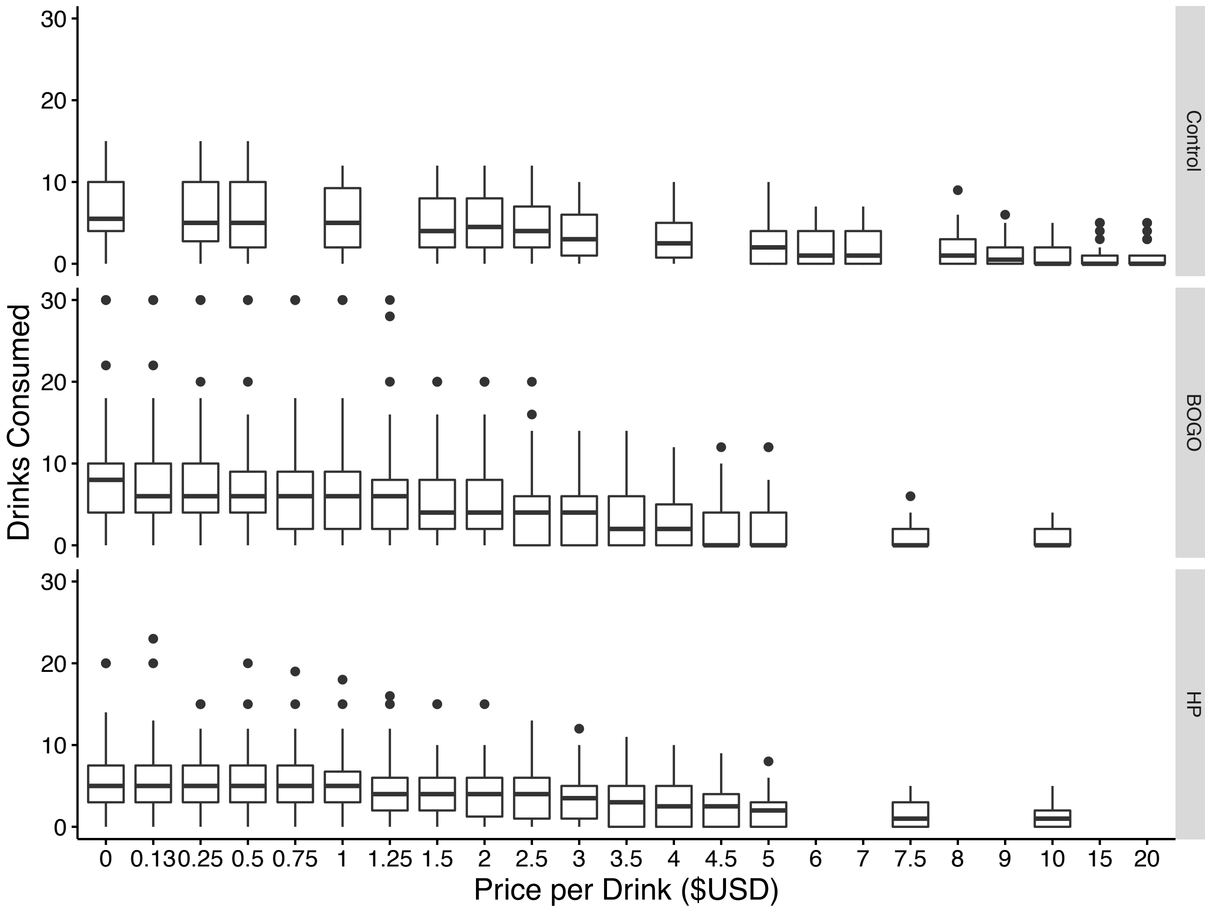


Figure 7. Experiment 1 Box Plots of Consumption by Price at Time 2

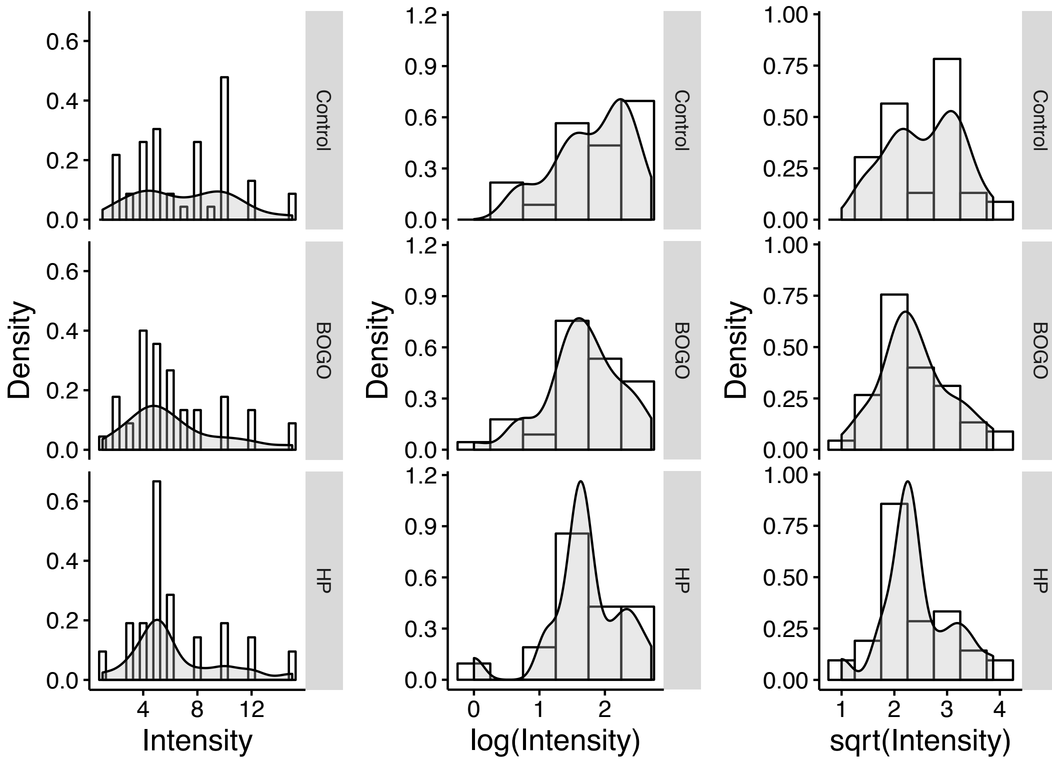


Figure 8. Experiment 1 Histograms of Intensity at Time 1

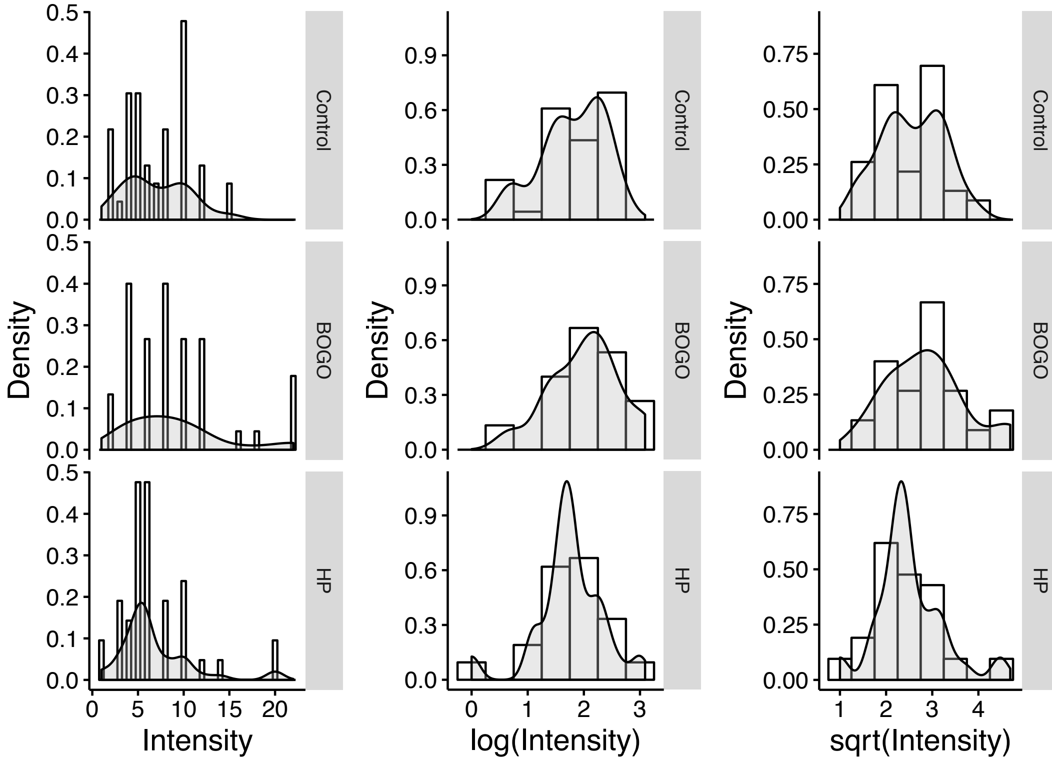


Figure 9. Experiment 1 Histograms of Intensity at Time 2

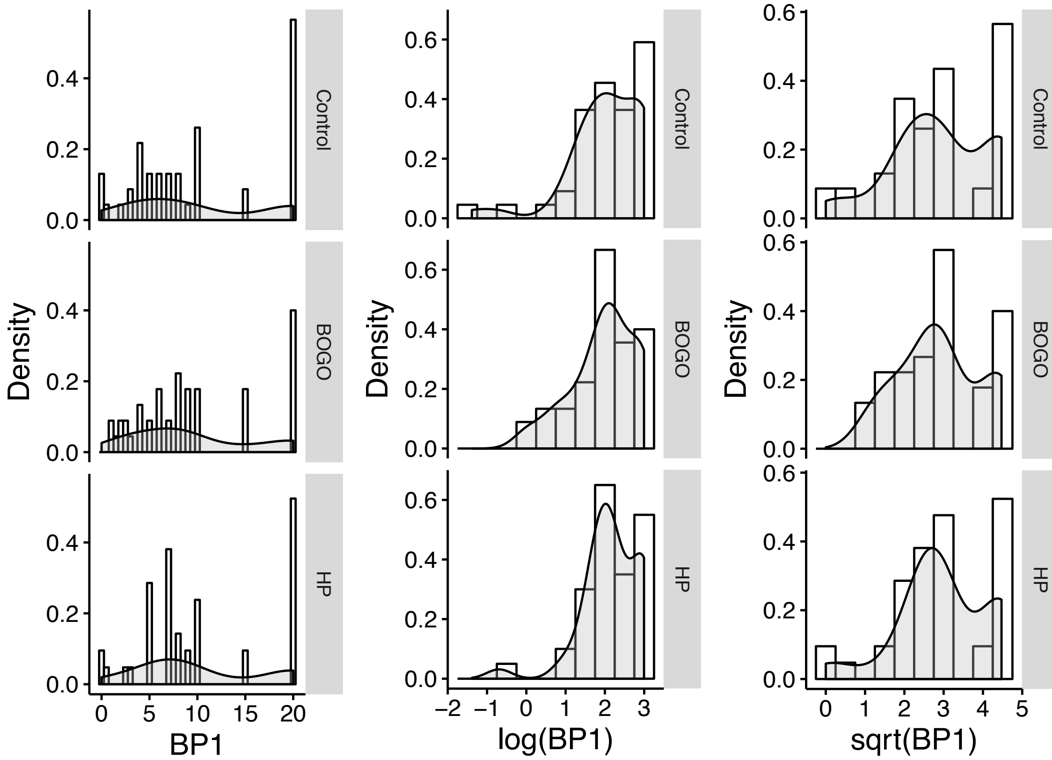


Figure 10. Experiment 1 Histograms of BP_1 at Time 1

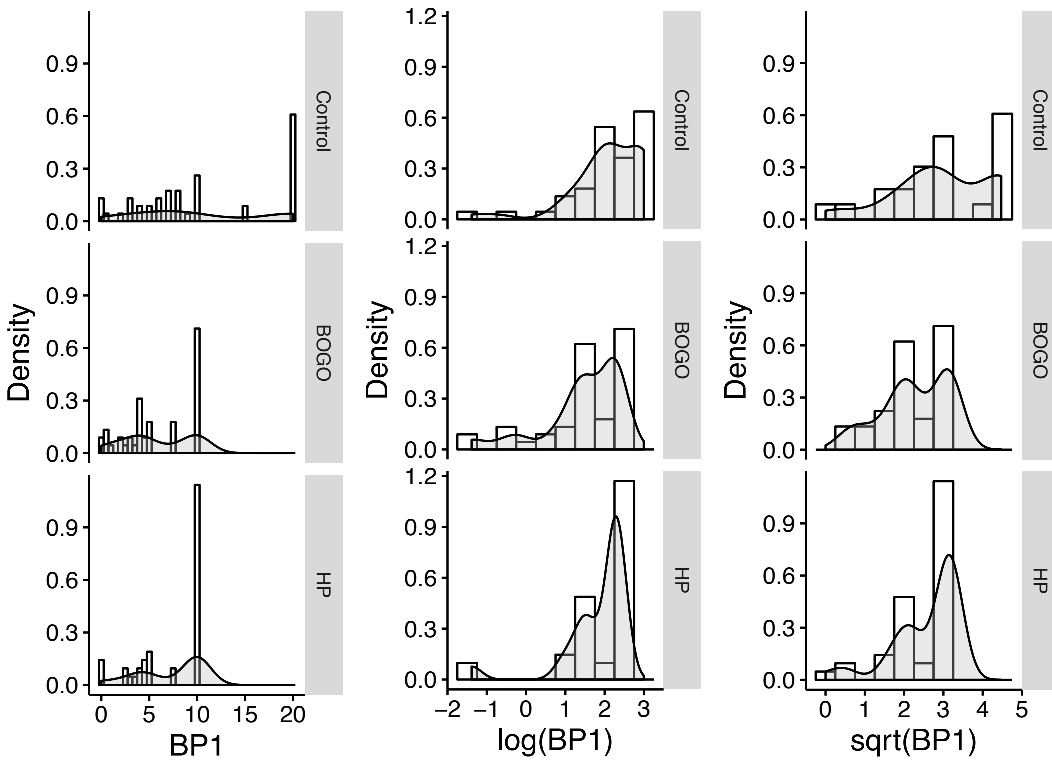


Figure 11. Experiment 1 Histograms of BP_1 at Time 2

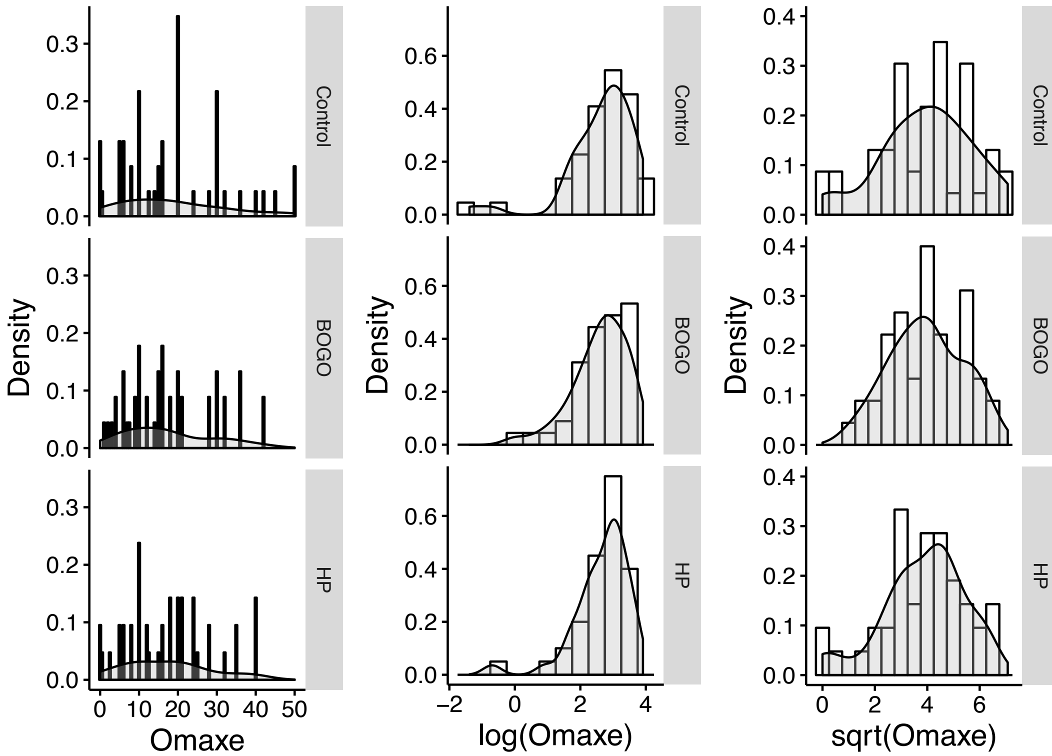


Figure 12. Experiment 1 Histograms of O_{max} at Time 1

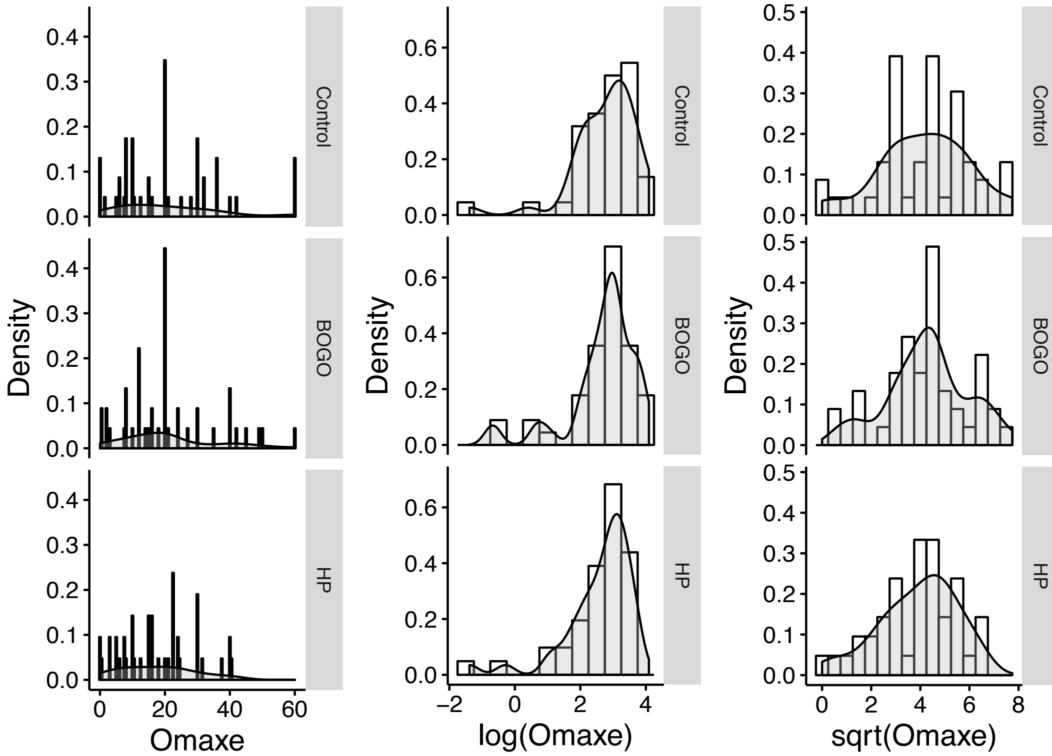


Figure 13. Experiment 1 Histograms of O_{max} at Time 2

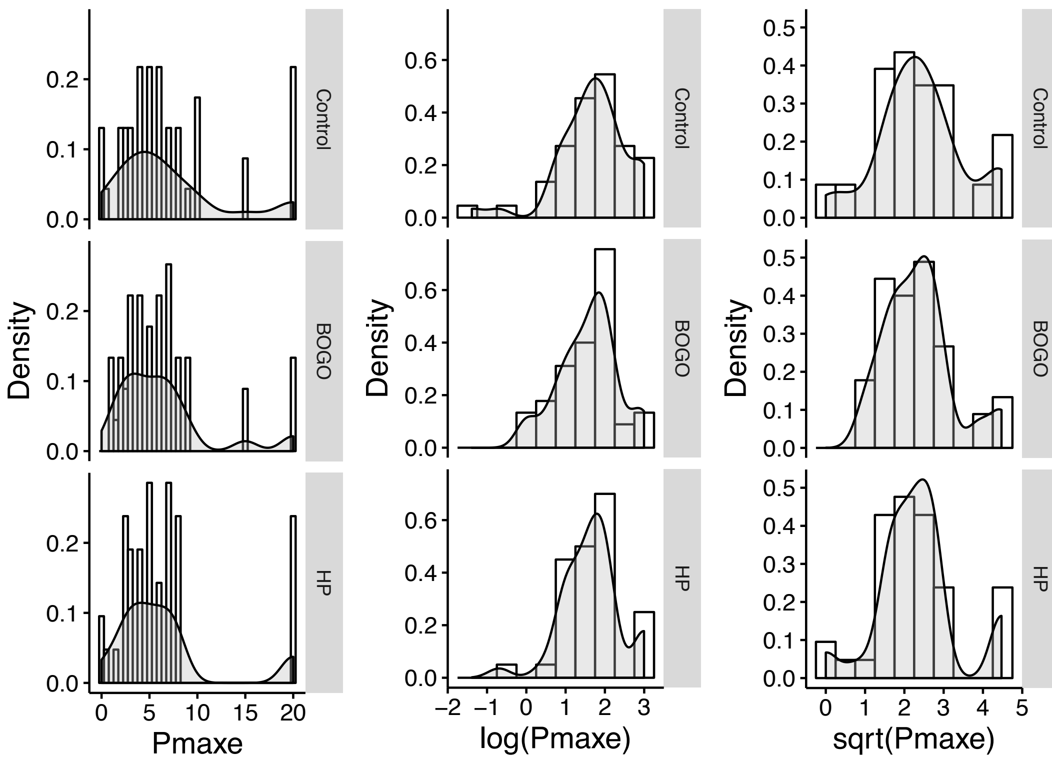


Figure 14. Experiment 1 Histograms of P_{max} at Time 1

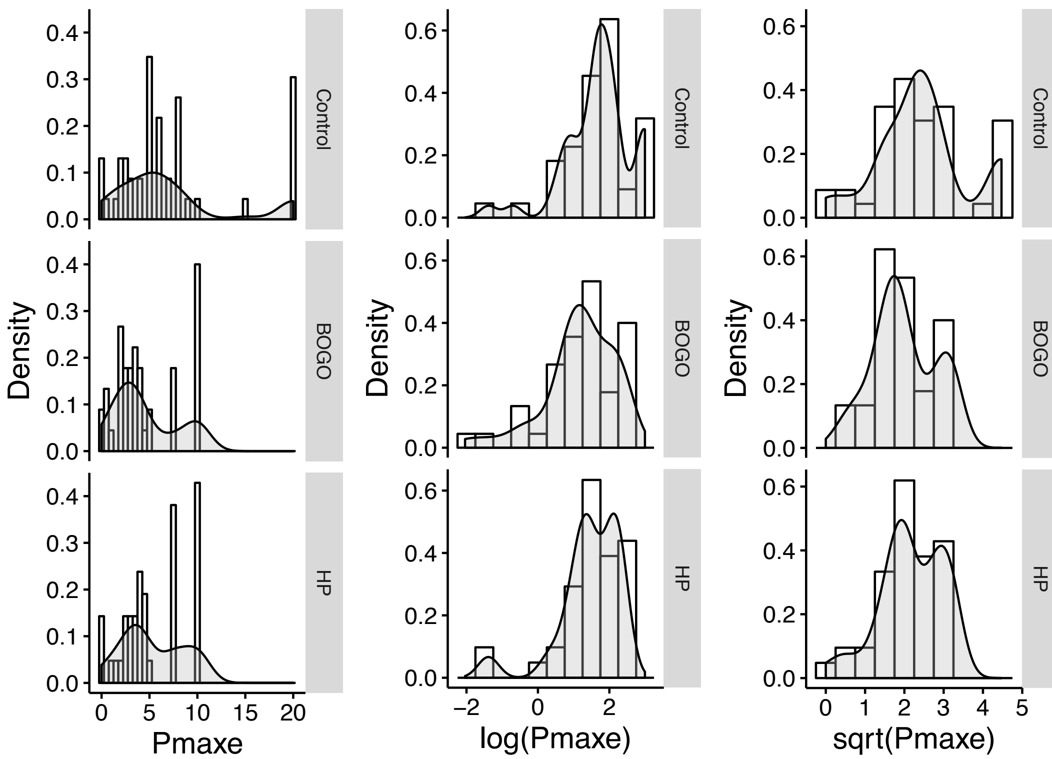


Figure 15. Experiment 1 Histograms of P_{max} at Time 2

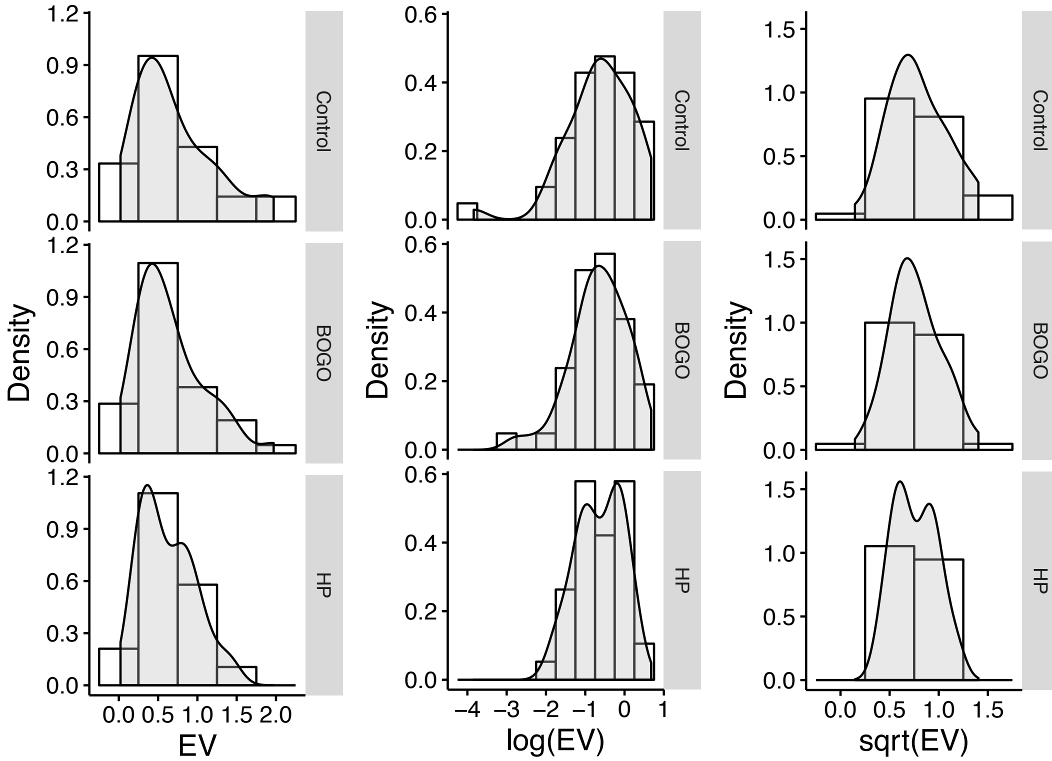


Figure 16. Experiment 1 Histograms of *EV* at Time 1

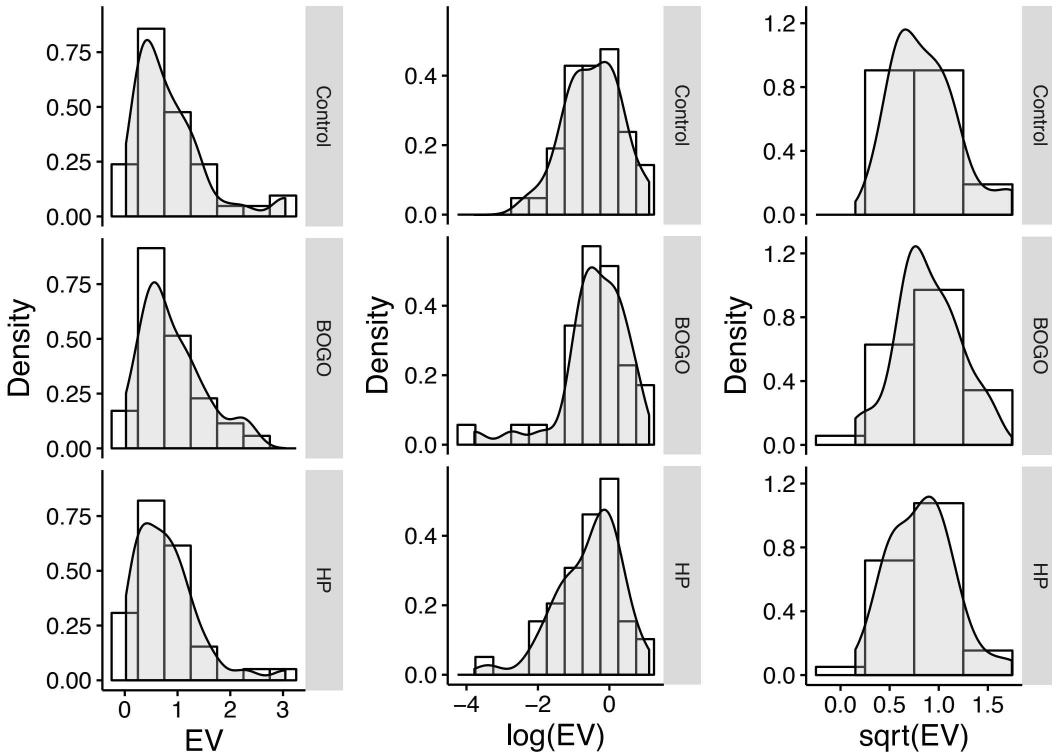


Figure 17. Experiment 1 Histograms of *EV* at Time 2

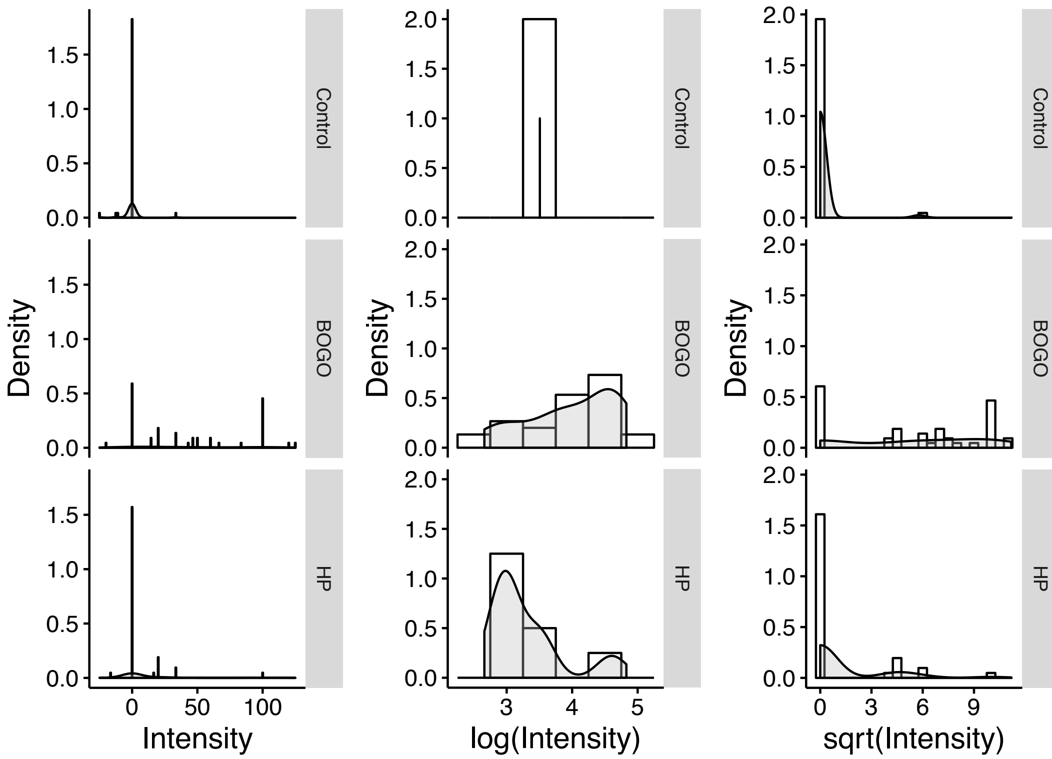


Figure 18. Experiment 1 Histograms for Percent Change in Intensity

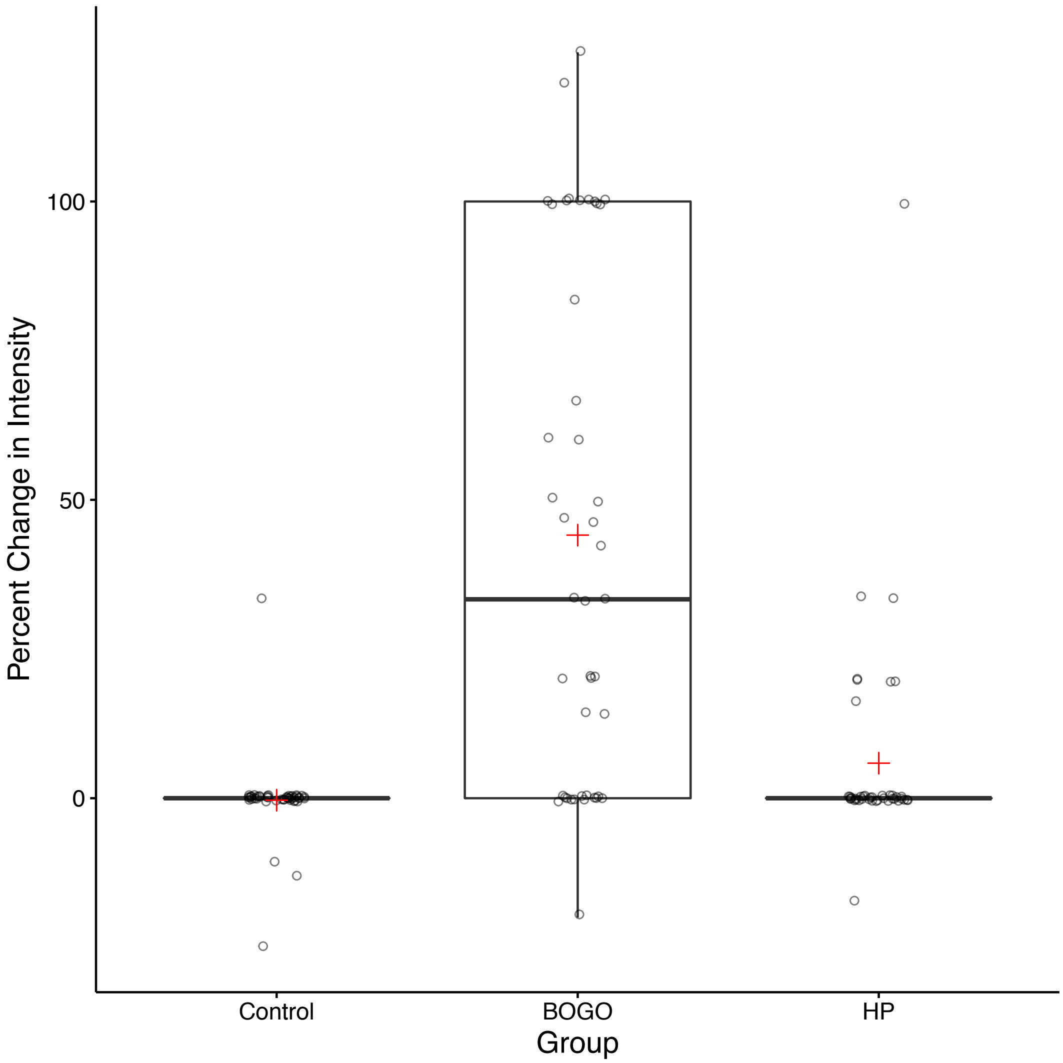


Figure 19. Experiment 1 Box Plots of Change in Intensity. Red crosses indicate the mean.

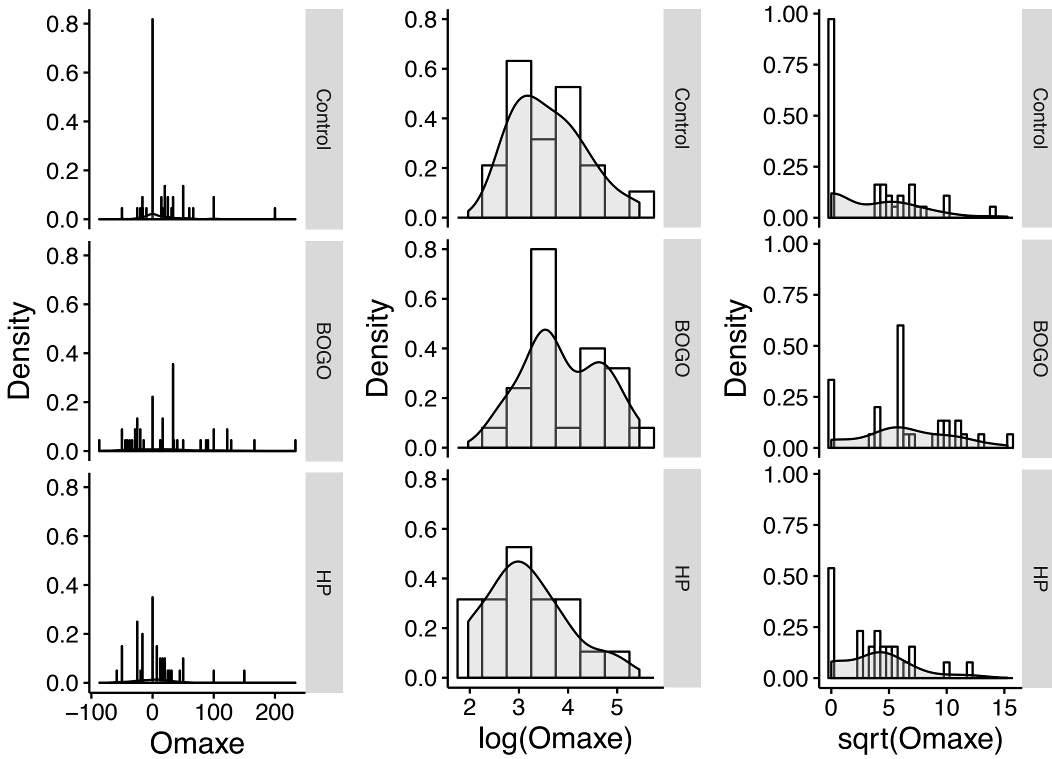


Figure 20. Experiment 1 Histograms for Percent Change in O_{max}

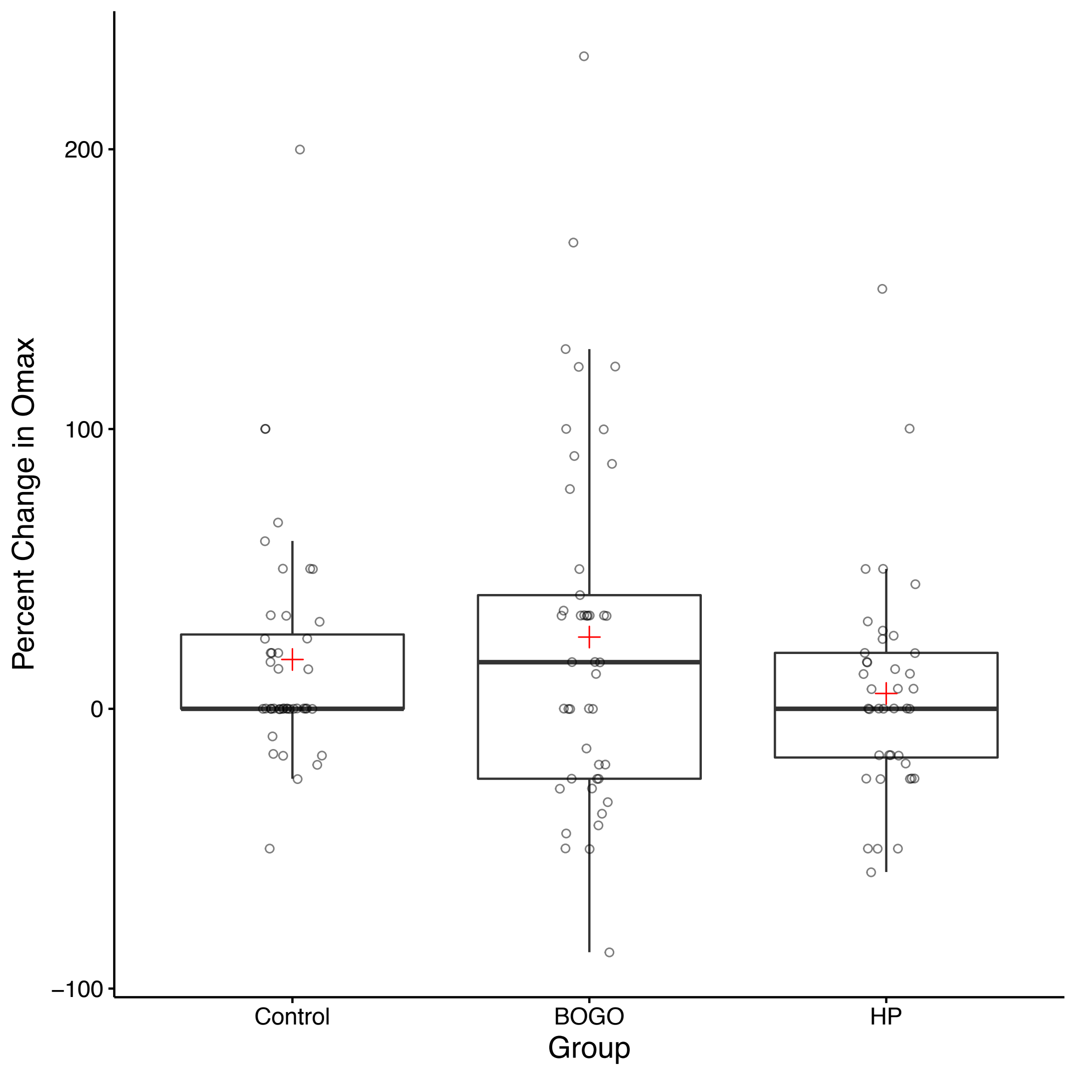


Figure 21. Experiment 1 Box Plots of Change in O_{max}. Red crosses indicate the mean.

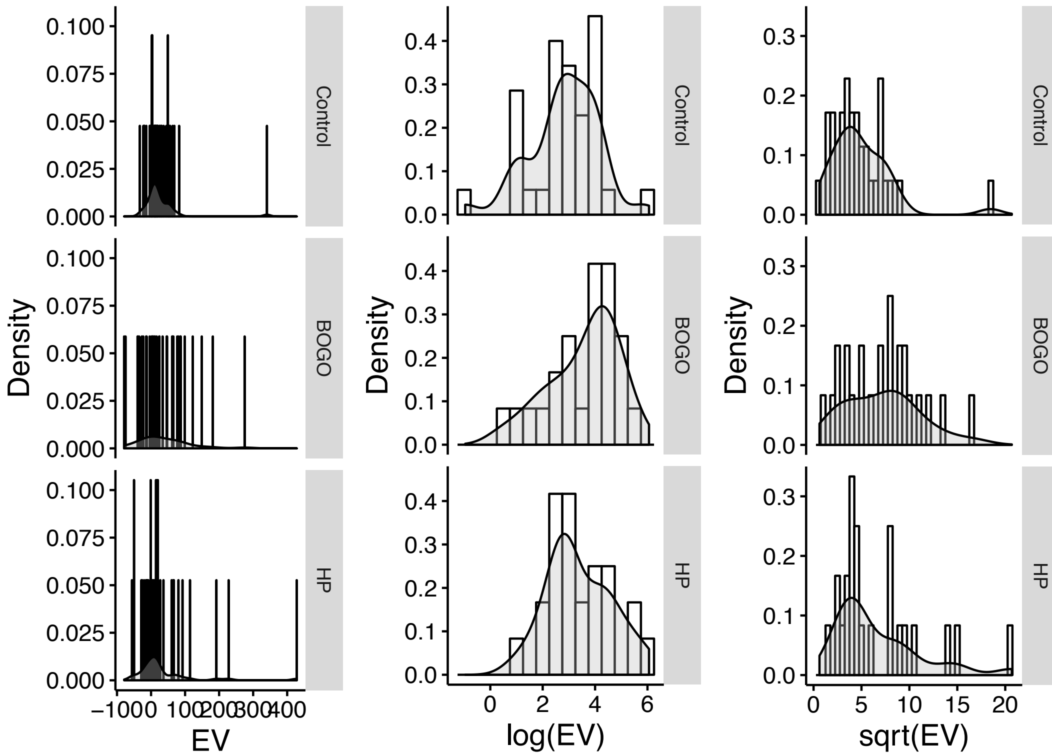


Figure 22. Experiment 1 Histogram of Percent Change in *EV*

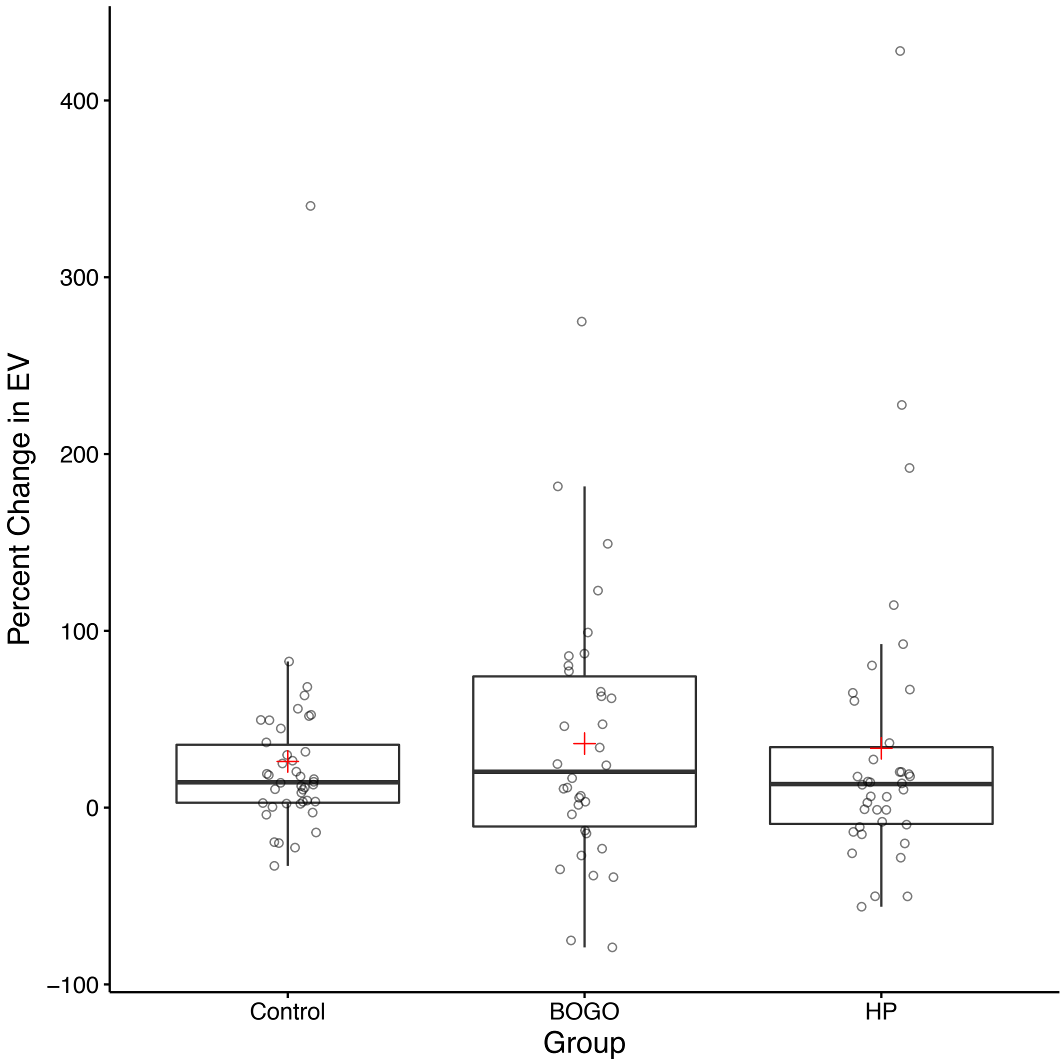


Figure 23. Experiment 1 Box Plots of Change in *EV*. Red crosses indicate the mean.

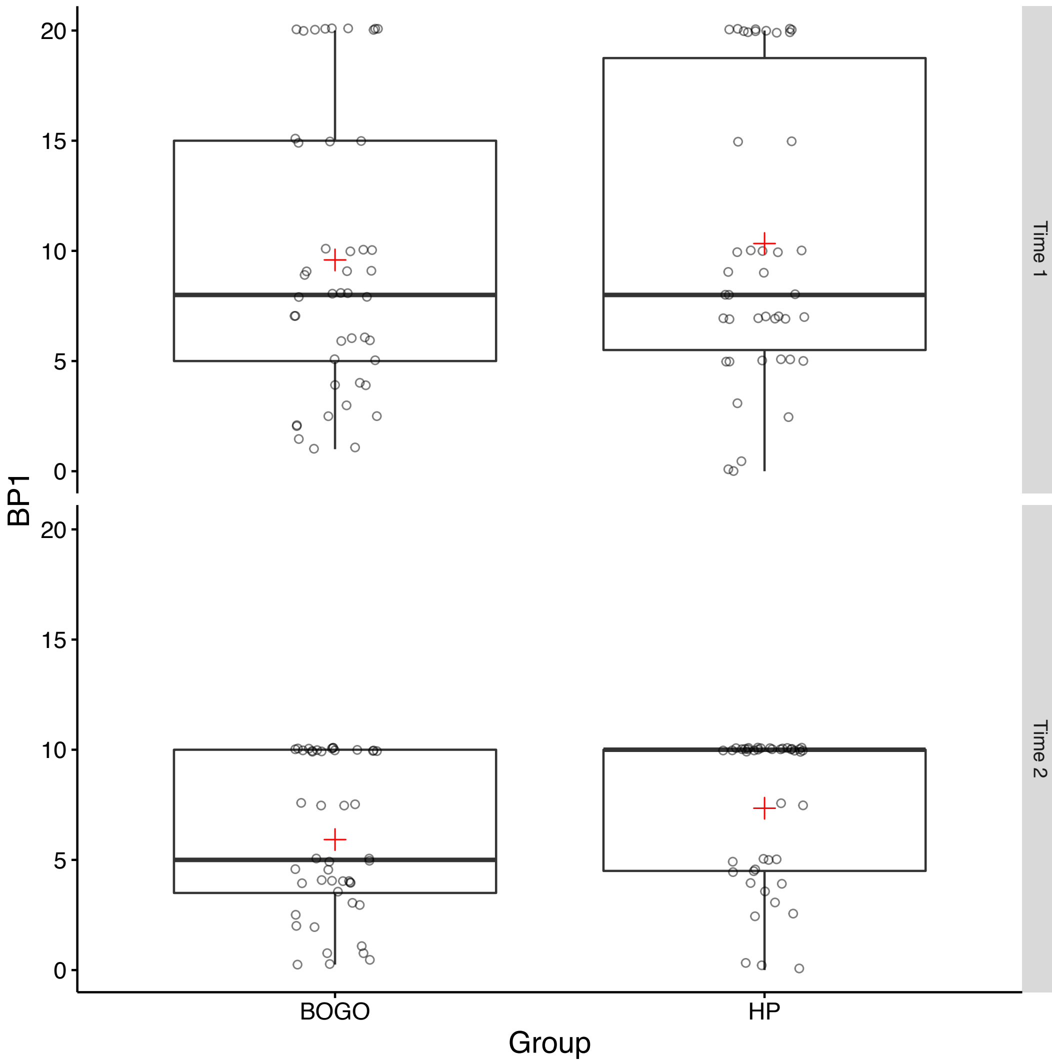


Figure 24. Experiment 1 Box Plots of BP_1 by Group and Time. Red crosses indicate the mean.

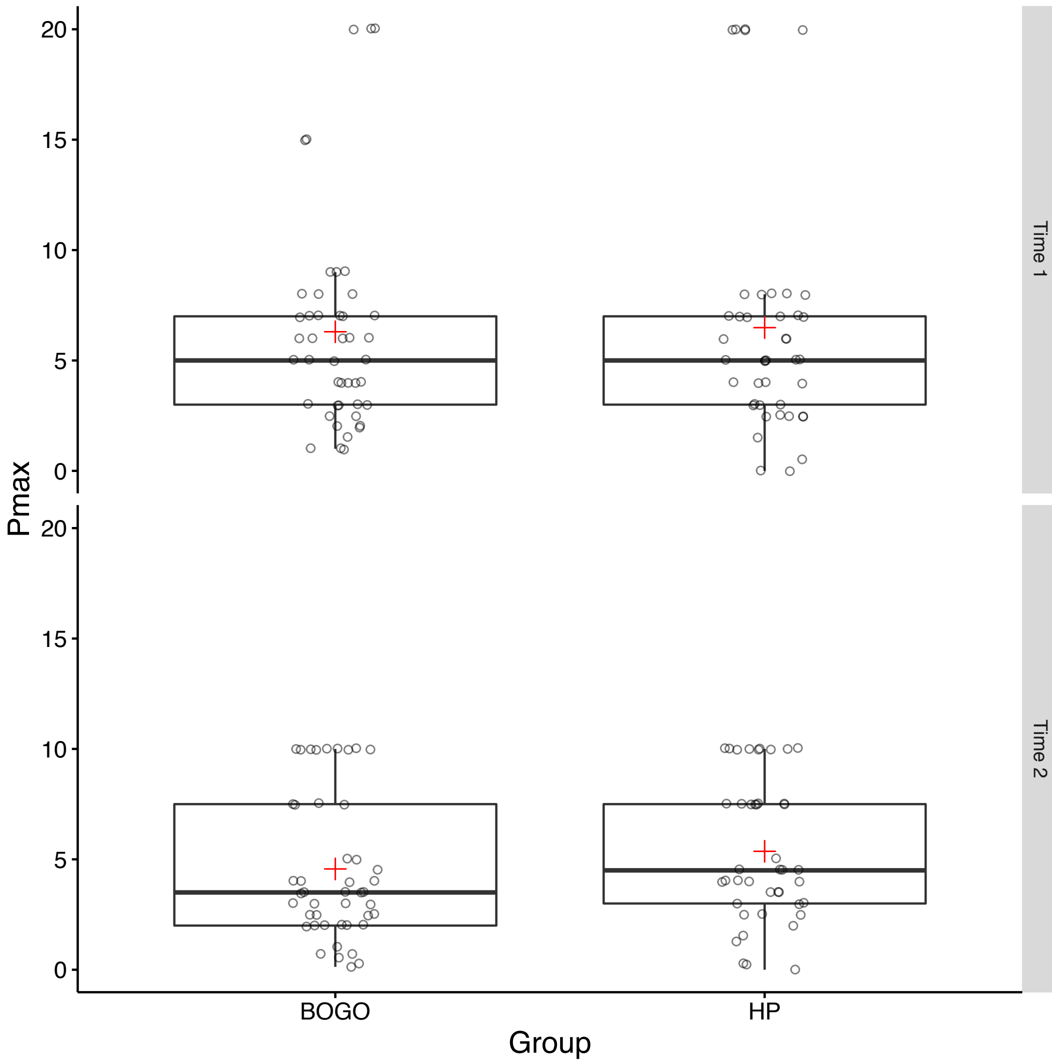


Figure 25. Experiment 1 Box Plots of P_{max} by Group and Time. Red crosses indicate the mean.

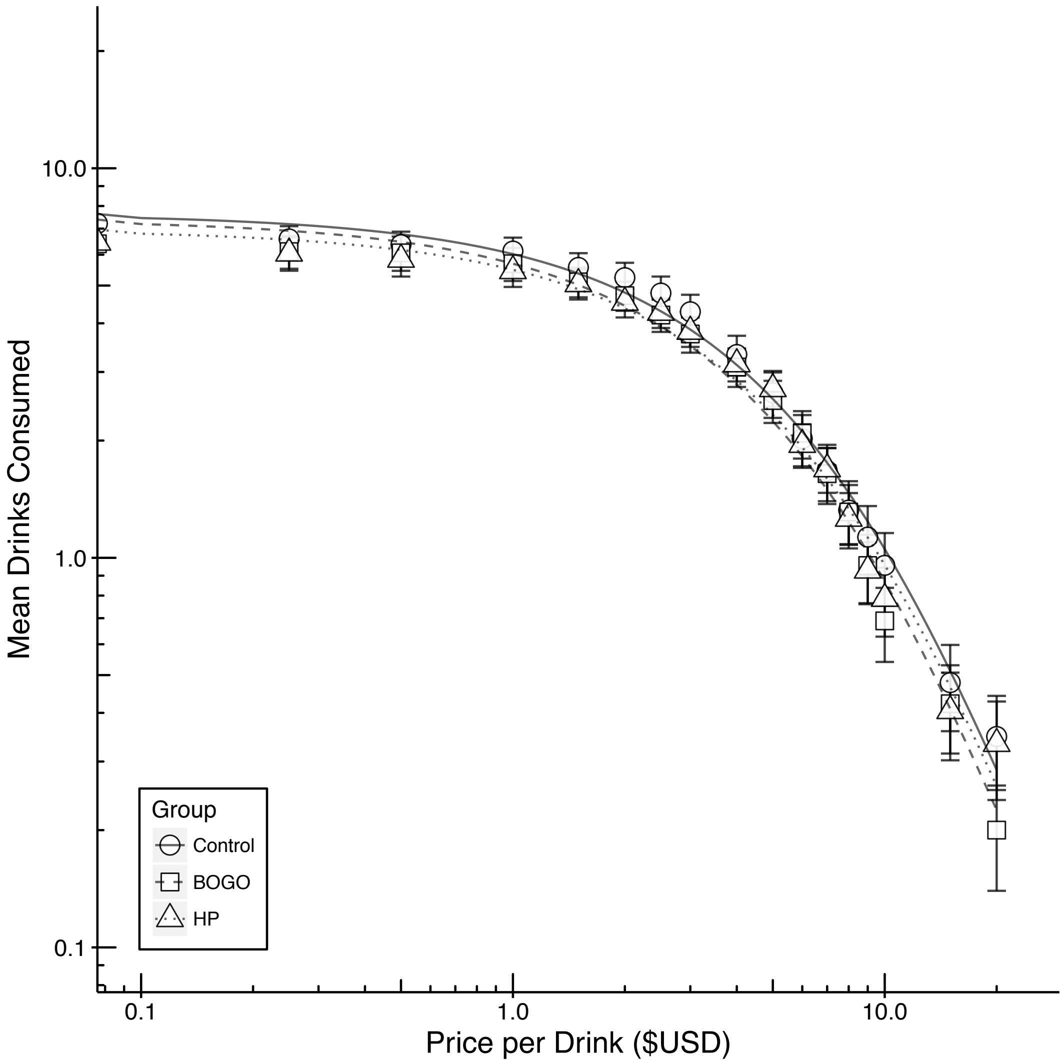


Figure 26. Experiment 1 Aggregated Consumption at Time 1. Best-fit lines using best-fit α from equation 6

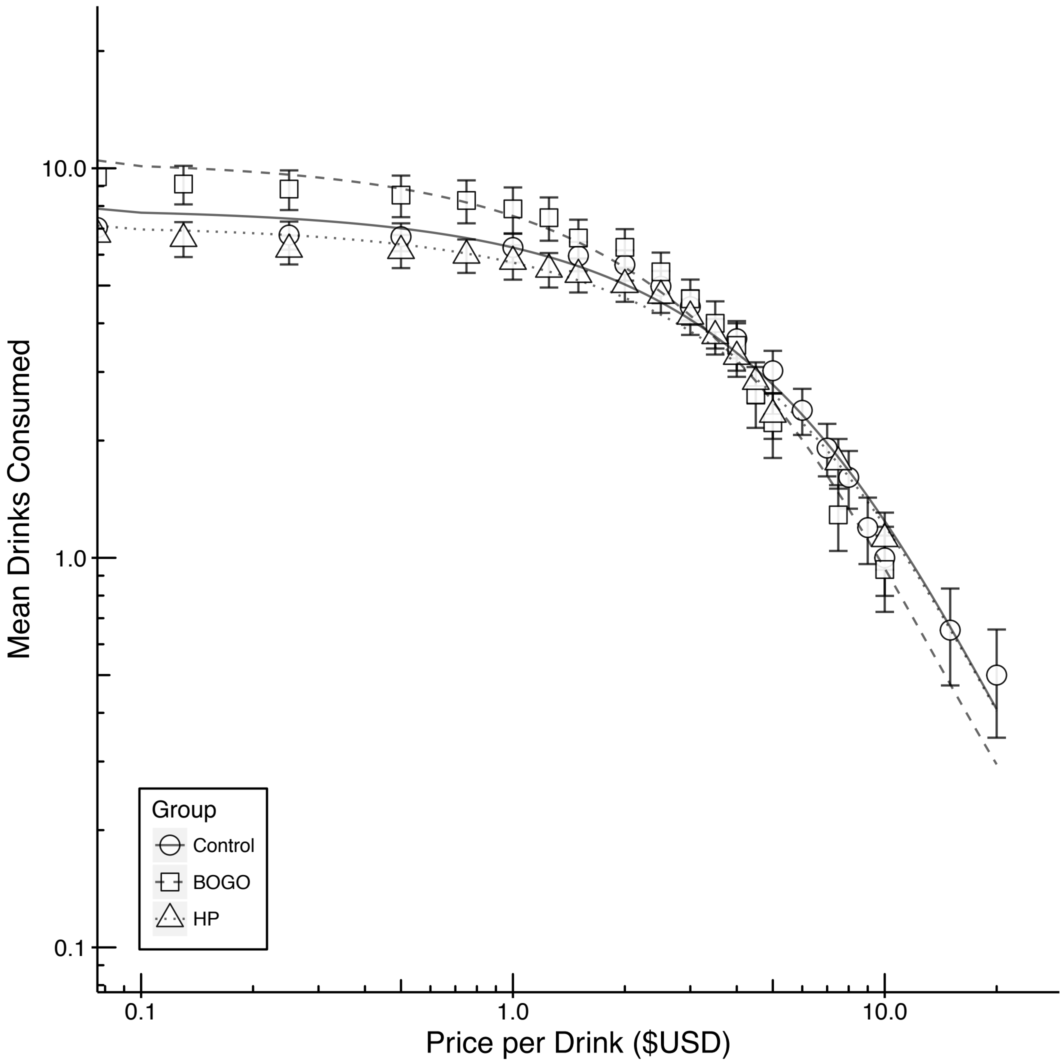


Figure 27. Experiment 1 Aggregated Consumption at Time 2. Best-fit lines using best-fit α from equation 6

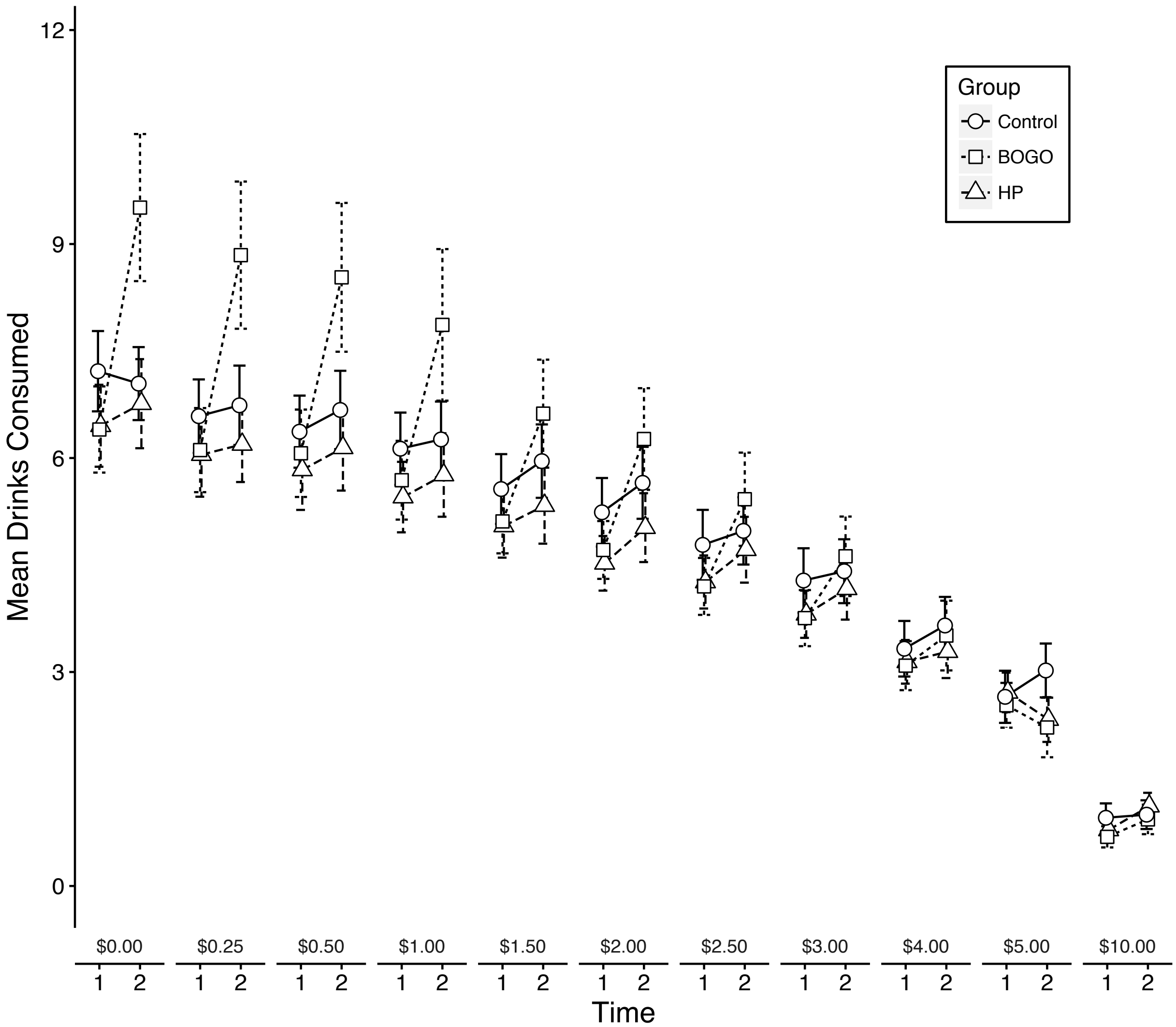


Figure 28. Experiment 1 Consumption by Price, Time, and Group

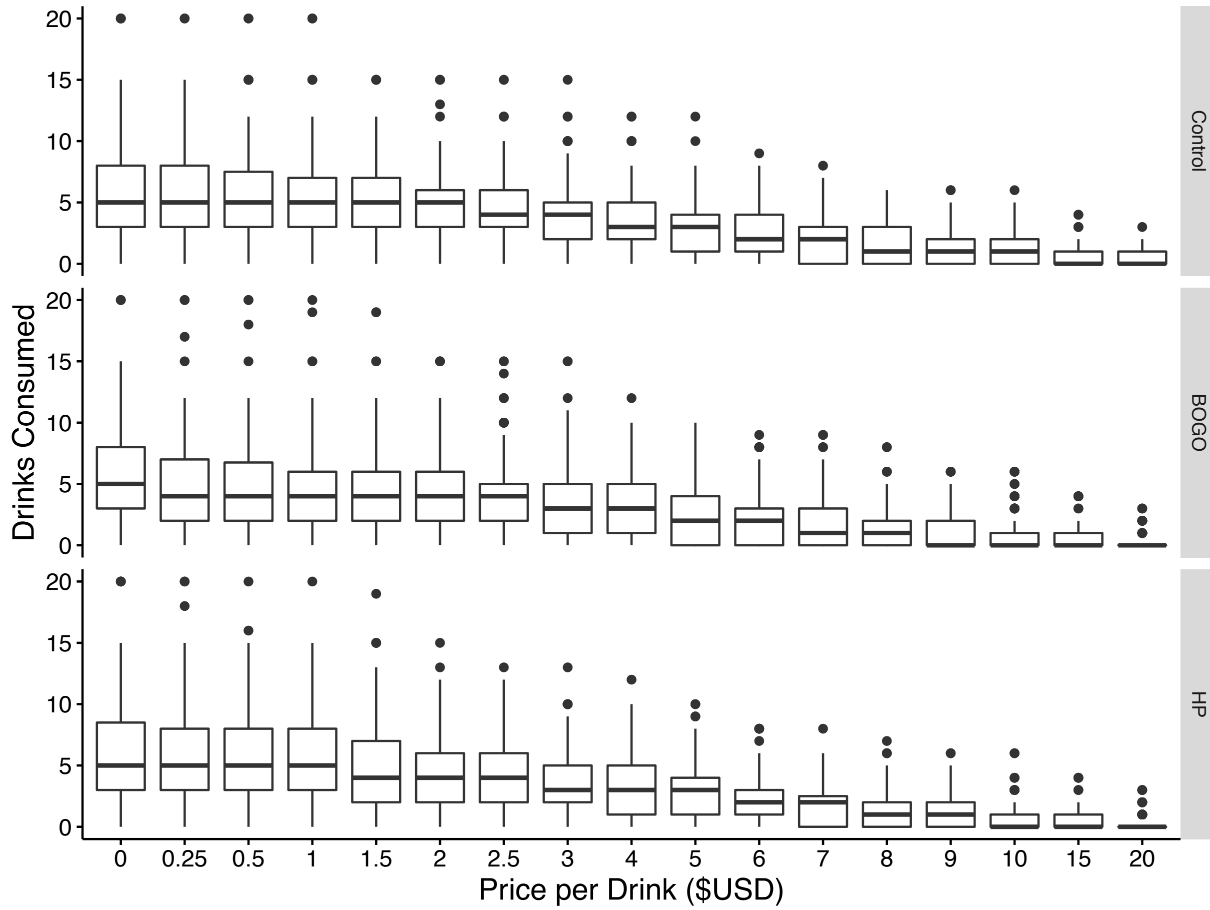


Figure 29. Experiment 2 Box Plots of Consumption by Price for Time 1 APT (Banned States)

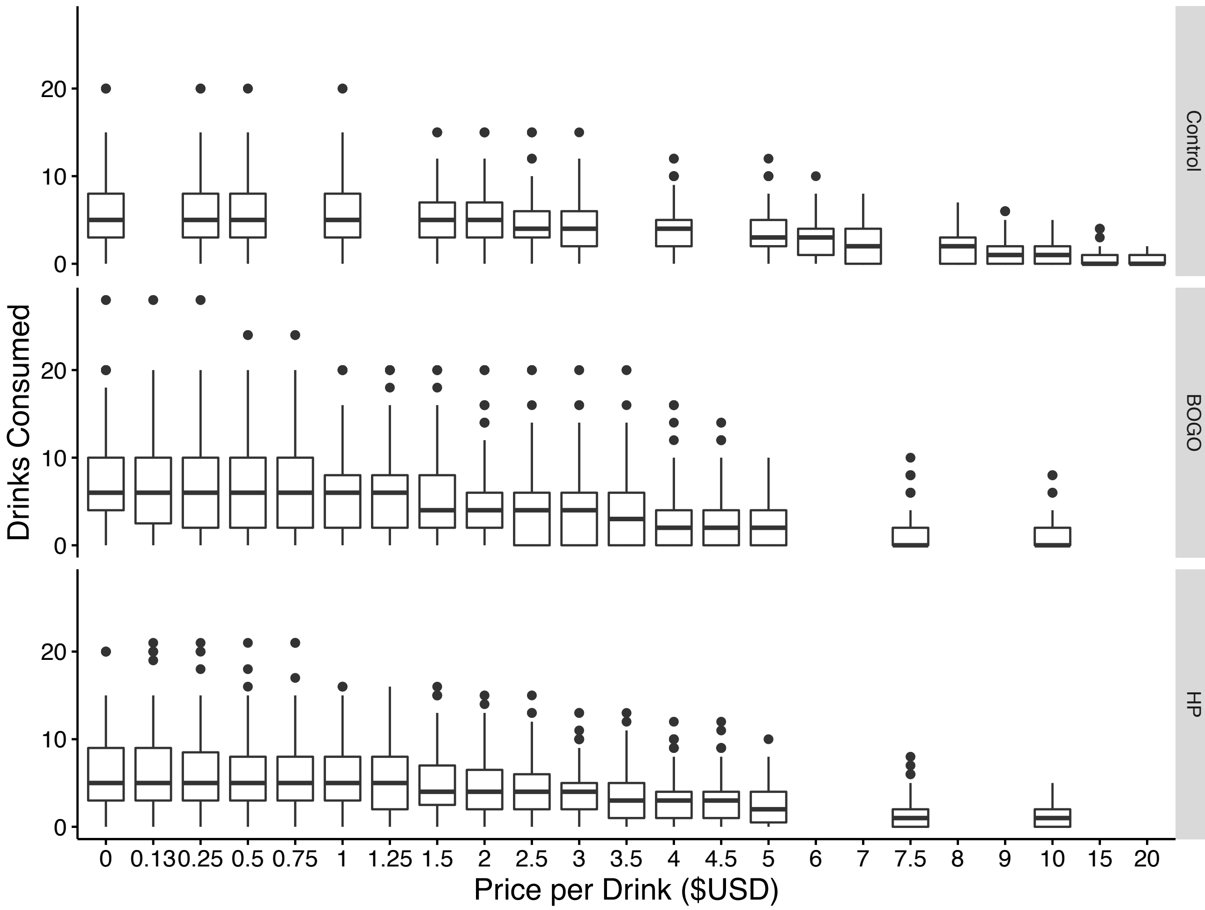


Figure 30. Experiment 2 Box Plots of Consumption by Price for Time 2 APT (Banned States)

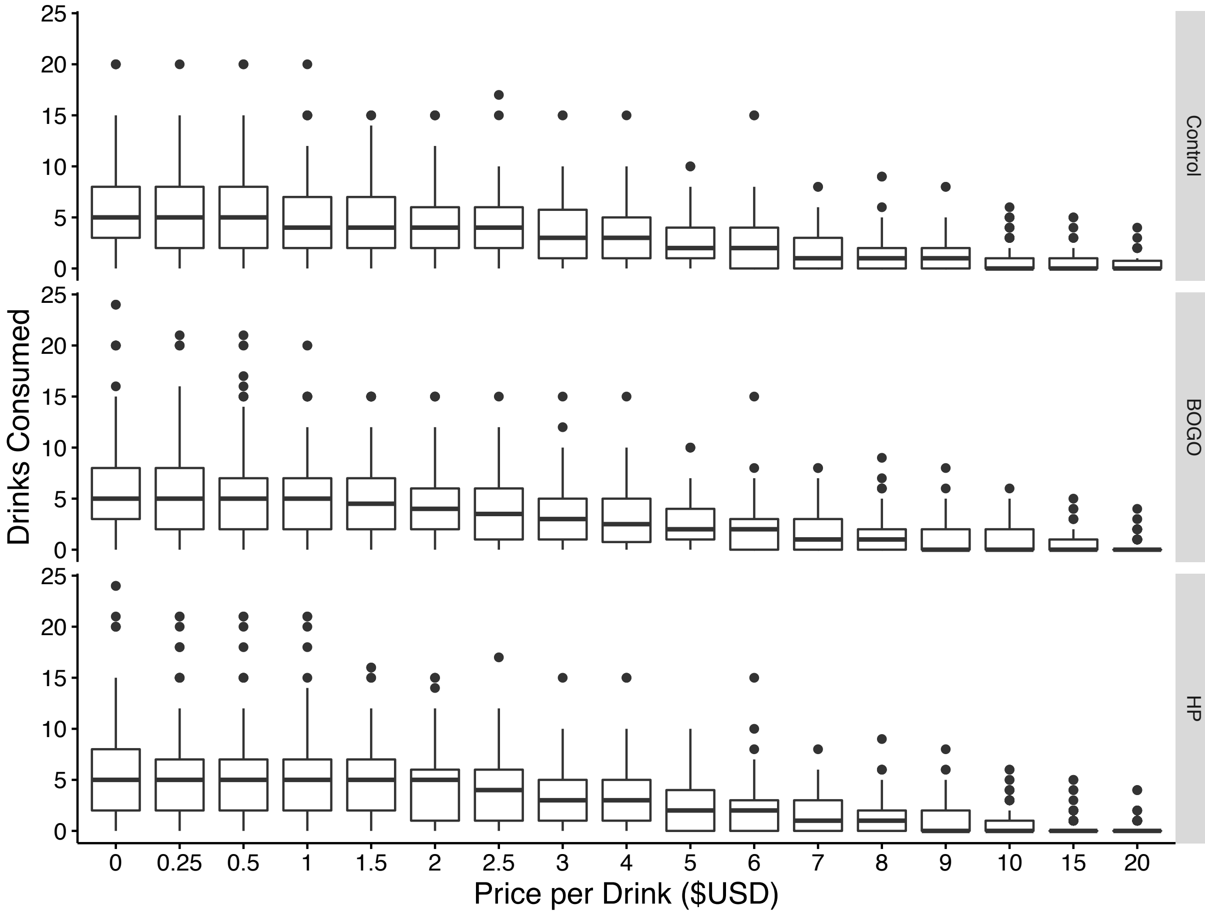


Figure 31. Experiment 2 Box Plots of Consumption by Price for Time 1 APT (Not Banned States)

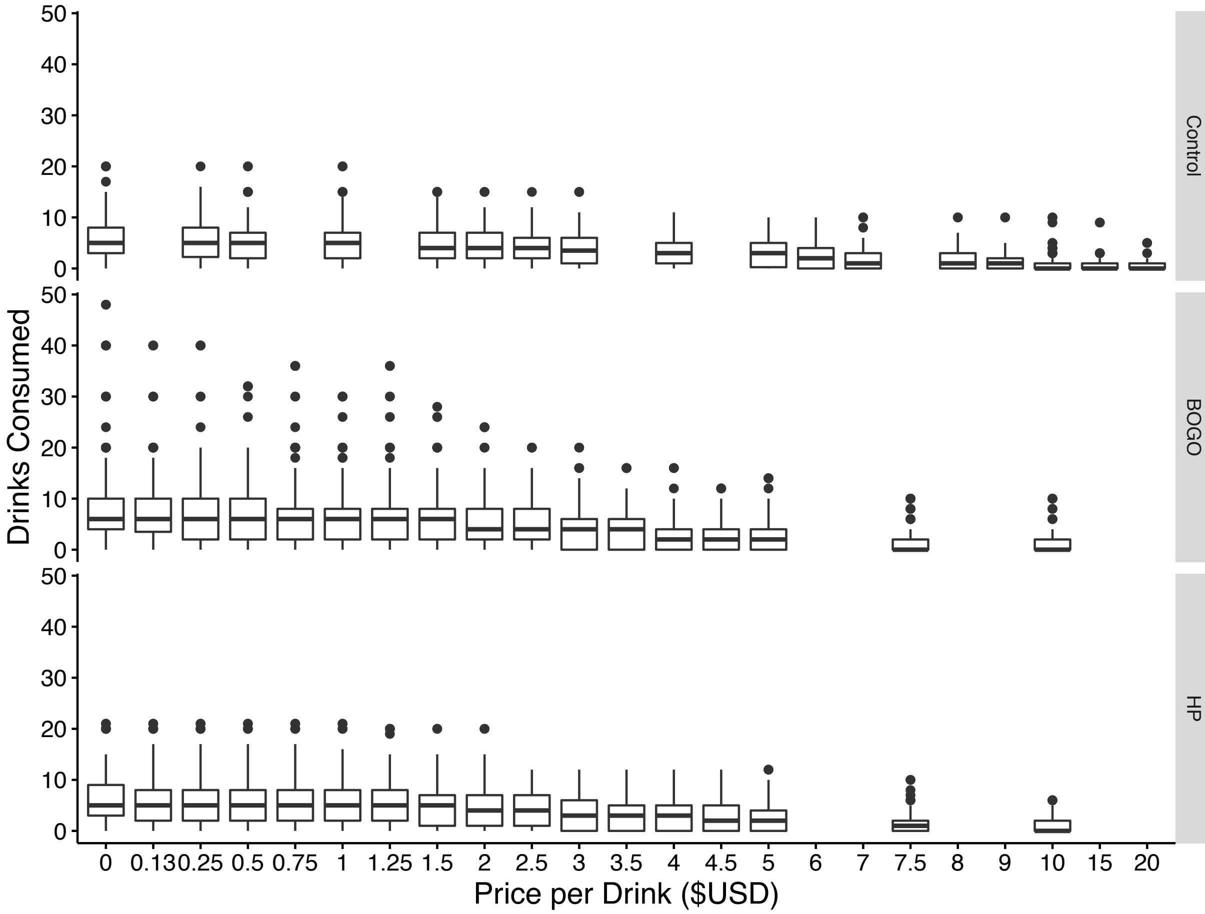


Figure 32. Experiment 2 Box Plots of Consumption by Price for Time 2 APT (Not Banned States)

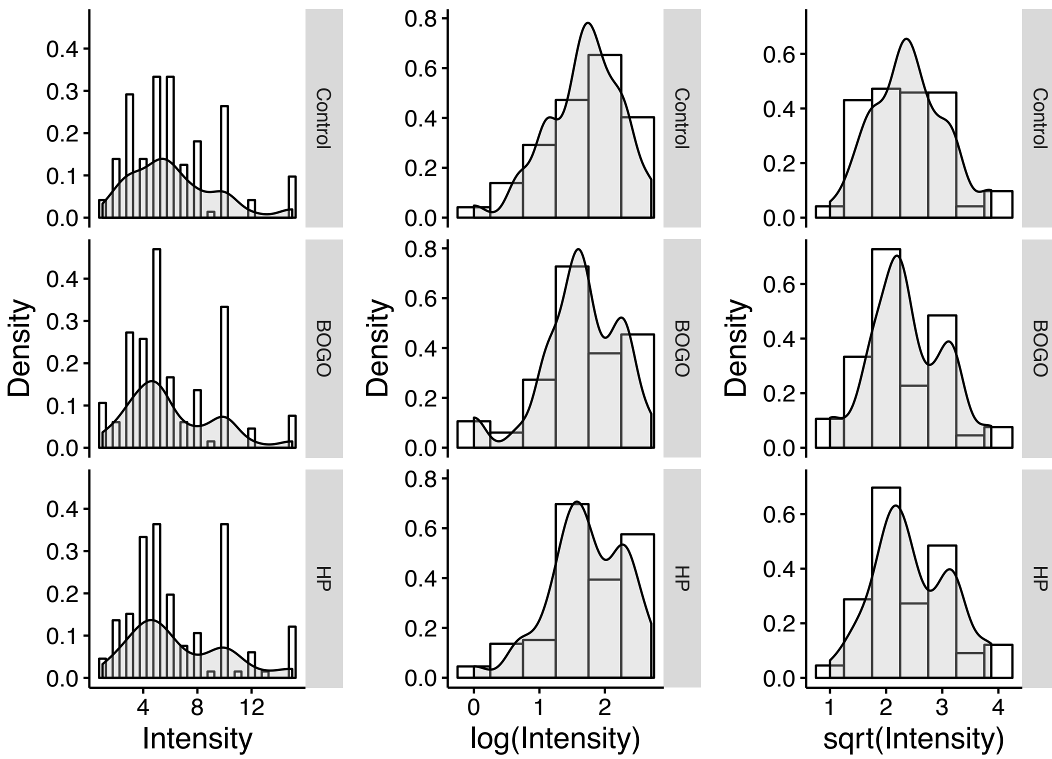


Figure 33. Experiment 2 Histograms of Intensity at Time 1 (Banned States)

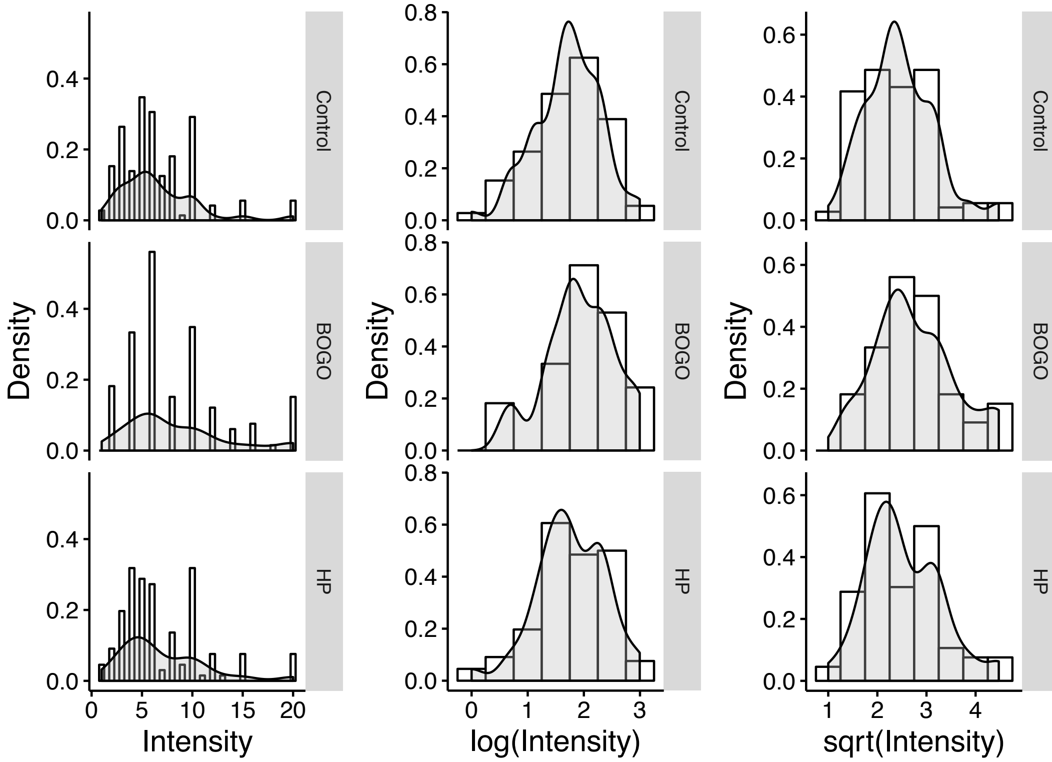


Figure 34. Experiment 2 Histograms of Intensity at Time 2 (Banned States)

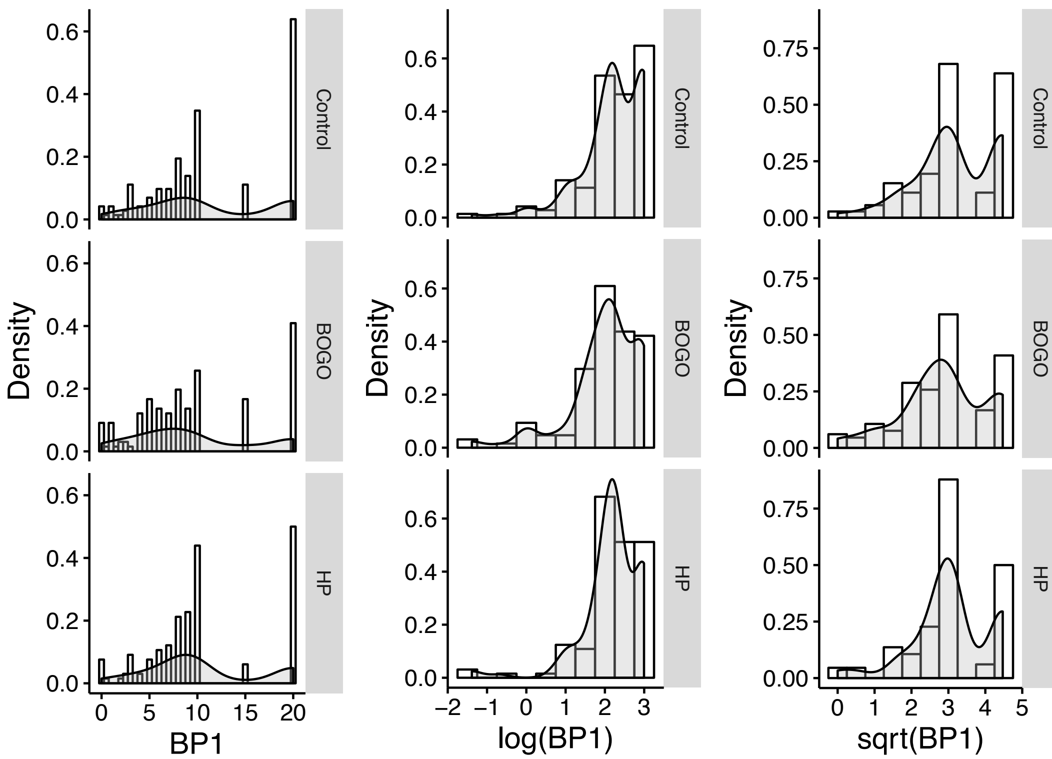


Figure 35. Experiment 2 Histograms of BP_1 at Time 1 (Banned States)

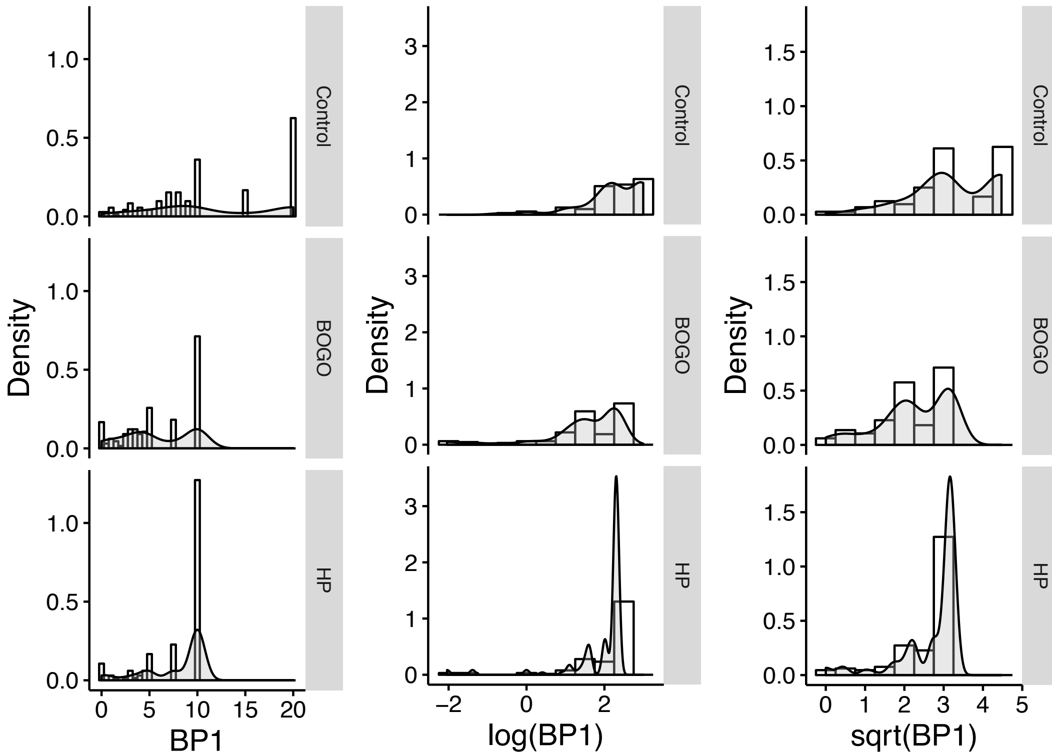


Figure 36. Experiment 2 Histograms of BP_1 at Time 2 (Banned States)

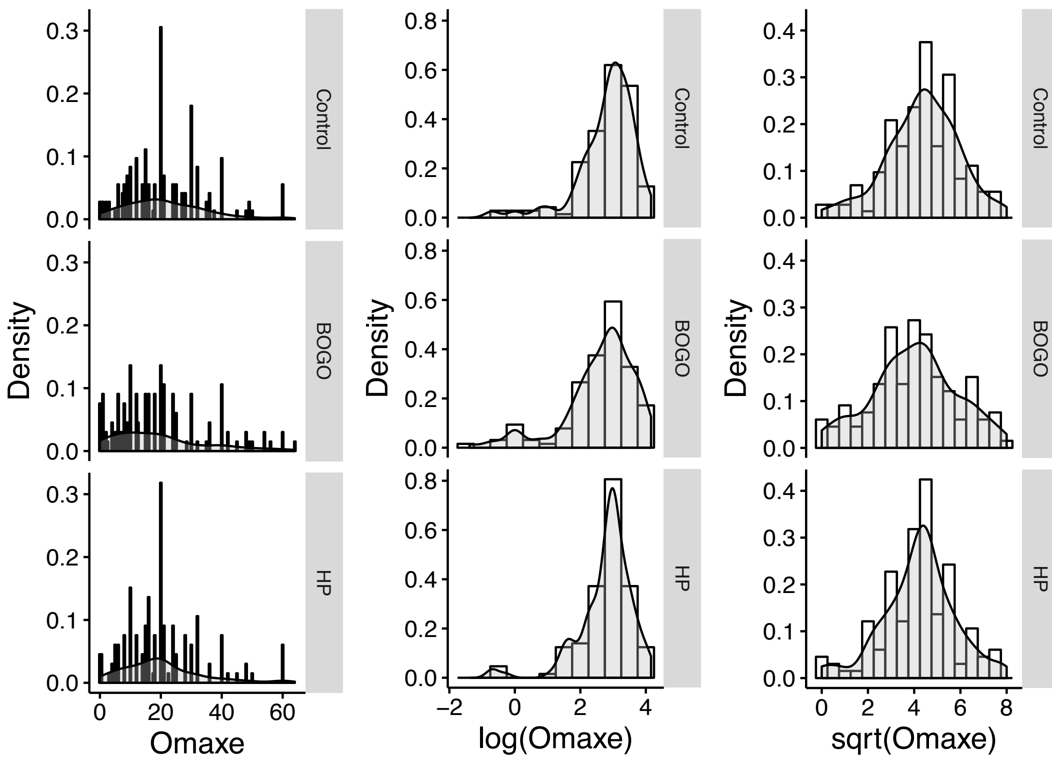


Figure 37. Experiment 2 Histograms of O_{max} at Time 1 (Banned States)

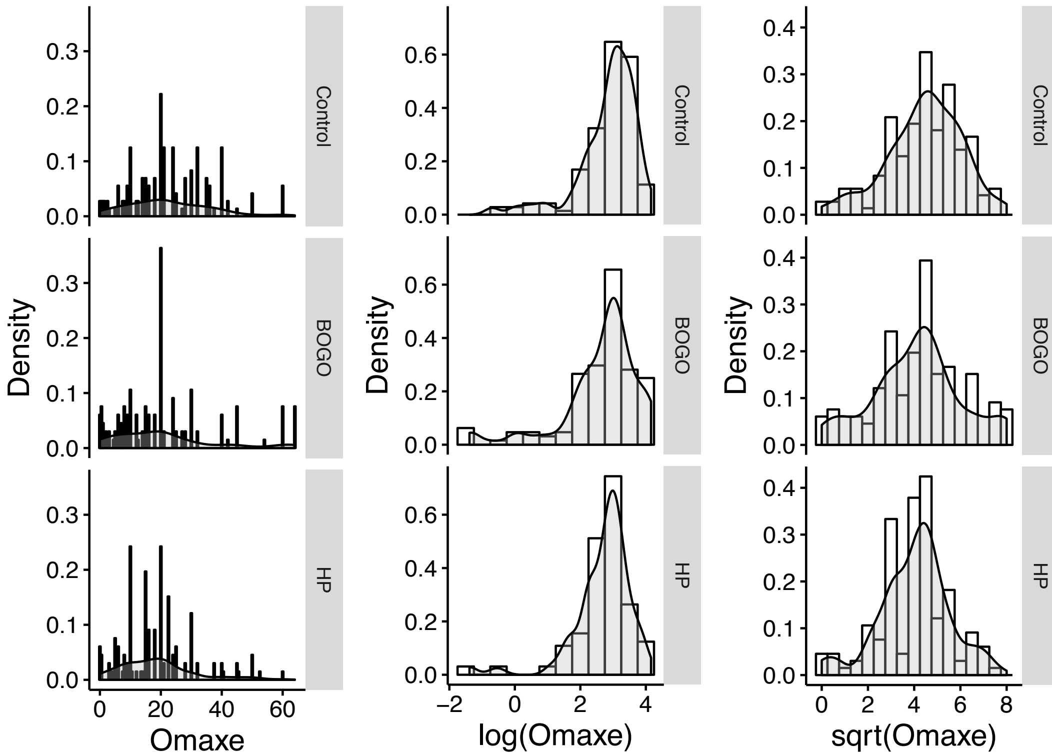


Figure 38. Experiment 2 Histograms of O_{max} at Time 2 (Banned States)

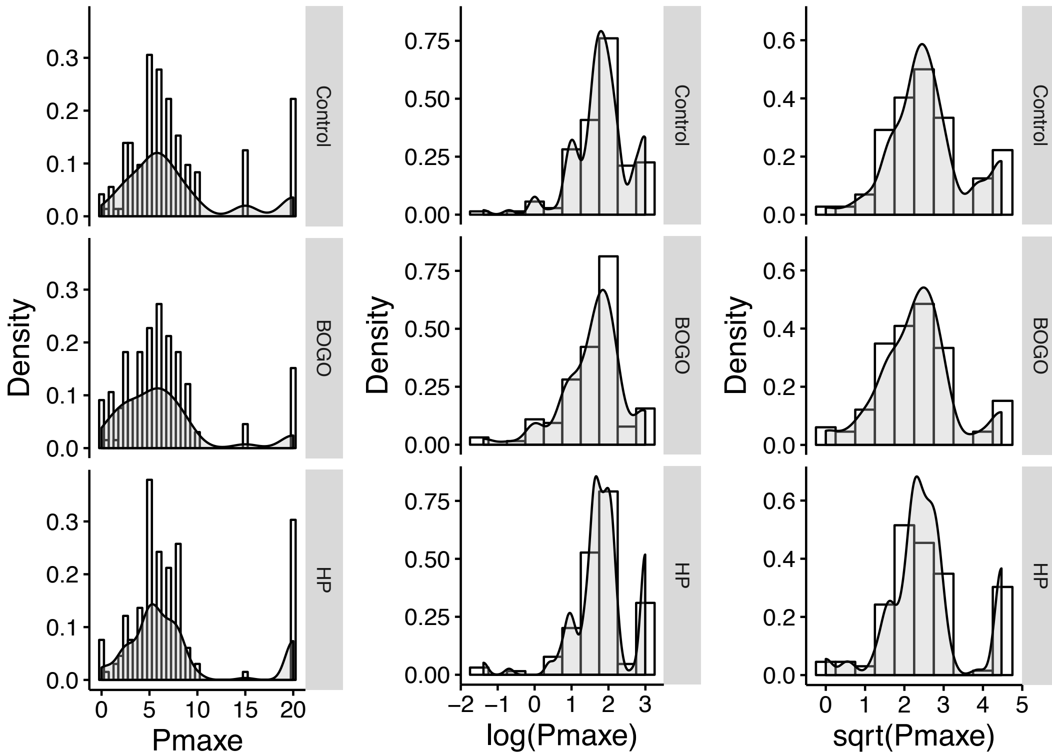


Figure 39. Experiment 2 Histograms of P_{max} at Time 1 (Banned States)

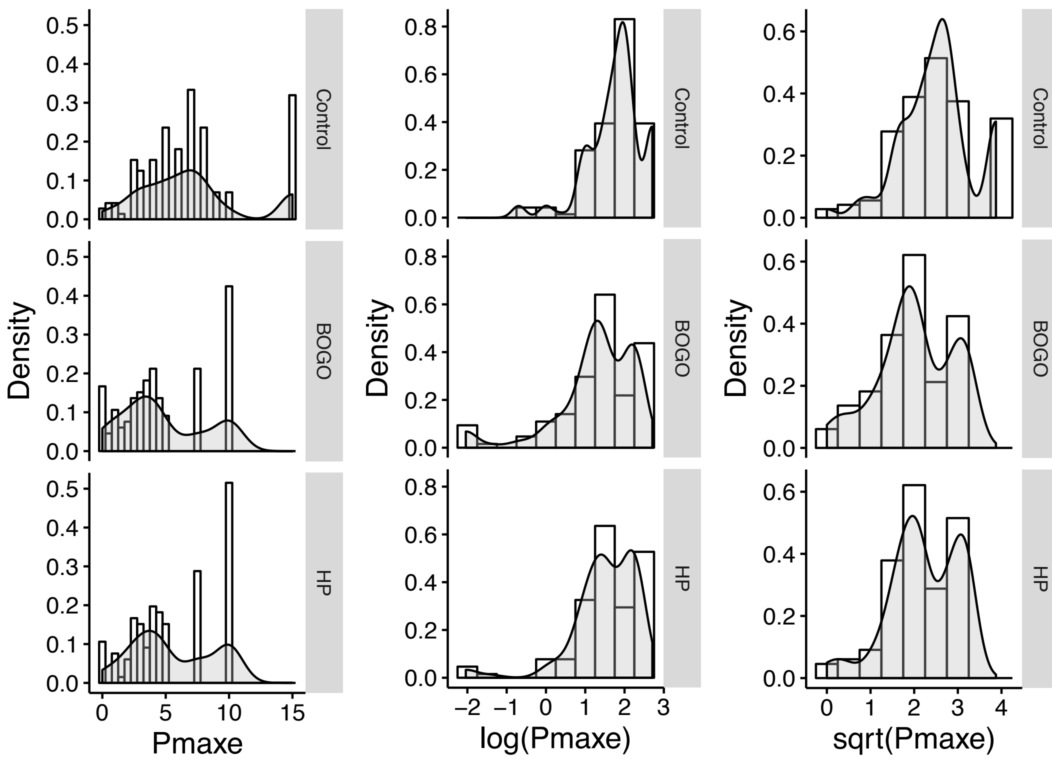


Figure 40. Experiment 2 Histograms of P_{max} at Time 2 (Banned States)

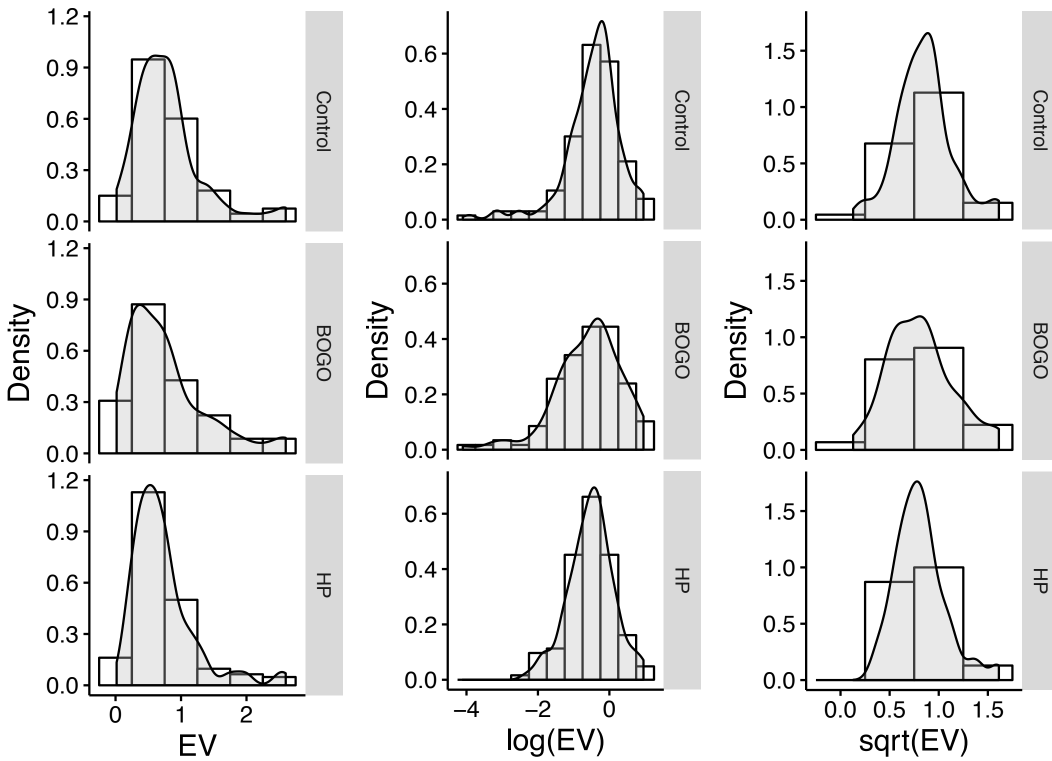


Figure 41. Experiment 2 Histograms of *EV* at Time 1 (Banned States)

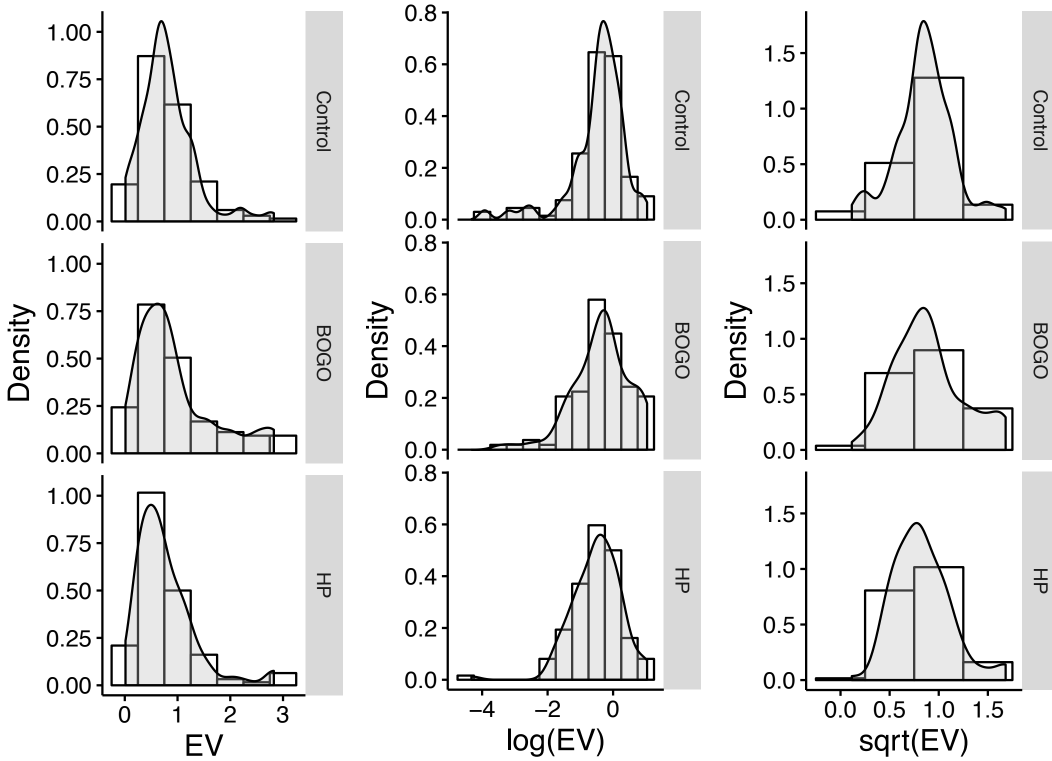


Figure 42. Experiment 2 Histograms of *EV* at Time 2 (Banned States)

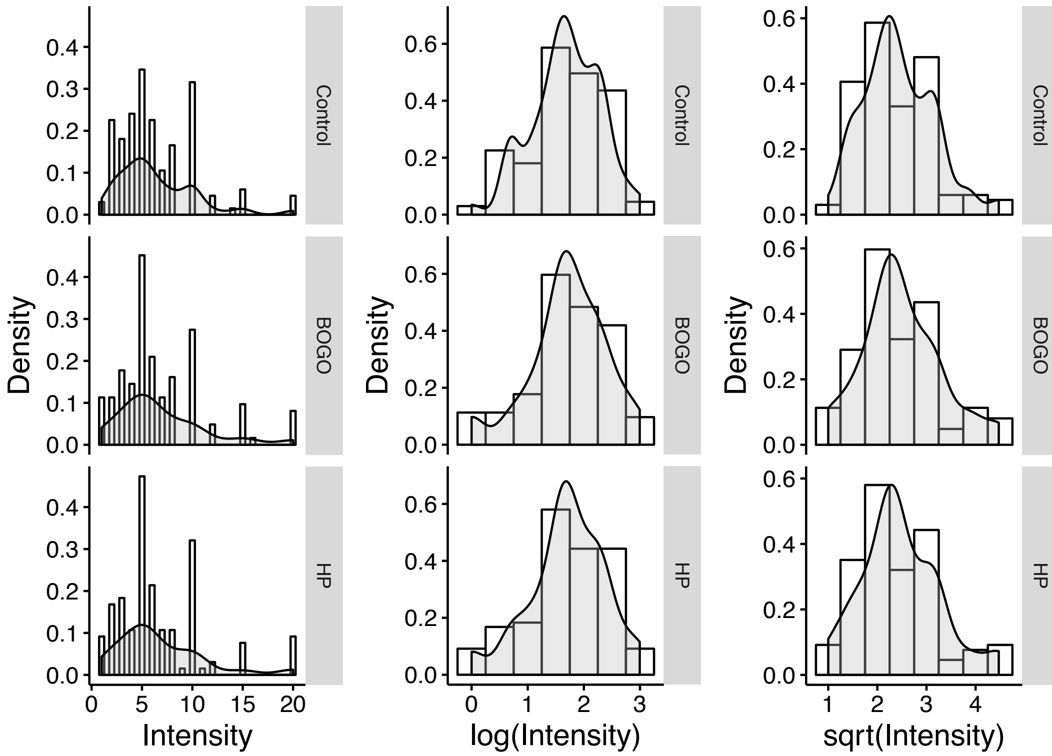


Figure 43. Experiment 2 Histograms of Intensity at Time 1 (Not Banned States)

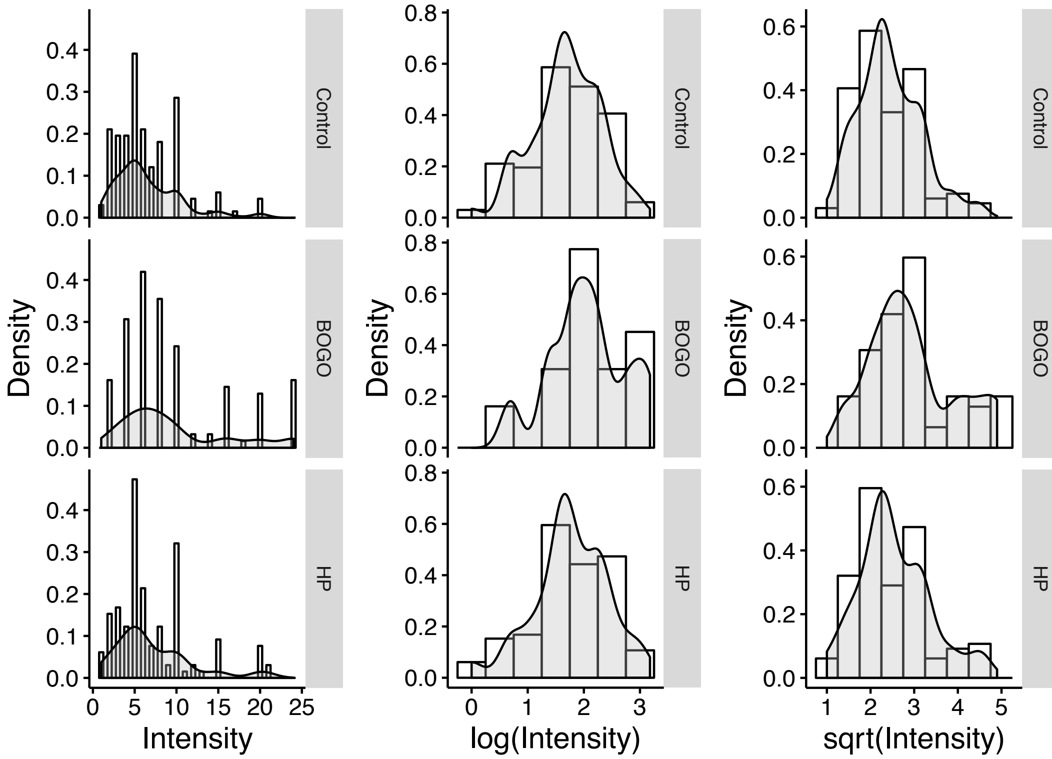


Figure 44. Experiment 2 Histograms of Intensity at Time 2 (Not Banned States)

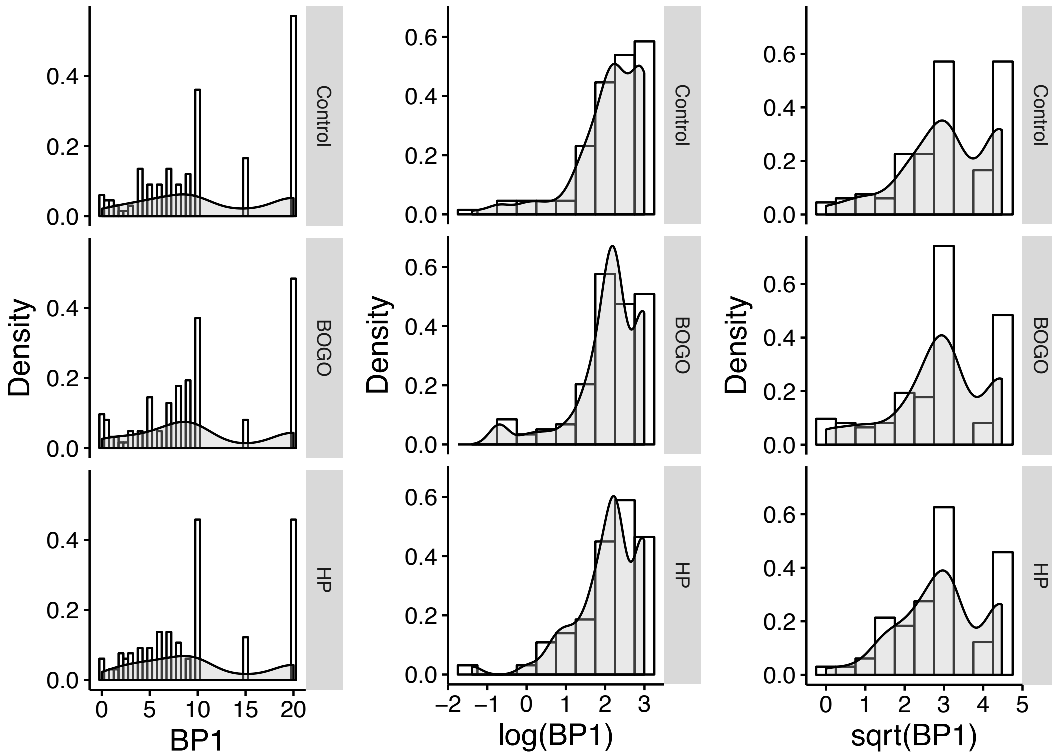


Figure 45. Experiment 2 Histograms of BP_1 at Time 1 (Not Banned States)

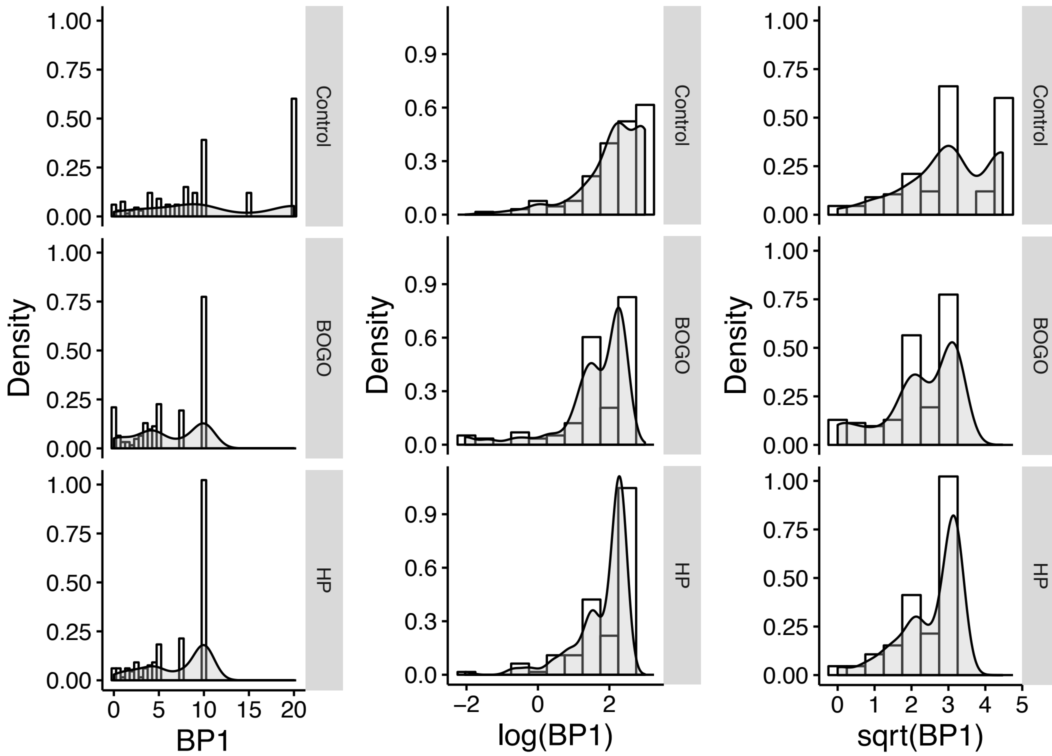


Figure 46. Experiment 2 Histograms of BP_1 at Time 2 (Not Banned States)

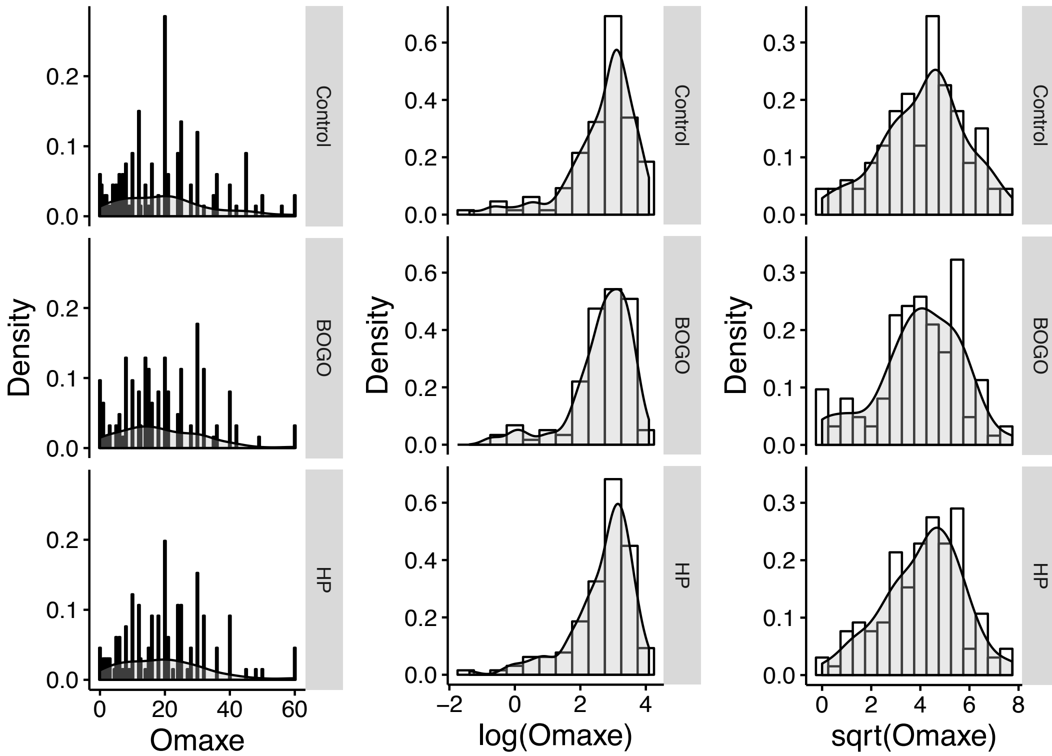


Figure 47. Experiment 2 Histograms of O_{max} at Time 1 (Not Banned States)

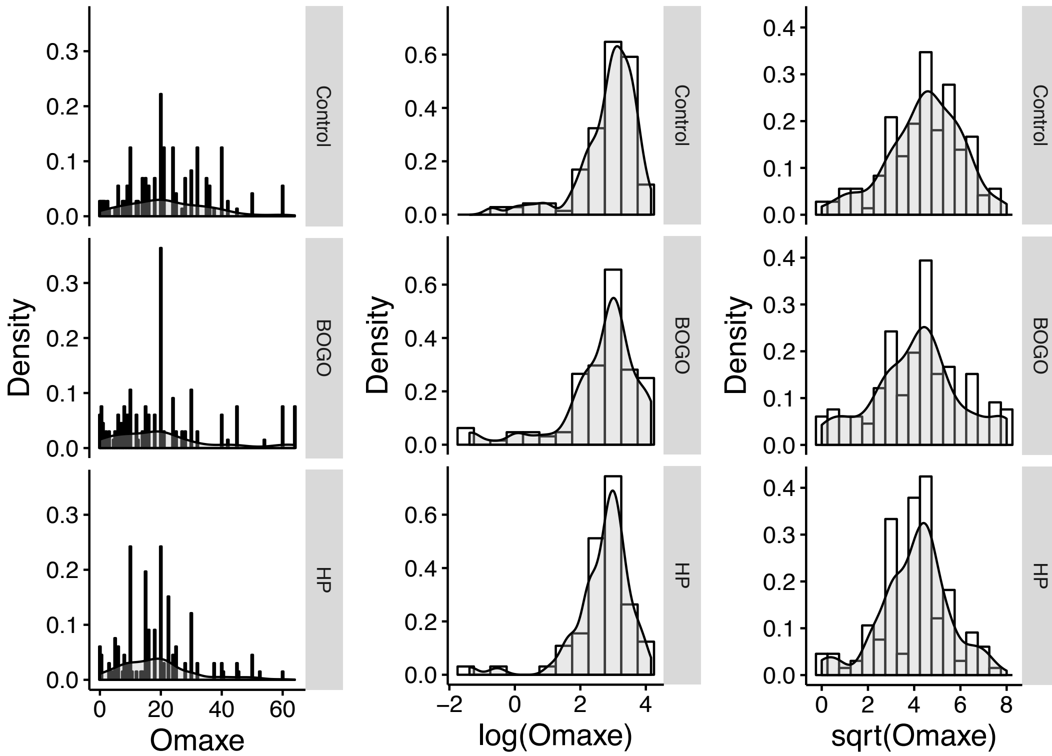


Figure 48. Experiment 2 Histograms of O_{max} at Time 2 (Not Banned States)

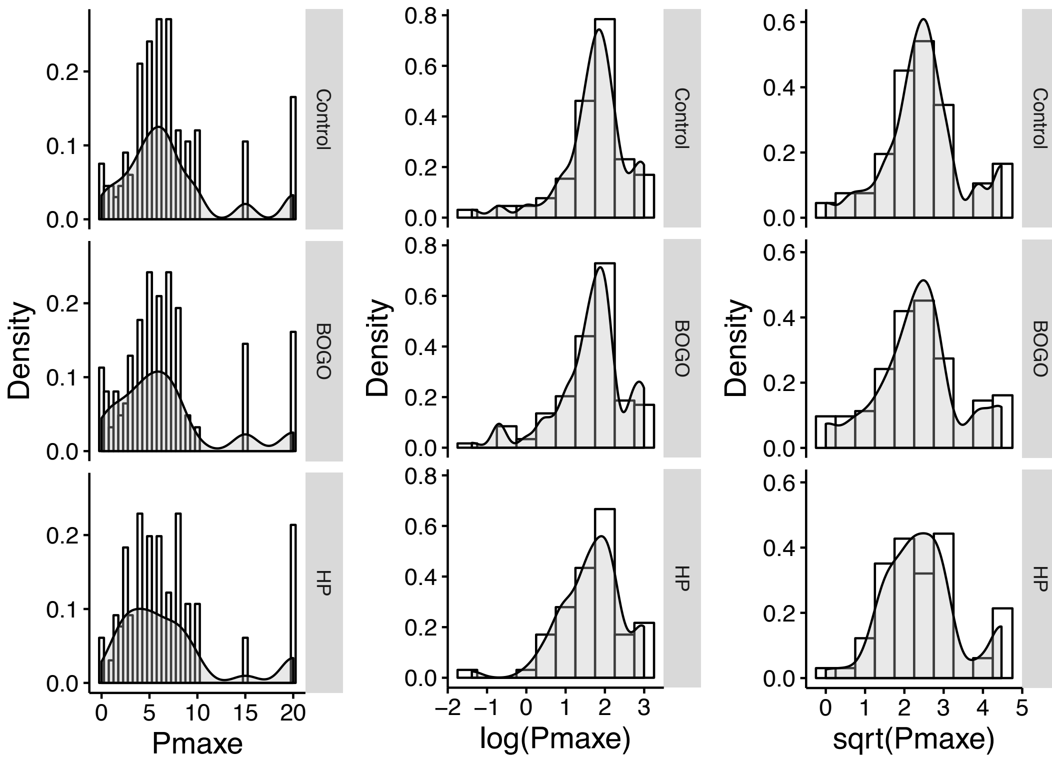


Figure 49. Experiment 2 Histograms of P_{max} at Time 1 (Not Banned States)

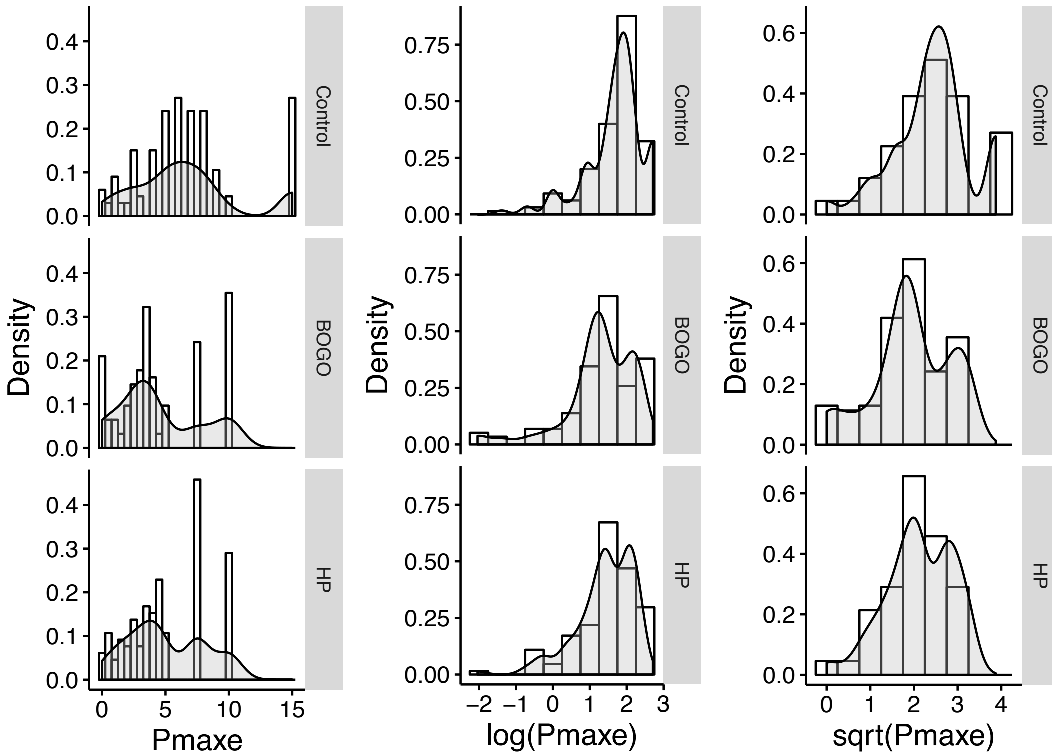


Figure 50. Experiment 2 Histograms of P_{max} at Time 2 (Not Banned States)

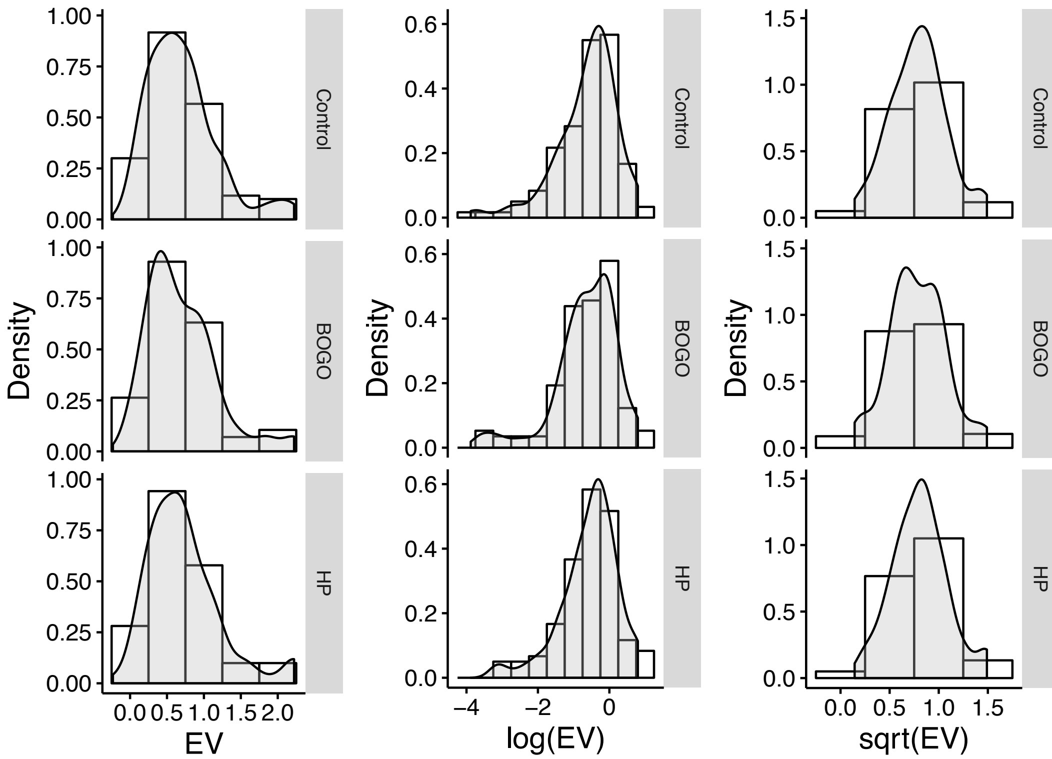


Figure 51. Experiment 2 Histograms of *EV* at Time 1 (Not Banned States)

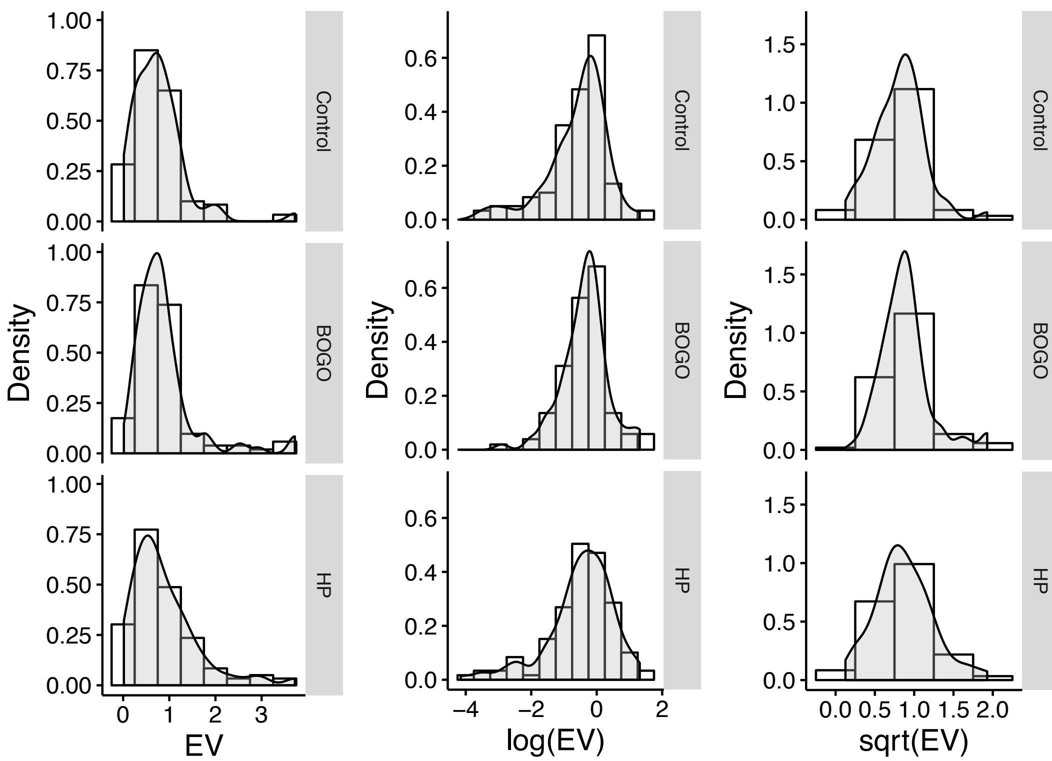


Figure 52. Experiment 2 Histograms of *EV* at Time 2 (Not Banned States)

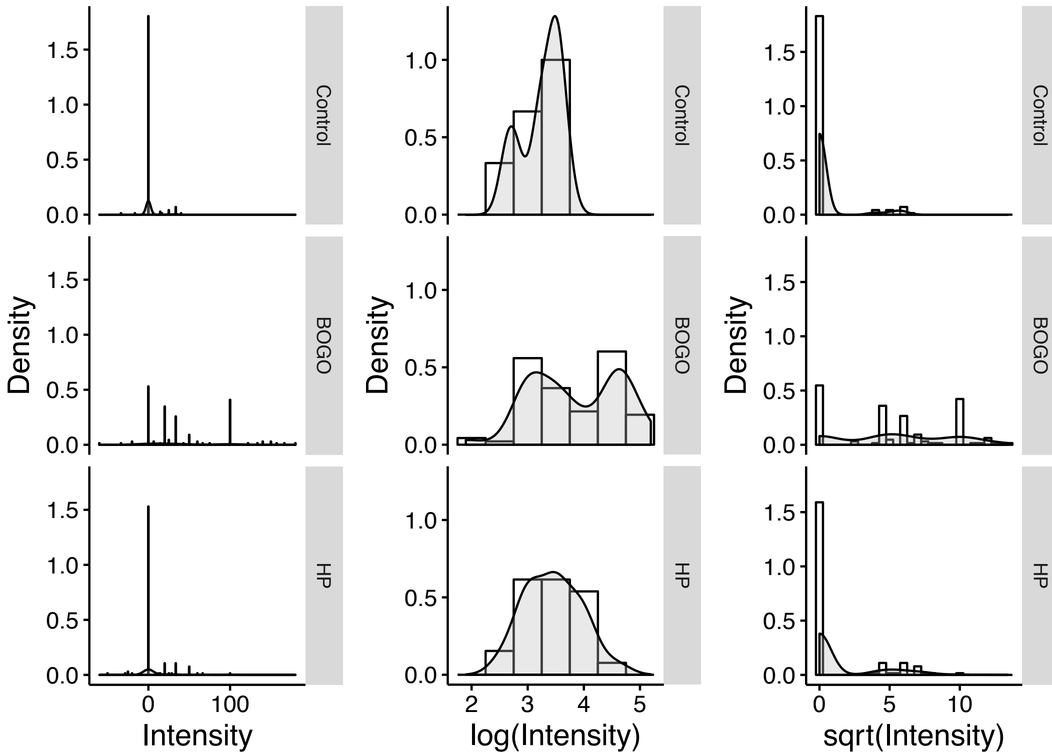


Figure 53. Experiment 2 Histograms of Percent Change in Intensity (Banned States)

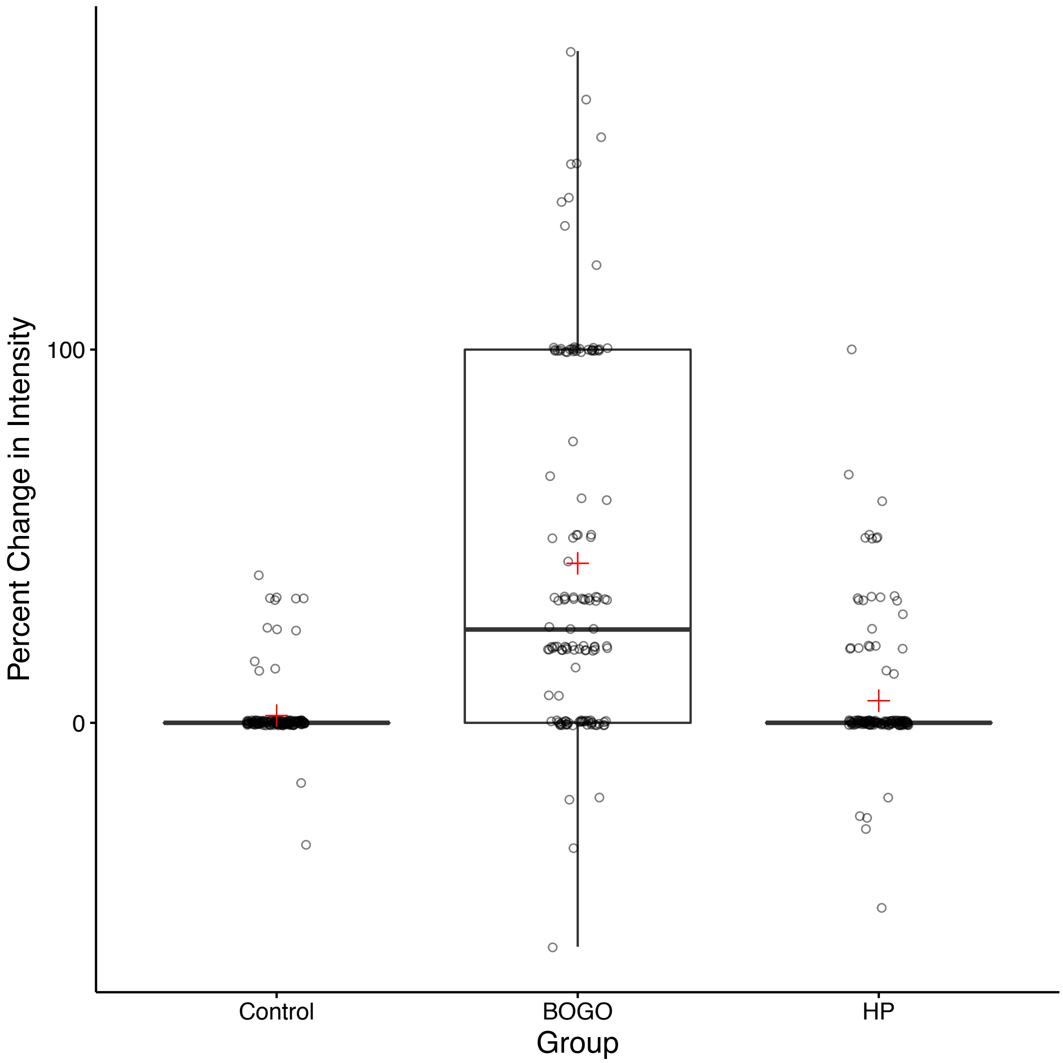


Figure 54. Experiment 2 Box Plots of Change in Intensity by Group. Red crosses indicate the mean (Banned States)

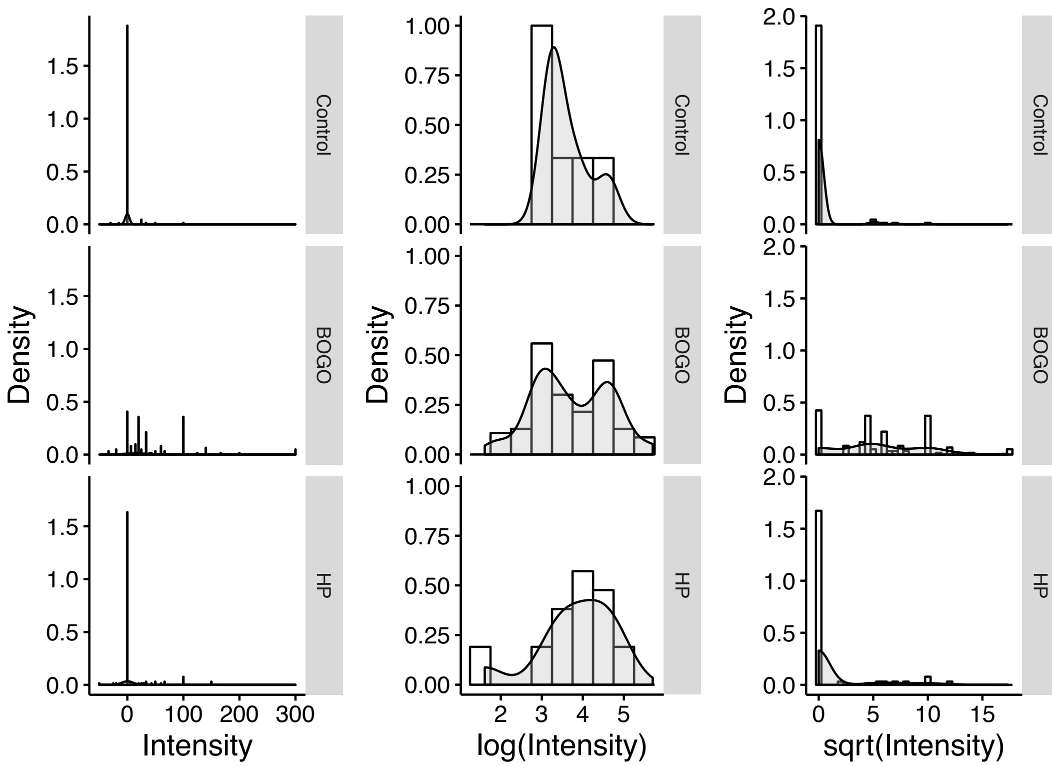


Figure 55. Experiment 2 Histograms of Percent Change in Intensity (Not Banned States)

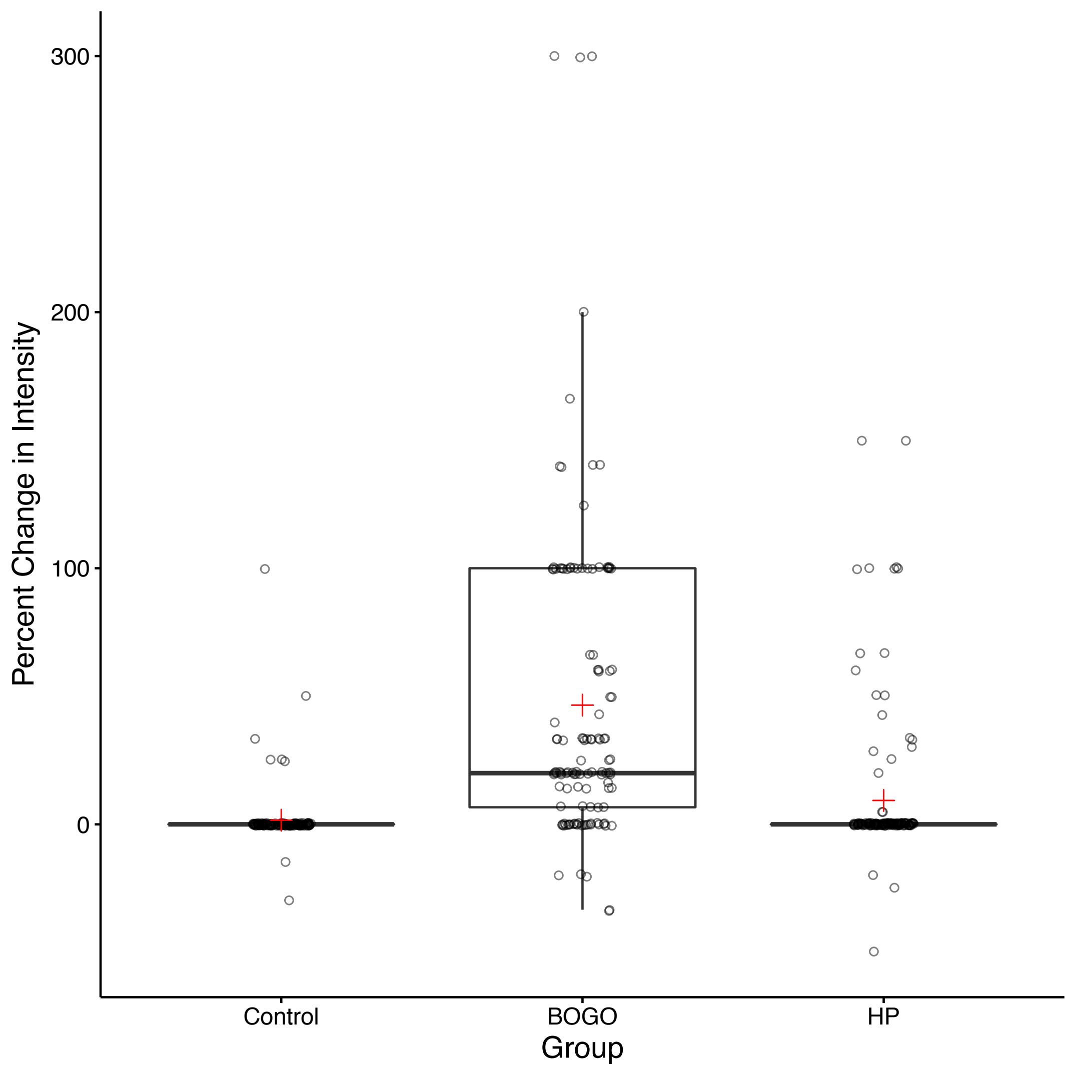


Figure 56. Experiment 2 Box Plots of Percent Change in Intensity. Red crosses indicate the mean (Not Banned States)

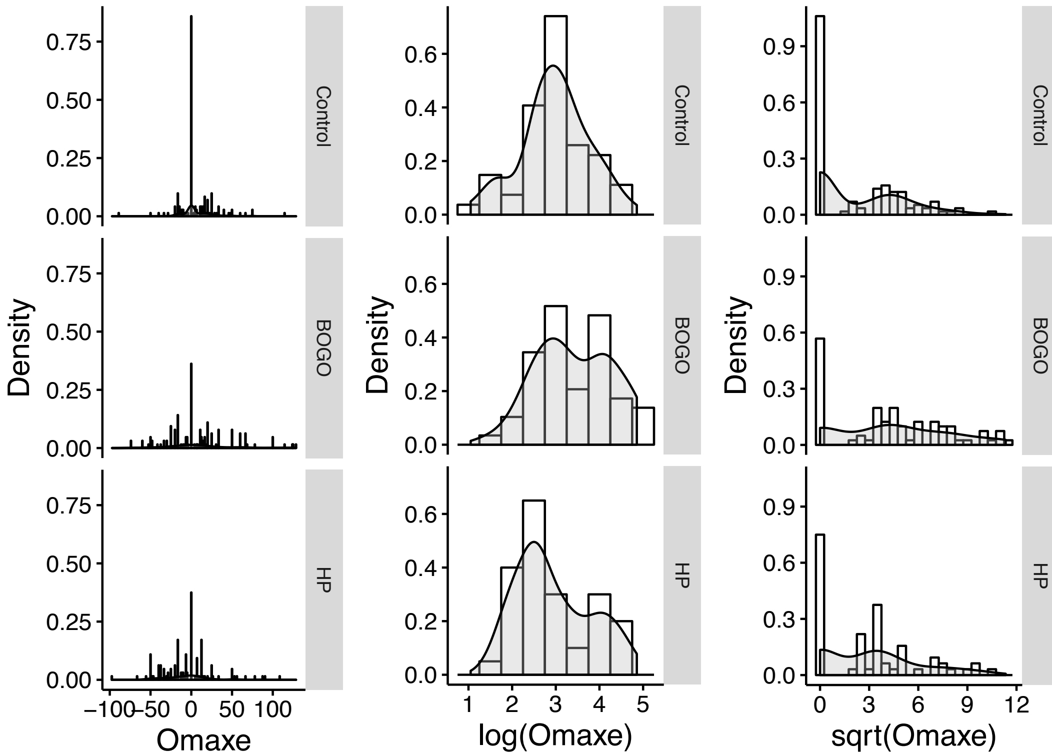


Figure 57. Experiment 2 Histograms of Percent Change in O_{max} (Banned States)

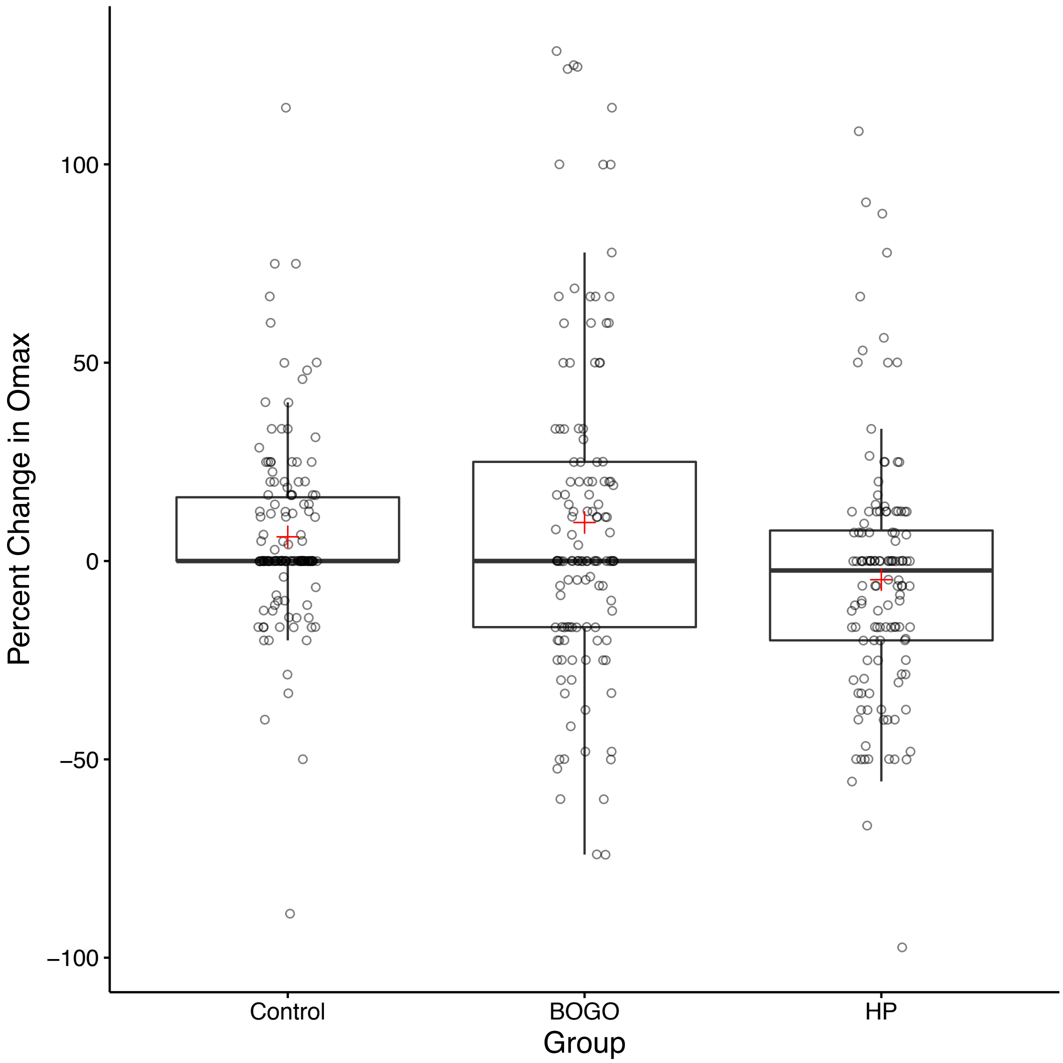


Figure 58. Experiment 2 Box Plots of Percent Change in O_{max}. Red crosses indicate the mean (Banned States)

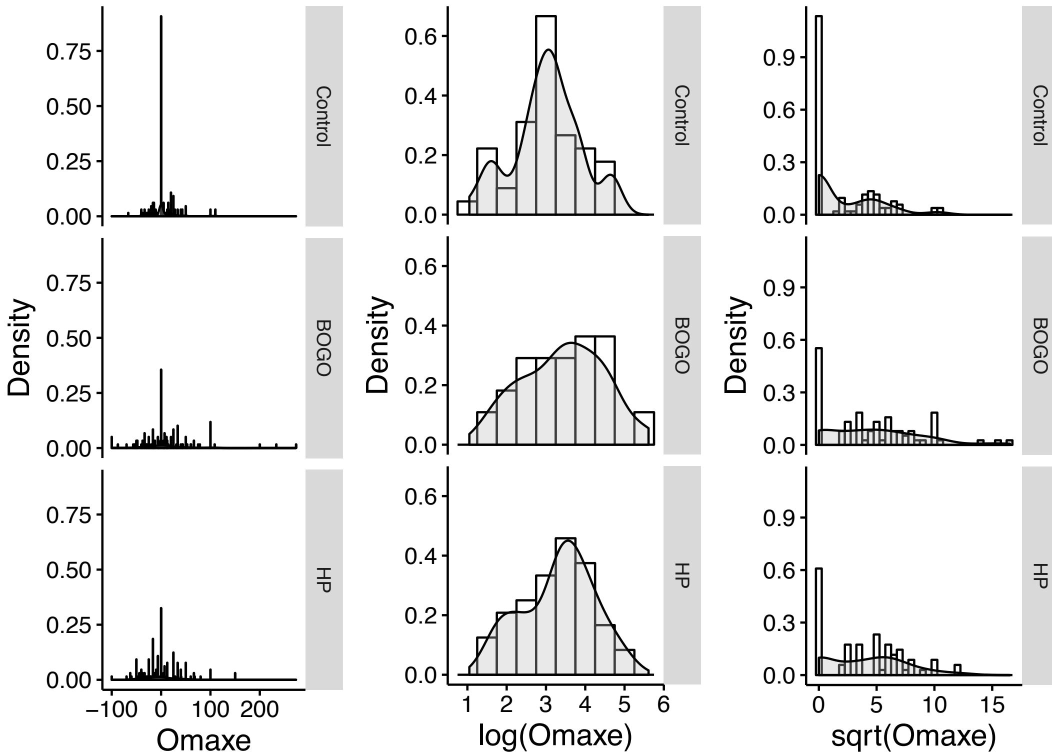


Figure 59. Experiment 2 Histograms of Percent Change in O_{max} (Not Banned States)

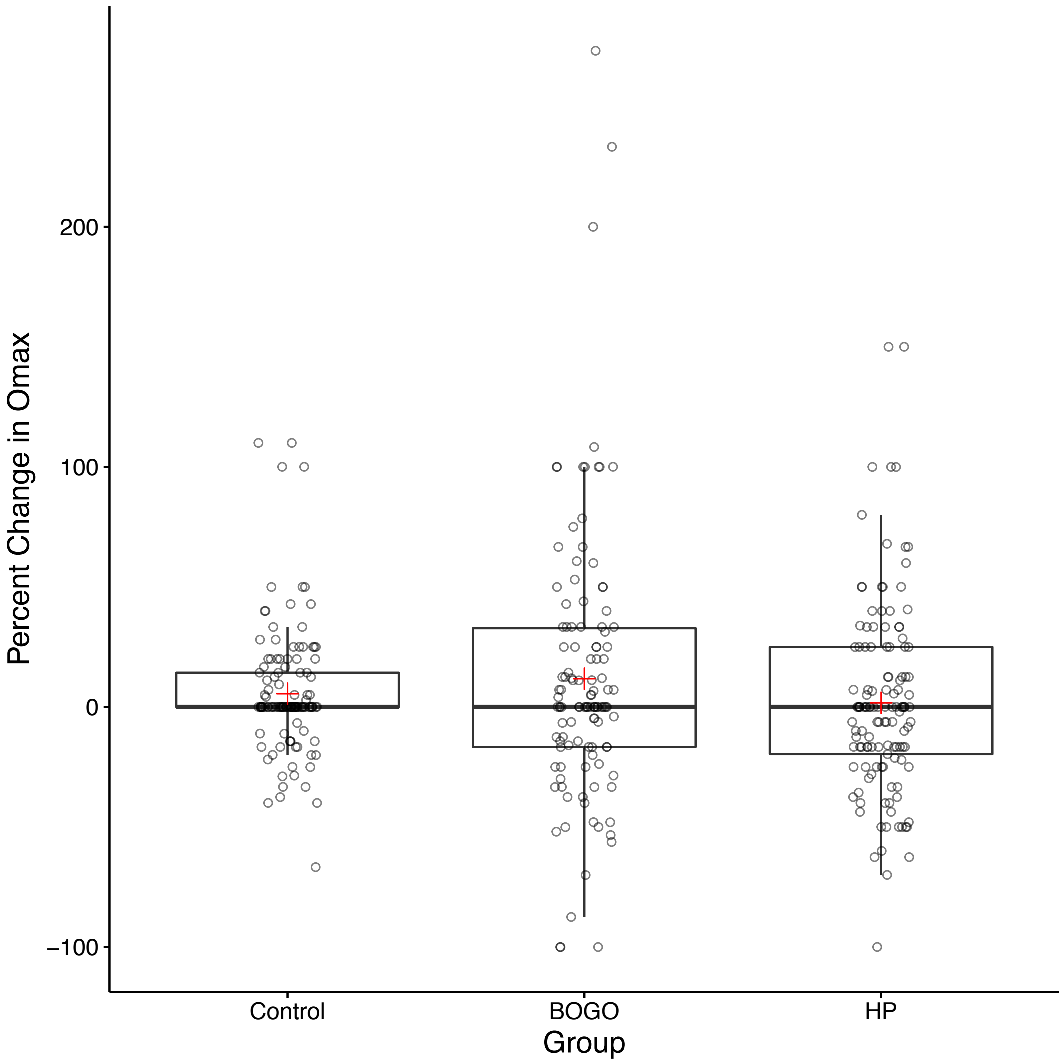


Figure 60. Experiment 2 Box Plots of Percent Change in O_{max}. Red crosses indicate the mean (Not Banned States)

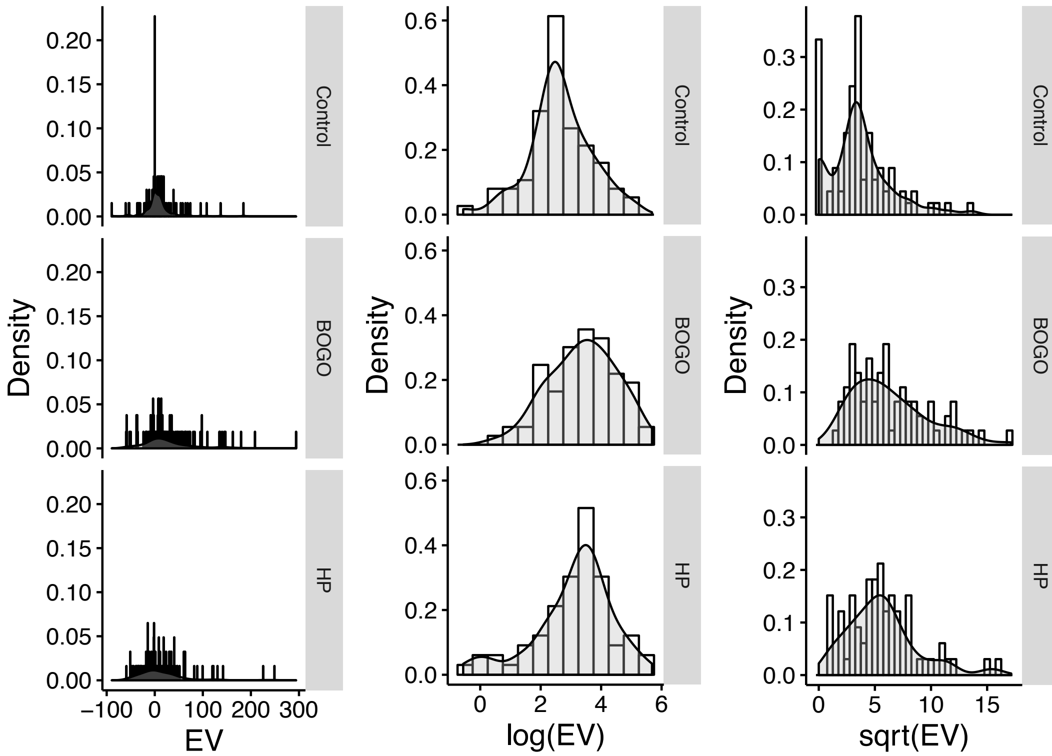


Figure 61. Experiment 2 Histograms of Percent Change in *EV* (Banned States)

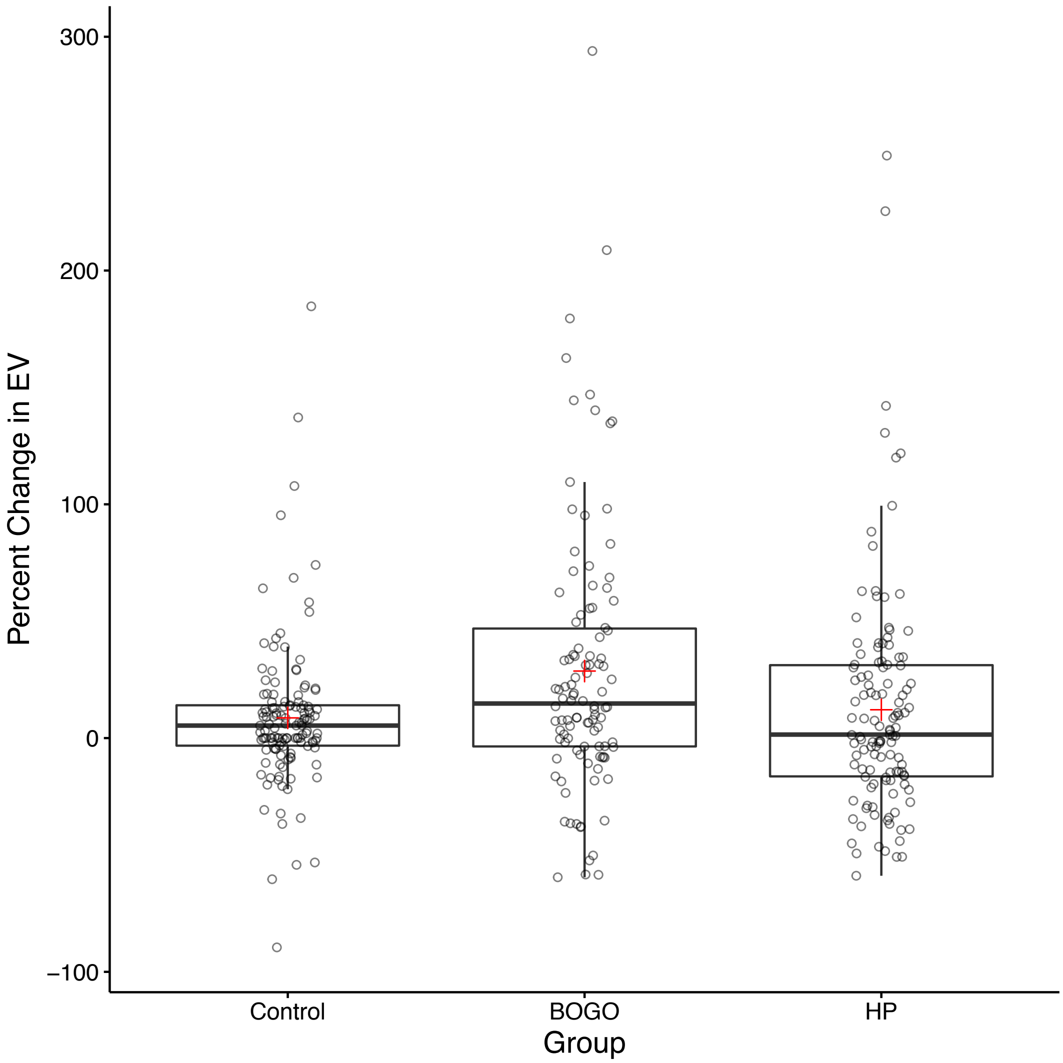


Figure 62. Experiment 2 Box Plots of Percent Change in *EV*. Red crosses indicate the mean (Banned States)

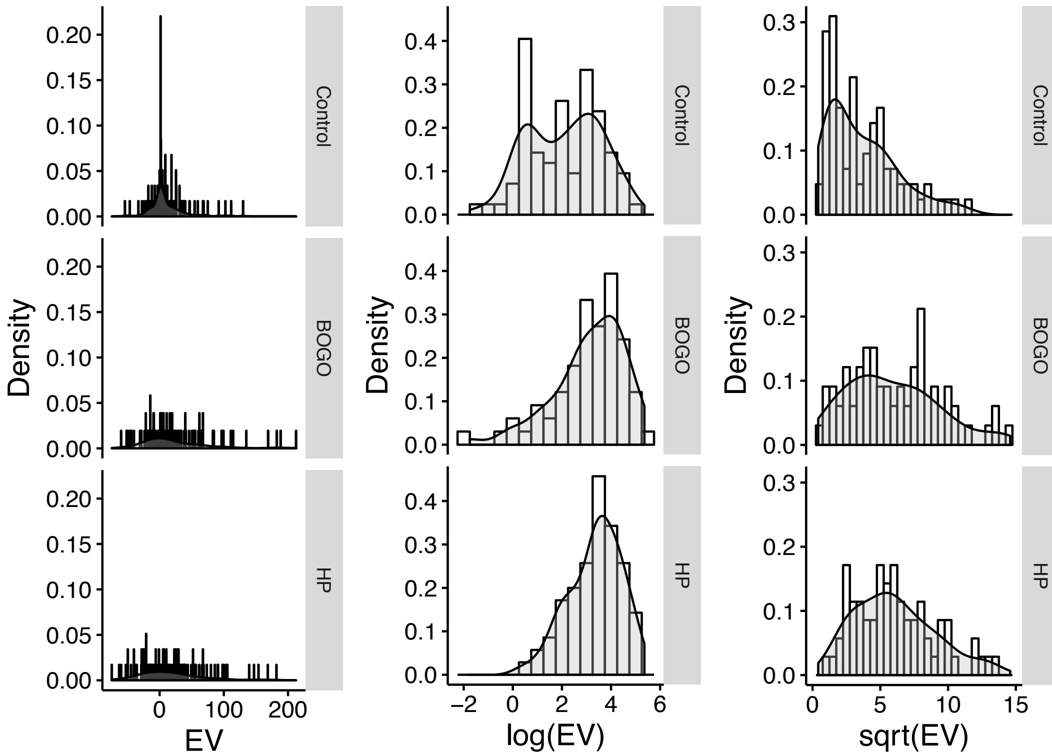


Figure 63. Experiment 2 Histograms of Percent Change in *EV* (Not Banned States)

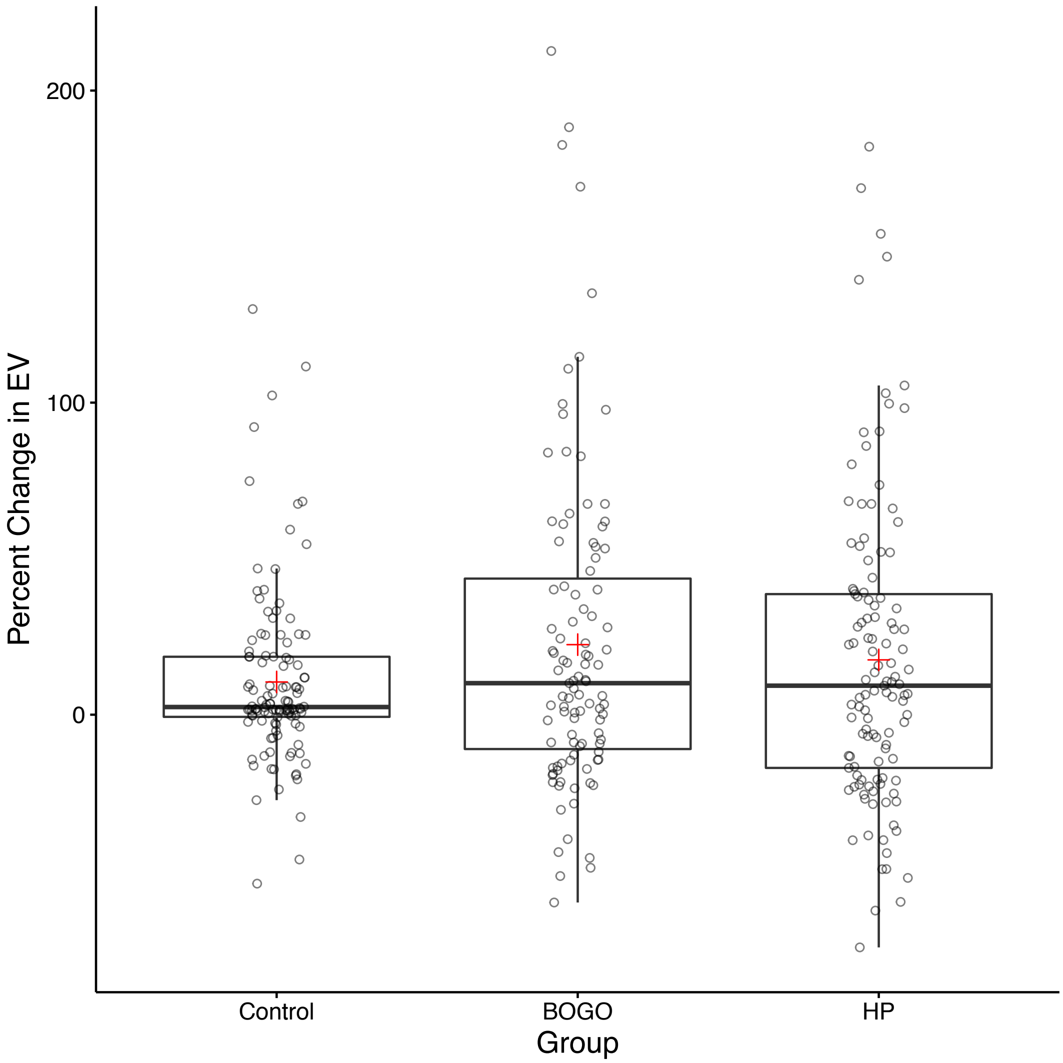


Figure 64. Experiment 2 Box Plots of Percent Change in *EV*. Red crosses indicate the mean (Not Banned States)

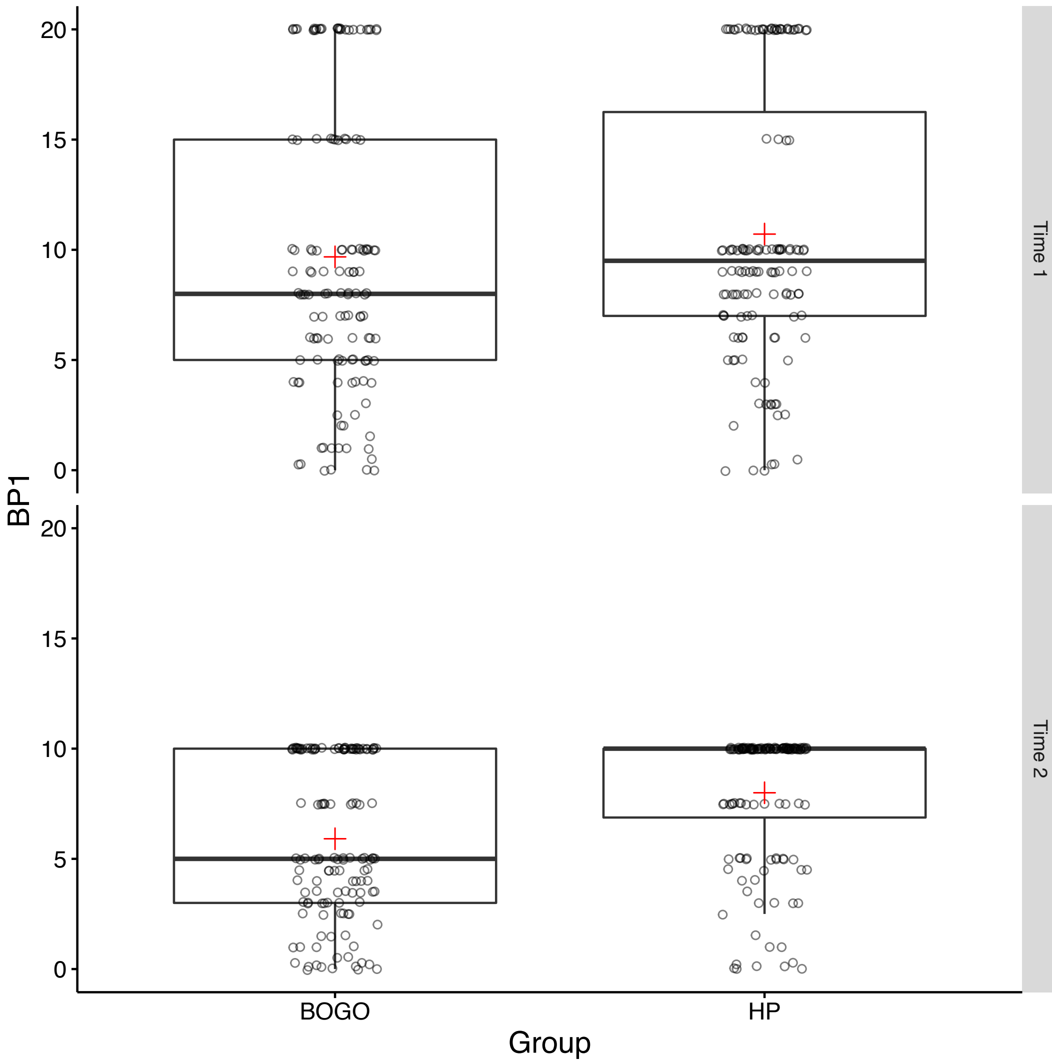


Figure 65. Experiment 2 Box Plots of BP_1 by Group and Time. Red crosses indicate the mean (Banned States)

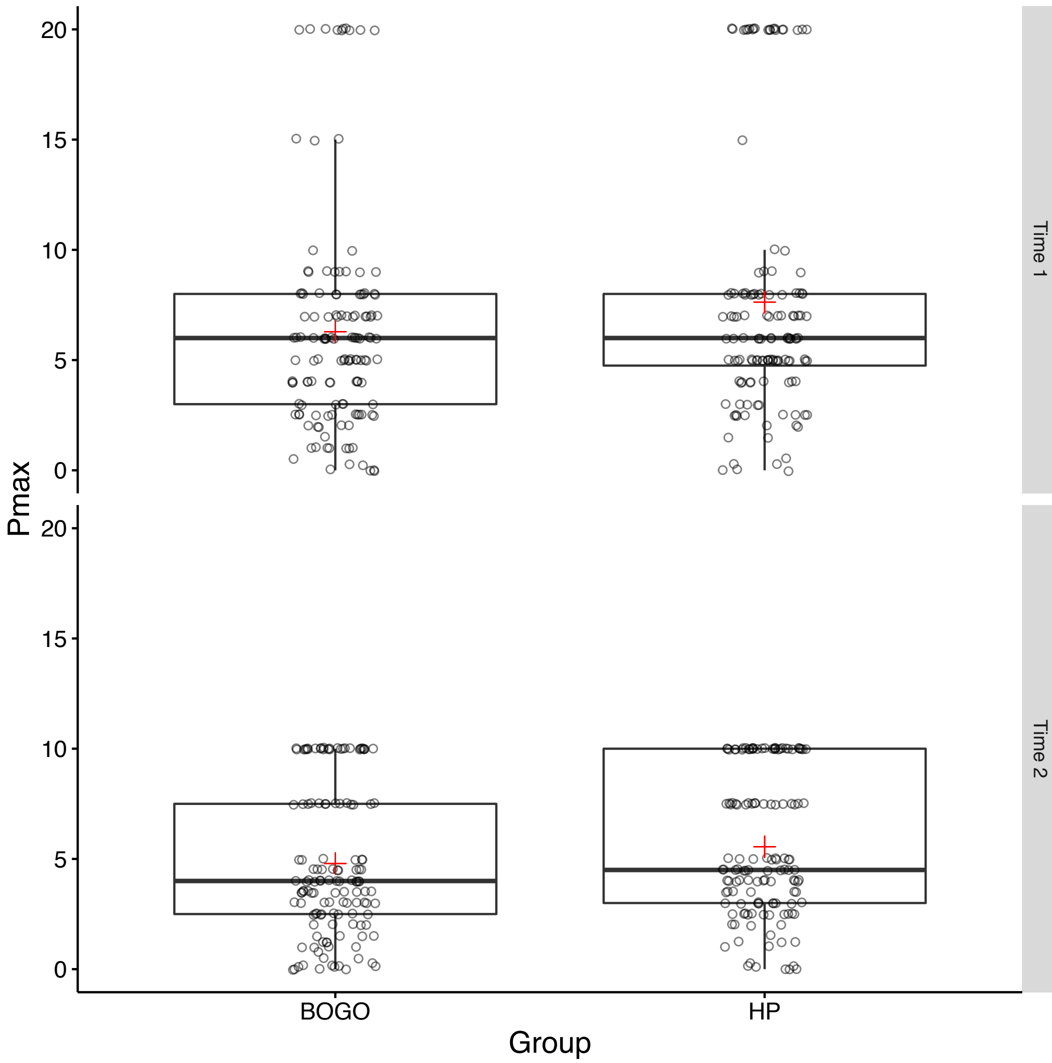


Figure 66. Experiment 2 Box Plots of P_{max} by Group and Time. Red crosses indicate the mean (Banned States)

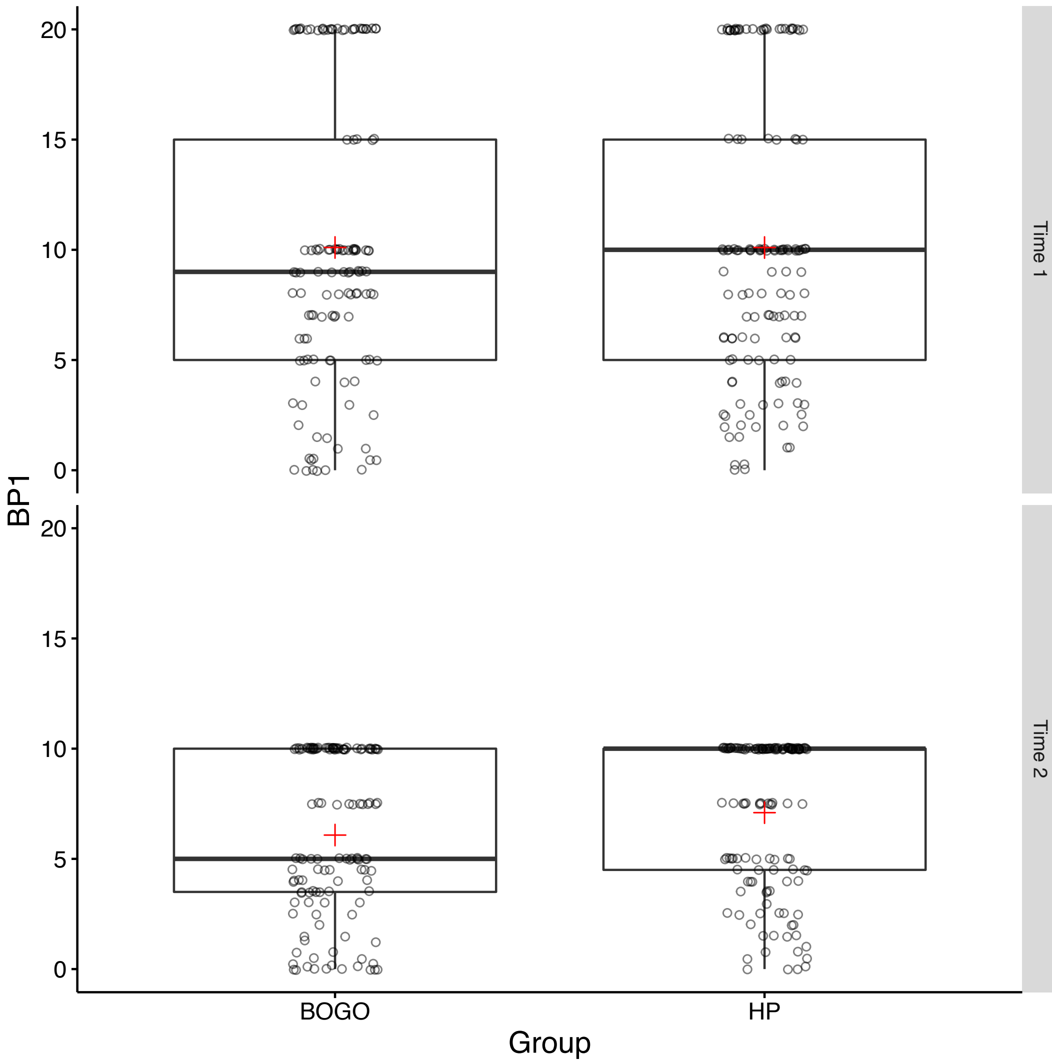


Figure 67. Experiment 2 Box Plots of BP_1 by Group and Time. Red crosses indicate the mean (Not Banned States)

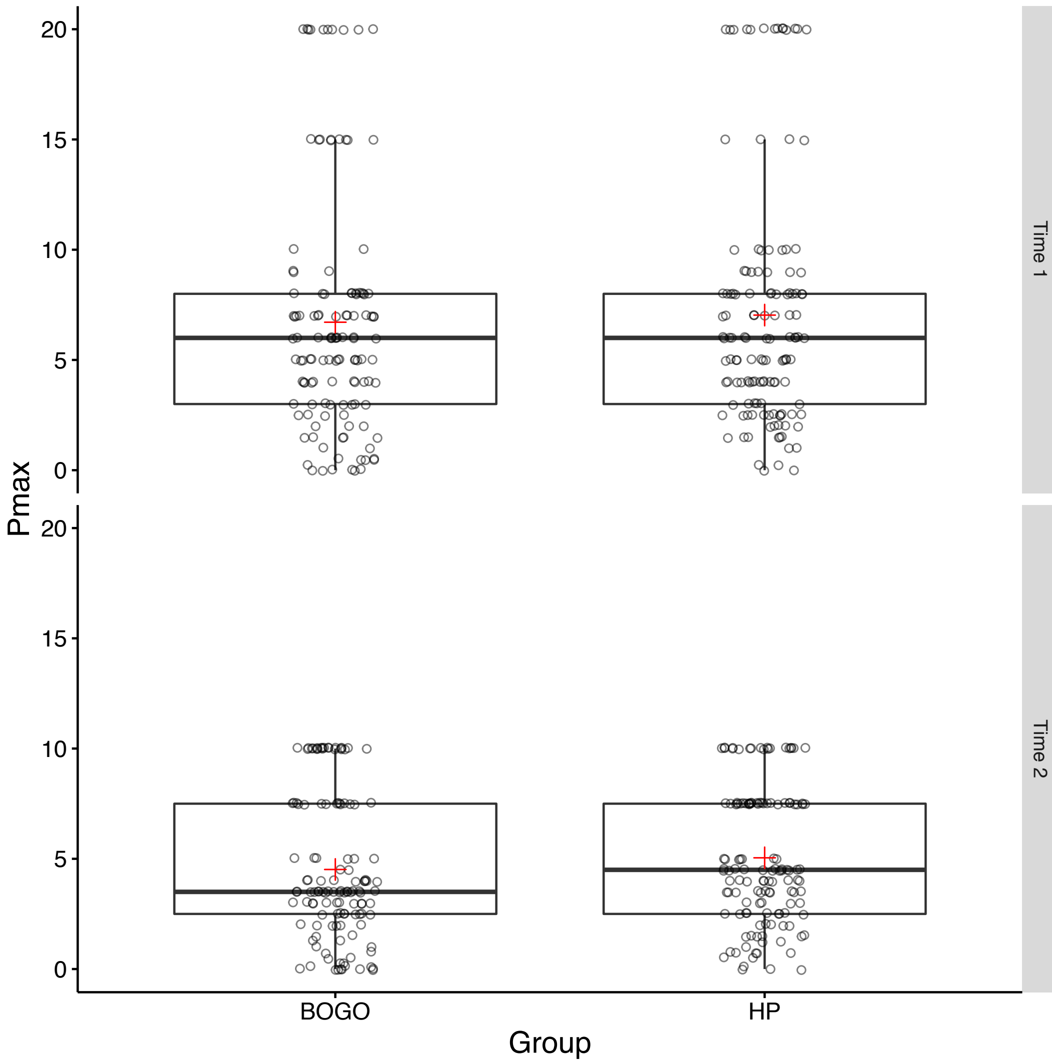


Figure 68. Experiment 2 Box Plots of P_{max} by Group and Time. Red crosses indicate the mean (Not Banned States)

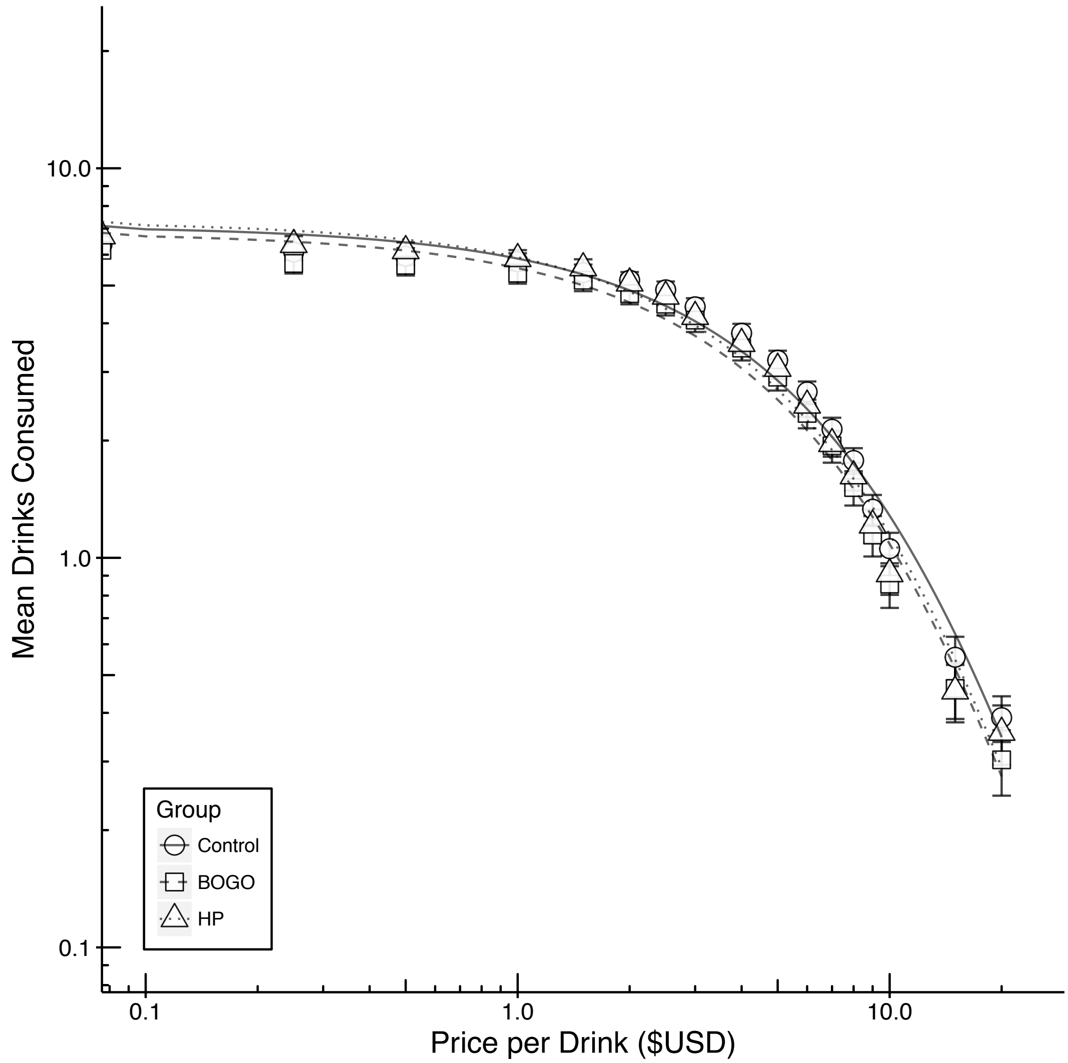


Figure 69. Experiment 2 Aggregate Demand Curves at Time 1. Best-fit lines using best-fit α from equation 6 (Banned States)

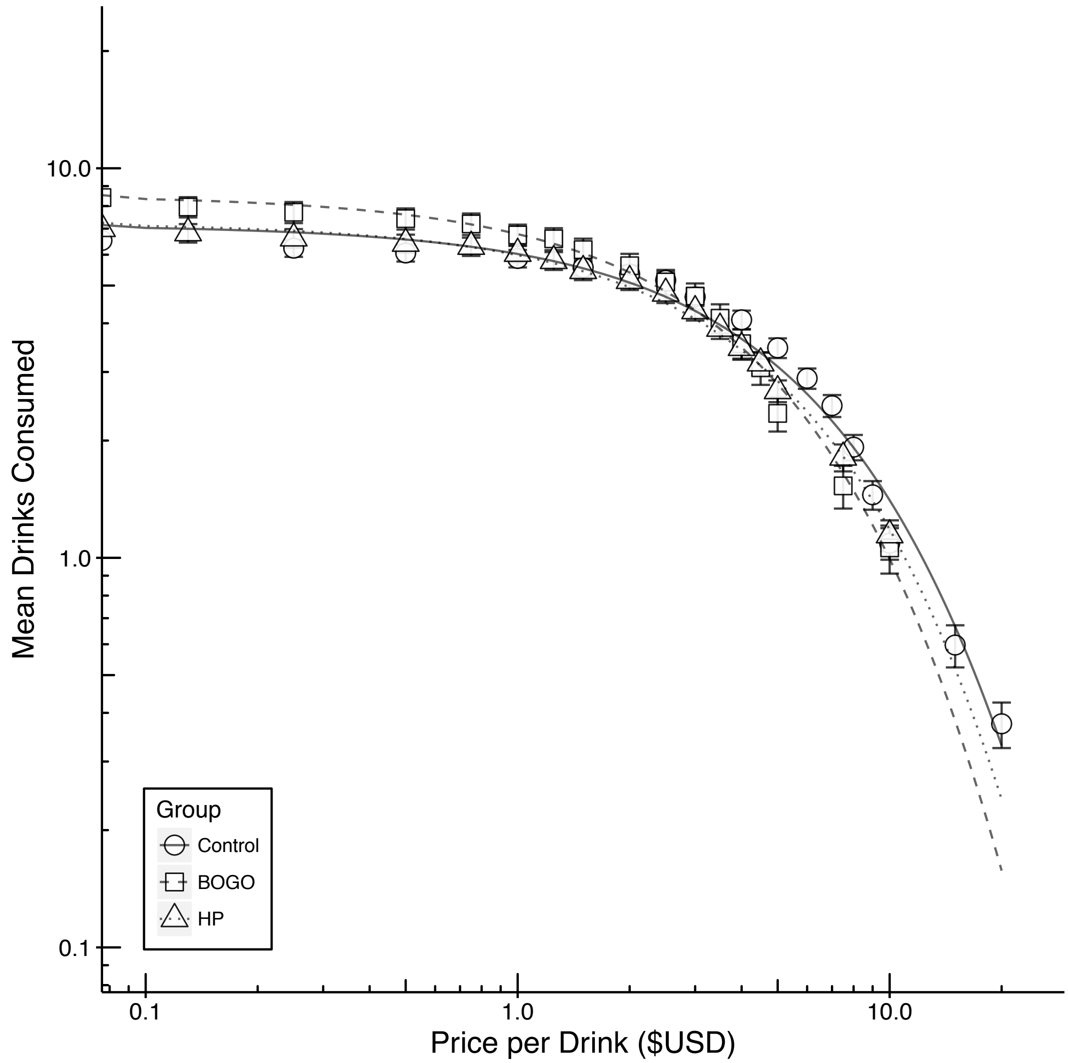


Figure 70. Experiment 2 Aggregate Demand Curves at Time 2. Best-fit lines using best-fit α from equation 6 (Banned States)

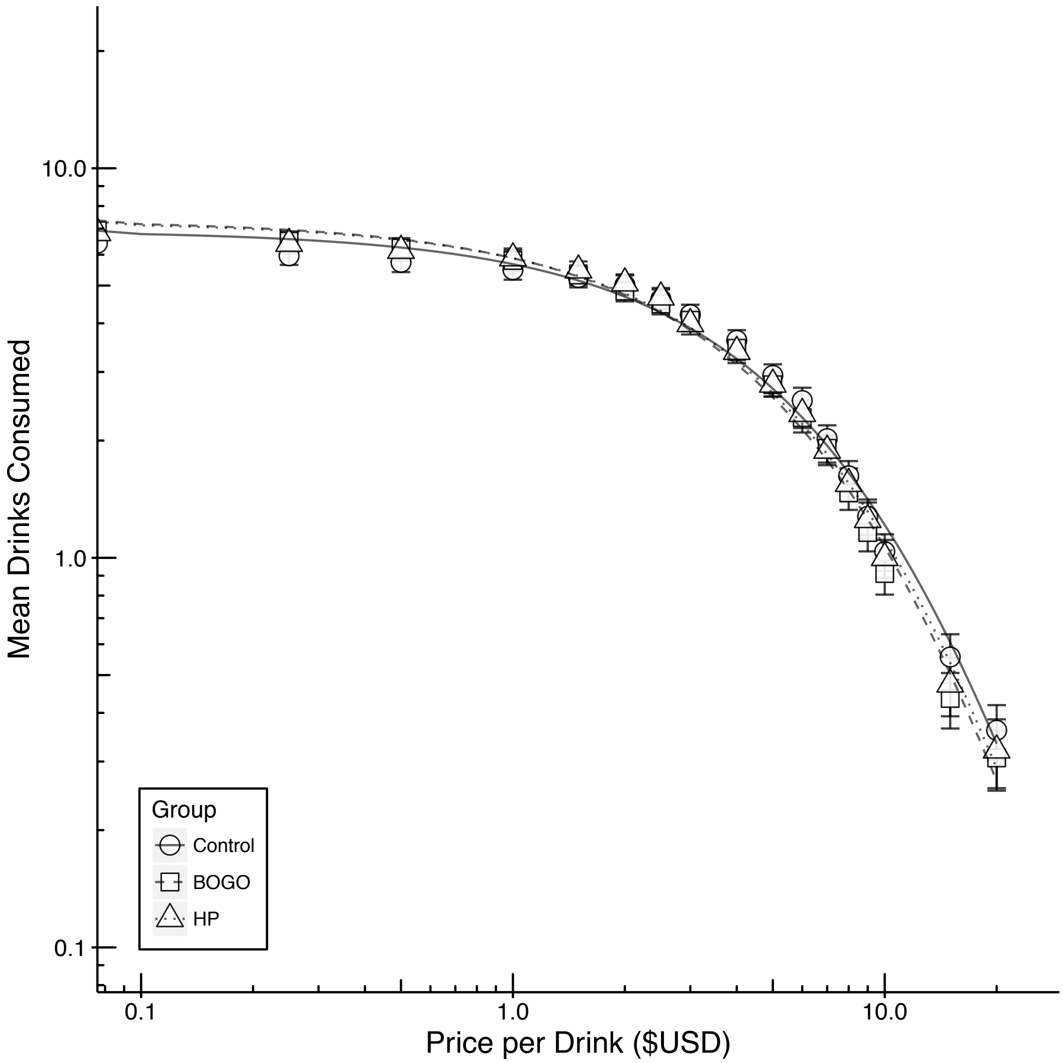


Figure 71. Experiment 2 Aggregate Demand Curves at Time 1. Best-fit lines using best-fit α from equation 6 (Not Banned States)

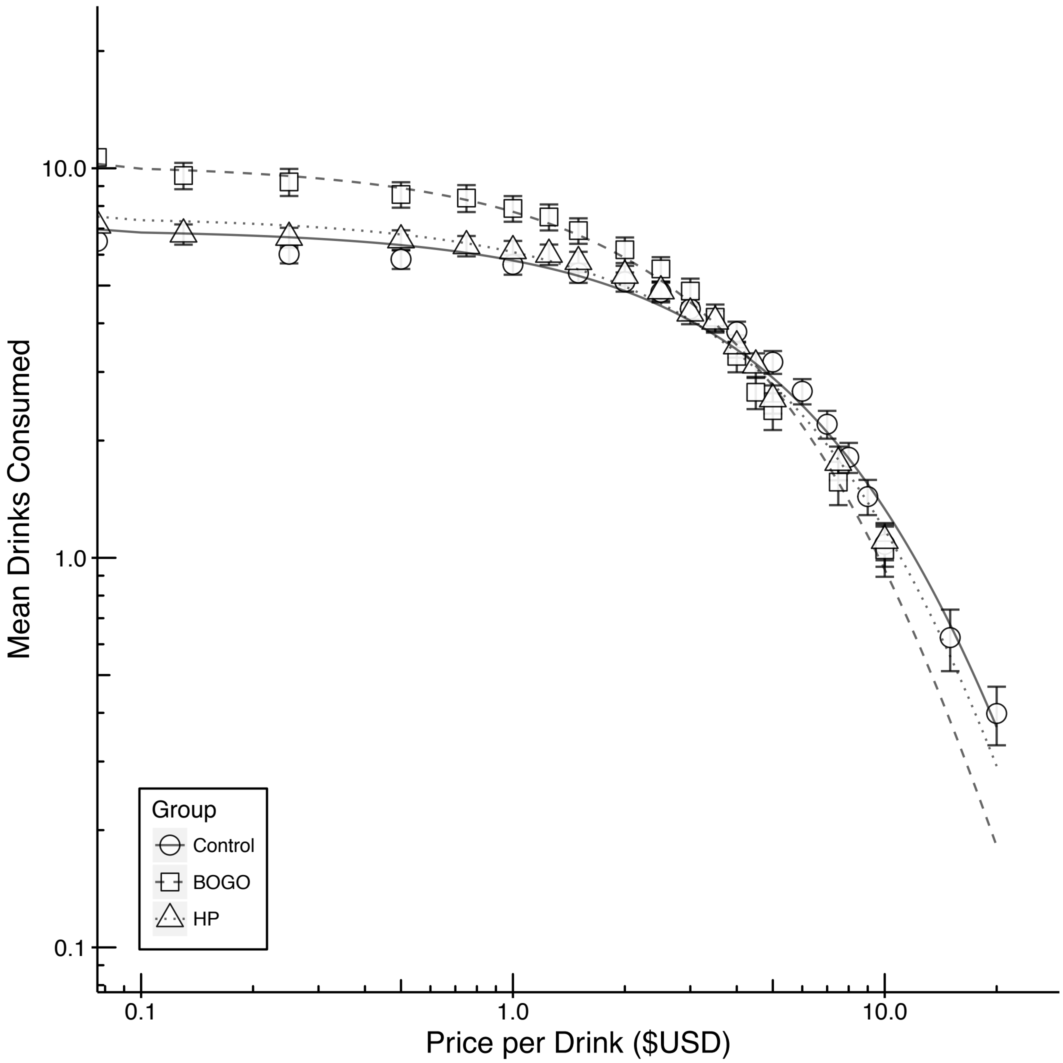


Figure 72. Experiment 2 Aggregate Demand Curves at Time 2. Best-fit lines using best-fit α from equation 6 (Not Banned States)

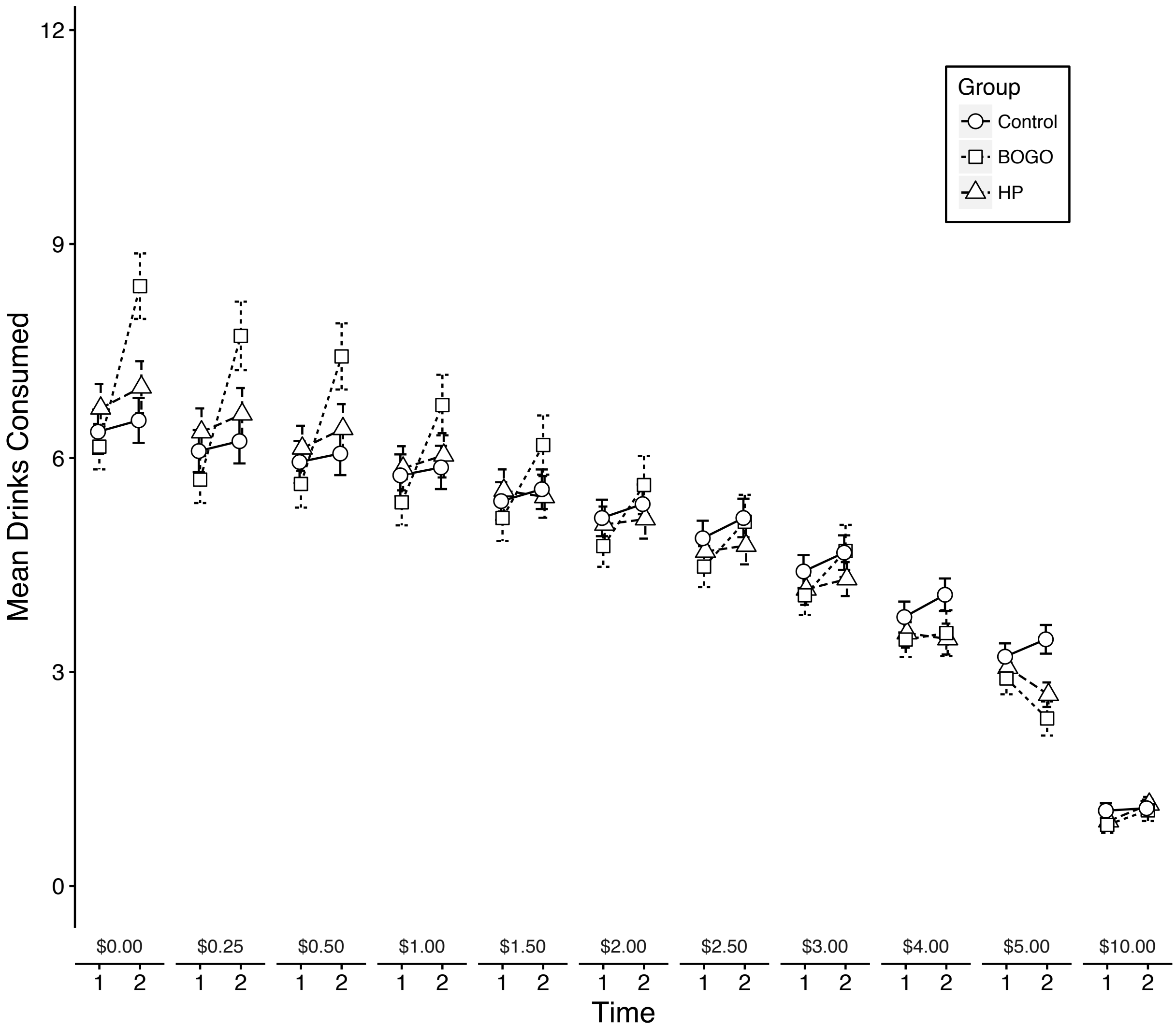


Figure 73. Experiment 2 Consumption by Group, Time, and Price (Banned States)

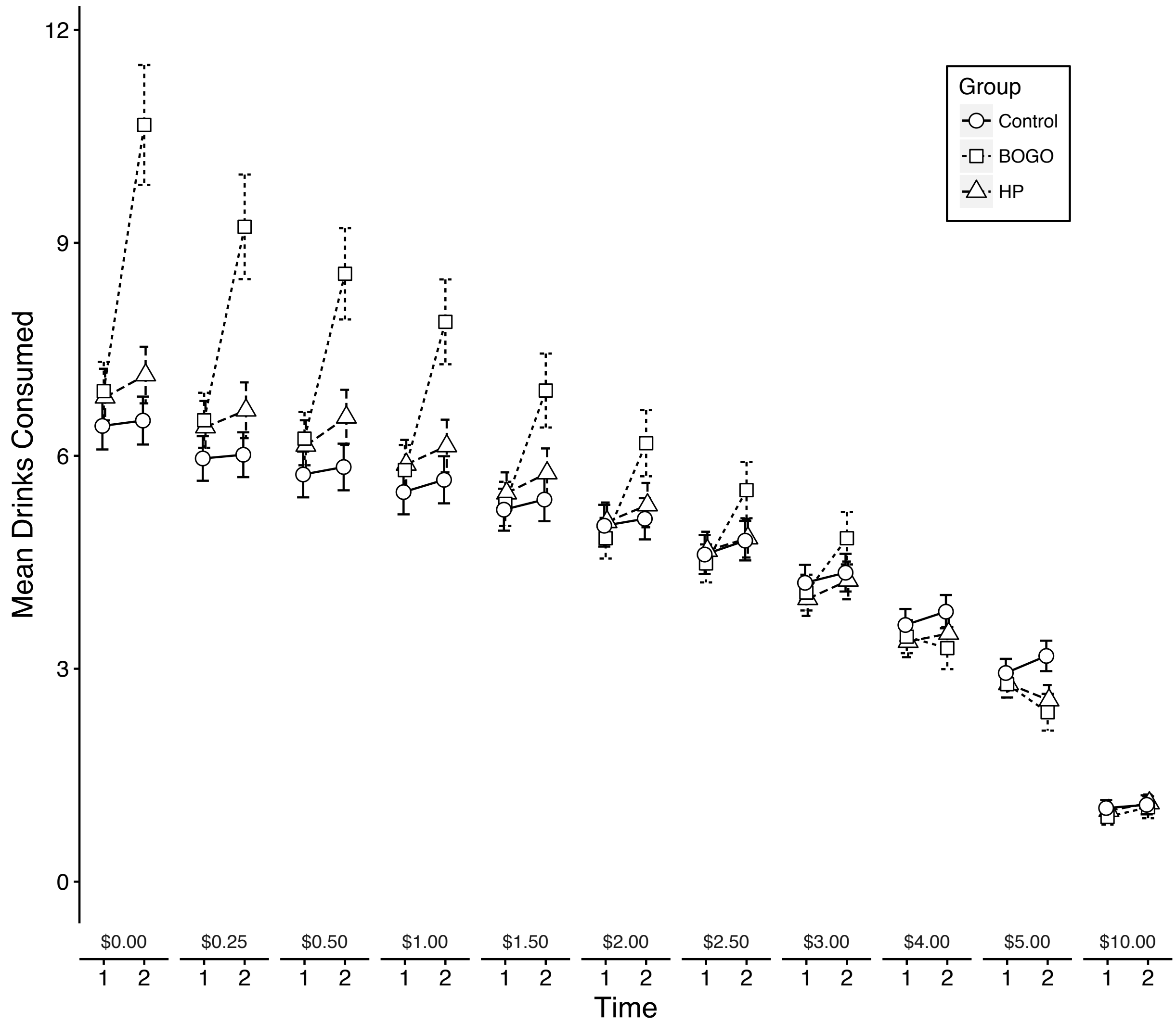
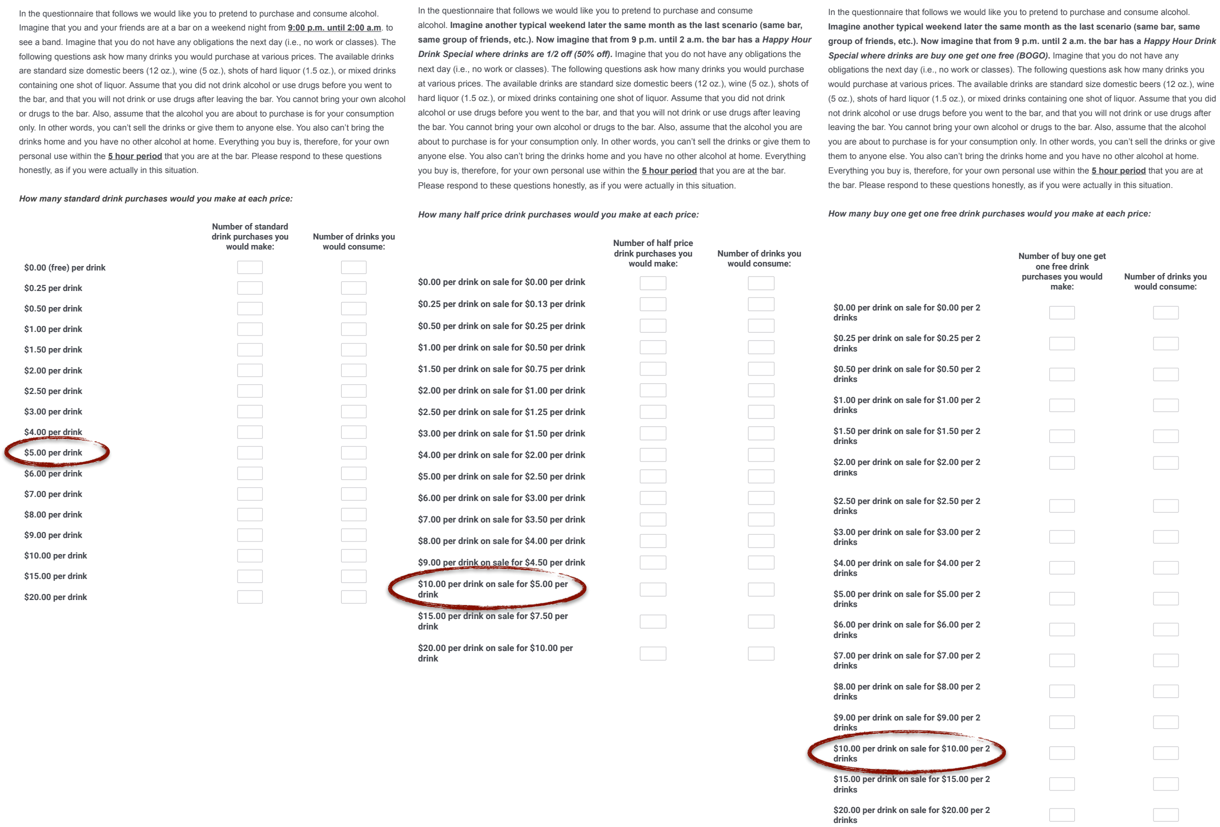


Figure 74. Experiment 2 Consumption by Group, Time, and Price (Not Banned States)



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 on a weekend night from **9:00 p.m. until 2:00 a.m**. to see a band. Imagine that you do not have any obligations the next day (i.e., no work or classes). 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 or use drugs before you went to the bar, and that you will not drink or use drugs after leaving the bar. You cannot bring your own alcohol or drugs to the bar. Also, assume that the alcohol you are about to purchase is for your consumption only. In other words, you can't sell the drinks or give them to anyone else. You also can't bring the drinks home and you have no other alcohol at home. Everything you buy is, therefore, for your own personal use within the **5 hour period** that you are at the bar. Please respond to these questions honestly, as if you were actually in this situation.

How many standard drink purchases would you make at each price:

	Number of standard drink purchases you would make:	Number of drinks you would consume:
$0.00 (free) per drink		
$0.25 per drink		
$0.50 per drink		
$1.00 per drink		
$1.50 per drink		
$2.00 per drink		
$2.50 per drink		
$3.00 per drink		
$4.00 per drink		
$5.00 per drink		
$6.00 per drink		
$7.00 per drink		
$8.00 per drink		
$9.00 per drink		
$10.00 per drink		
$15.00 per drink		
$20.00 per drink		

In the questionnaire that follows we would like you to pretend to purchase and consume alcohol. **Imagine another typical weekend later the same month as the last scenario (same bar, same group of friends, etc.). Now imagine that from 9 p.m. until 2 a.m. the bar has a *Happy Hour Drink Special where drinks are 1/2 off (50% off).*** Imagine that you do not have any obligations the next day (i.e., no work or classes). 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 or use drugs before you went to the bar, and that you will not drink or use drugs after leaving the bar. You cannot bring your own alcohol or drugs to the bar. Also, assume that the alcohol you are about to purchase is for your consumption only. In other words, you can't sell the drinks or give them to anyone else. You also can't bring the drinks home and you have no other alcohol at home. Everything you buy is, therefore, for your own personal use within the **5 hour period** that you are at the bar. Please respond to these questions honestly, as if you were actually in this situation.

How many half price drink purchases would you make at each price:

	Number of half price drink purchases you would make:	Number of drinks you would consume:
$0.00 per drink on sale for $0.00 per drink		
$0.25 per drink on sale for $0.13 per drink		
$0.50 per drink on sale for $0.25 per drink		
$1.00 per drink on sale for $0.50 per drink		
$1.50 per drink on sale for $0.75 per drink		
$2.00 per drink on sale for $1.00 per drink		
$2.50 per drink on sale for $1.25 per drink		
$3.00 per drink on sale for $1.50 per drink		
$4.00 per drink on sale for $2.00 per drink		
$5.00 per drink on sale for $2.50 per drink		
$6.00 per drink on sale for $3.00 per drink		
$7.00 per drink on sale for $3.50 per drink		
$8.00 per drink on sale for $4.00 per drink		
$9.00 per drink on sale for $4.50 per drink		
$10.00 per drink on sale for $5.00 per drink		
$15.00 per drink on sale for $7.50 per drink		
$20.00 per drink on sale for $10.00 per drink		

In the questionnaire that follows we would like you to pretend to purchase and consume alcohol. **Imagine another typical weekend later the same month as the last scenario (same bar, same group of friends, etc.). Now imagine that from 9 p.m. until 2 a.m. the bar has a *Happy Hour Drink Special where drinks are buy one get one free (BOGO).*** Imagine that you do not have any obligations the next day (i.e., no work or classes). 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 or use drugs before you went to the bar, and that you will not drink or use drugs after leaving the bar. You cannot bring your own alcohol or drugs to the bar. Also, assume that the alcohol you are about to purchase is for your consumption only. In other words, you can't sell the drinks or give them to anyone else. You also can't bring the drinks home and you have no other alcohol at home. Everything you buy is, therefore, for your own personal use within the **5 hour period** that you are at the bar. Please respond to these questions honestly, as if you were actually in this situation.

How many buy one get one free drink purchases would you make at each price:

	Number of buy one get one free drink purchases you would make:	Number of drinks you would consume:
$0.00 per drink on sale for $0.00 per 2 drinks		
$0.25 per drink on sale for $0.25 per 2 drinks		
$0.50 per drink on sale for $0.50 per 2 drinks		
$1.00 per drink on sale for $1.00 per 2 drinks		
$1.50 per drink on sale for $1.50 per 2 drinks		
$2.00 per drink on sale for $2.00 per 2 drinks		
$2.50 per drink on sale for $2.50 per 2 drinks		
$3.00 per drink on sale for $3.00 per 2 drinks		
$4.00 per drink on sale for $4.00 per 2 drinks		
$5.00 per drink on sale for $5.00 per 2 drinks		
$6.00 per drink on sale for $6.00 per 2 drinks		
$7.00 per drink on sale for $7.00 per 2 drinks		
$8.00 per drink on sale for $8.00 per 2 drinks		
$9.00 per drink on sale for $9.00 per 2 drinks		
$10.00 per drink on sale for $10.00 per 2 drinks		
$15.00 per drink on sale for $15.00 per 2 drinks		
$20.00 per drink on sale for $20.00 per 2 drinks		

Figure 75. Control, HP, and BOGO APTs.

Appendix A

Demographics Form

Question	Answers
What is your primary language (i.e., the one you speak most of the time)?	• English • Spanish • Dutch • Japanese • Chinese • Hebrew • French • Swedish • German • Other (specify): ____________
With which gender do you most identify?	• Female • Male • Other (specify): ____________ • Would rather not say
What was your total income during the PAST 12 MONTHS? This includes wages, salary, tips etc.; self-employment income; interest, dividends, net rental income, royalty income etc.; social security or railroad retirement; supplemental security income; public assistance or welfare payments; retirement, survivor or disability pensions; and other sources.If you are currently part of a dual income or shared income household (for example, married), please enter your total combined income during the past 12 months.	• Rather not say • Under $10,000 • $10,000 - $19,999 • $20,000 - $29,999 • $30,000 - $39,999 • $40,000 - $49,999 • $50,000 - $74,999 • $75,000 - $99,999 • $100,000 - $150,000 • Over $150,000 • Would rather not say
How many dependents are you financially obligated to support (e.g., children)?	• ____________ dependents
What is your current age?	• ____________ years old

Question	Answers
What is the highest level of education you have completed?	• Less than High School • High School/GED • Some College • 2-Year College Degree (Associates) • 4-Year College Degree (BA, BS) • Master's Degree • Professional Degree (MD, JD, DDS, DVM, PsyD) • Doctorate (PhD, DSc, EdD, DFA)
What is your primary race or ancestry?	• White/Caucasian • African American • Hispanic • Asian • Native American • Pacific Islander • Other (specify): ____________ • Would rather not say
What is your current height?	• __________ feet __________ inches
What is your current weight?	• __________ pounds
What is your current employment status?	• Employed • Unemployed • Retired

Question	Answers
What is your primary profession or field of study? If you are working in a profession, then select the field or industry most relevant to your job description. If you are studying at a college, university, or trade school as your primary occupation, then select "Student." If you are unemployed or retired, then select the field closest to your background/major/concentration.	• Biology • Business/Marketing/Accounting • Chemistry • Communications/Media • Computer Science/Technology • Culinary Arts • Education • Engineering • English Language and Literature • First Responder (police, fire, EMT) • Food Service • Foreign Language/Linguistics • Health Sciences/Medicine/Nursing • History • Hospitality/Tourism • Law • Mathematics/Statistics • Military/Armed Forces • Philosophy/Religion • Physics • Political Science/Government • Psychology - Research • Psychology - Clinical • Retail • Skilled Trade (construction, plumbing, artisan, etc.) • Sociology • Student
What is your smoking status?	• Current smoker (if yes, _________ cigarettes per day) • Previous smoker • Never smoker • I don't smoke but use another form of tobacco (if yes, specify: _______________)

Appendix B

27-item Monetary Choice Questionnaire

Monetary Choice Questionnaire

For each of the next 27 choices, please indicate which reward you would prefer: the smaller reward today, or the larger reward in the specified number of days.

Please take the choices seriously: they are for REAL MONEY. At the end of the session one of the 27 questions will be selected at random and you will get the reward that you chose on that question. If you choose the smaller reward, you will get paid before you leave today. If you choose the delayed reward, you will get paid in the specified number of days and not before. So to make sure that you get a reward you prefer, you should answer every question as though it were the one you will win.

Which would you prefer?	$54 today	$55 in 117 days
Which would you prefer?	$55 today	$75 in 61 days
Which would you prefer?	$19 today	$25 in 53 days
Which would you prefer?	$31 today	$85 in 7 days
Which would you prefer?	$14 today	$25 in 19 days
Which would you prefer?	$47 today	$50 in 160 days
Which would you prefer?	$15 today	$35 in 13 days
Which would you prefer?	$25 today	$60 in 14 days
Which would you prefer?	$78 today	$80 in 162 days
Which would you prefer?	$40 today	$55 in 62 days
Which would you prefer?	$11 today	$30 in 7 days
Which would you prefer?	$67 today	$75 in 119 days
Which would you prefer?	$34 today	$35 in 186 days
Which would you prefer?	$27 today	$50 in 21 days
Which would you prefer?	$69 today	$85 in 91 days
Which would you prefer?	$49 today	$60 in 89 days
Which would you prefer?	$80 today	$85 in 157 days
Which would you prefer?	$24 today	$35 in 29 days
Which would you prefer?	$33 today	$80 in 14 days
Which would you prefer?	$28 today	$30 in 179 days
Which would you prefer?	$34 today	$50 in 30 days
Which would you prefer?	$25 today	$30 in 80 days
Which would you prefer?	$41 today	$75 in 20 days
Which would you prefer?	$54 today	$60 in 111 days
Which would you prefer?	$54 today	$80 in 30 days
Which would you prefer?	$22 today	$25 in 136 days
Which would you prefer?	$20 today	$55 in 7 days

Appendix C

Daily Drinking Questionnaire

Daily Drinking Questionnaire

How many times in the past month have you drank 4/5* or more drinks in a single occasion?

*4 drinks for females; 5 drinks for males

IN THE CALENDAR BELOW, PLEASE FILL-IN YOUR DRINKING RATE AND TIME DRINKING DURING A **TYPICAL WEEK** IN THE LAST **30 DAYS**.

First, think of a *typical week* in the *last 30 days*. (Where did you live? What were your regular weekly activities? Where you working or going to school? Etc.) Try to remember as accurately as you can, *how much* and for *how long you typically drank* in a week during that one month period?

For each day of the week in the calendar below, fill in the **number of standard drinks typically consumed on that day** in the upper box and the **typical number of hours you drank that day** in the lower box.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Number of Drinks							
Number of Hours Drinking							

Appendix D

Timeline Followback

Instructions*:
To help us evaluate your drinking, we need to get an idea of what your alcohol use was like in the past 28 days. To do this, we would like you to fill out the attached calendar.

- Filling out the calendar is not hard!
- Try to be as accurate as possible.
- We recognize you won't have perfect recall. That's OKAY.

What to fill in

- The idea is to put a number in for **each day** on the calendar.
- On days when you did not drink, you should write a "0".
- On days when you did drink, you should write in the total number of drinks you had.
- We want you to record your drinking on the calendar using Standard Drinks. For example, if you had 6 beers, write the number 6 for that day. If you drank two or more different kinds of alcoholic beverages in a day such as 2 beers and 3 glasses of wine, you would write the number 5 for that day.
- **It's important that something is written for every day, even if it is a "0".**

Your best estimate

- We realize it isn't easy to recall things with 100% accuracy.
- If you are not sure whether you drank 7 or 11 drinks or whether you drank on a Thursday or a Friday, **give it your best guess!** What is important is that 7 or 11 drinks is very different from 1 or 2 drinks or 25 drinks. The goal is to get a sense of how frequently you drank, how much you drank, and your patterns of drinking.

Helpful hints

- If you have an appointment book you can use it to help you recall your drinking.
- Holidays such as Thanksgiving and Christmas are marked on the calendar to help you better recall your drinking. Also, think about how much you drank on personal holidays & events such as birthdays, vacations, or parties.
- If you have regular drinking patterns you can use these to help you recall your drinking. For example, you may have a daily or weekend/weekday pattern, or drink more in the summer or on trips, or you may drink on Wednesdays after playing sports.

Completing the calendar

- A blank calendar is attached. Write in the number of Standard Drinks that you had each day.
- The time period we are talking about on the calendar is from {beginning date} to {ending date}.
- In estimating your drinking, be as accurate as possible.

1 Standard Drink is Equal to


One 12 oz can/bottle of beer


One 5 oz glass of regular (12%) wine


1 ½ oz of hard liquor (e.g. rum, vodka, whiskey)


1 mixed or straight drink with 1 ½ oz hard liquor

Start Date (Day 1): August 1 2016 | **End Date (yesterday):** August 28 2016

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28						

*Instructions and sample calendar adapted from

http://www.nova.edu/gsc/online_files.html#time_followback

Appendix E

Alcohol Use Disorders Identification Task

For each question, please select the box that best describes your answer to each question.					
Questions	0	1	2	3	4
1. How often do you have a drink containing alcohol?	Never	Monthly or less	2-4 times a month	2-3 times a week	4 or more times a week
2. How many drinks containing alcohol do you have on a typical day when you are drinking?	1 or 2	3 or 4	5 or 6	7 to 9	10 or more
3. How often do you have six or more drinks on one occasion ?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily
4. How often during the last year have you found that you were not able to stop drinking once you had started?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily
5. How often during the last year have you failed to do what was normally expected of you because of drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily
6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session ?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily
7. How often during the last year have you had a feeling of guilt or remorse after drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily

For each question, please select the box that best describes your answer to each question.					
Questions	0	1	2	3	4
8. How often during the last year have you been unable to remember what happened the night before because of your drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily
9. Have you or someone else been injured because of your drinking?	No		Yes, but not in the last year		Yes, during the last year
10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	No		Yes, but not in the last year		Yes, during the last year

Appendix F

BOGO and HP Versions of the APT

In the questionnaire that follows we would like you to pretend to purchase and consume alcohol. **Imagine another typical weekend later the same month as the last scenario (same bar, same group of friends, etc.). Now imagine that from 9 p.m. until 2 a.m. the bar has a *Happy Hour Drink Special where drinks are buy one get one free (BOGO)*.** Imagine that you do not have any obligations the next day (i.e., no work or classes). 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 or use drugs before you went to the bar, and that you will not drink or use drugs after leaving the bar. You cannot bring your own alcohol or drugs to the bar. Also, assume that the alcohol you are about to purchase is for your consumption only. In other words, you can't sell the drinks or give them to anyone else. You also can't bring the drinks home and you have no other alcohol at home. Everything you buy is, therefore, for your own personal use within the **5 hour period** that you are at the bar. Please respond to these questions honestly, as if you were actually in this situation.

How many buy one get one free drink purchases would you make at each price:

	Number of buy one get one free drink purchases you would make:	**Number of drinks you would consume:**
$0.00 per drink on sale for $0.00 per 2 drinks		
$0.25 per drink on sale for $0.25 per 2 drinks		
$0.50 per drink on sale for $0.50 per 2 drinks		
$1.00 per drink on sale for $1.00 per 2 drinks		

In the questionnaire that follows we would like you to pretend to purchase and consume alcohol. **Imagine another typical weekend later the same month as the last scenario (same bar, same group of friends, etc.). Now imagine that from 9 p.m. until 2 a.m. the bar has a *Happy Hour Drink Special where drinks are 1/2 off (50% off).*** Imagine that you do not have any obligations the next day (i.e., no work or classes). 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 or use drugs before you went to the bar, and that you will not drink or use drugs after leaving the bar. You cannot bring your own alcohol or drugs to the bar. Also, assume that the alcohol you are about to purchase is for your consumption only. In other words, you can't sell the drinks or give them to anyone else. You also can't bring the drinks home and you have no other alcohol at home. Everything you buy is, therefore, for your own personal use within the **5 hour period** that you are at the bar. Please respond to these questions honestly, as if you were actually in this situation.

How many half price drink purchases would you make at each price:

	Number of half price drink purchases you would make:	**Number of drinks you would consume:**
$0.00 per drink on sale for $0.00 per drink		
$0.25 per drink on sale for $0.13 per drink		
$0.50 per drink on sale for $0.25 per drink		
$1.00 per drink on sale for $0.50 per drink		

Appendix G

Information Statement

Motivations for Alcohol
Information Statement for Internet Study via Amazon Mechanical Turk

The Department of Applied Behavioral Science at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You should be aware that even if you agree to participate, you are free to withdraw at any time without penalty.

We are conducting this study to better understand adults' motivations for alcohol consumption. This will entail your completion of several surveys. Your participation is expected to take between approximately 30-45 minutes to complete. The content of the survey should cause no more discomfort than you would experience in your everyday life.

Although participation may not benefit you directly, we believe that the information obtained from this study will help us gain a better understanding of better ways to survey individuals' motivations for alcohol consumption. Your participation is solicited, although strictly voluntary. Your name will not be associated in any way with the research findings. Your identifiable information will not be shared unless (a) it is required by law or university policy, or (b) you give written permission. All data collected will be anonymous. Your responses will be stored in the researchers locked filing cabinet in a locked office space and on password-protected encrypted hard drives. **It is possible, however, with internet communications, that through intent or accident someone other than the intended recipient may see your response.**

Your participation in this study is completely voluntary; however, if you enrolled through the Amazon Mechanical Turk system, you will be compensated with $1.00 in exchange for 30-45 minutes for a complete and valid survey if approved by the researchers. This is not market research; thus, we are paying less than what is typically provided in market research – we want to ensure that your participation is voluntary and not coercive. In academic research, we believe some of the benefit comes from helping science – not just financial remuneration. The information you provide may help alcohol researchers develop methods to better understand the processes associated with motivation to consume alcohol.

If you would like additional information concerning this study before or after it is completed, please feel free to contact us by phone or mail.

Completion of the surveys indicates your willingness to take part in this study and that you are at least 18 years old. If you have any additional questions about your rights as a research participant, you may call (785) 864-7429 or write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7563, email irb@ku.edu.

Sincerely,

Derek D. Reed, Ph.D., BCBA-D Principal Investigator & Faculty Sponsor
Department of Applied Behavioral Science 4048 Dole Human Development Center 1000 Sunnyside Avenue | University of Kansas
Lawrence, KS 66045

KU Lawrence IRB # STUDY00004569 | Approval Period 11/7/2016 – 9/18/2017