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Beer, Bourbon, and Bertrand: an Experimental Economics Analysis

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Beer, Bourbon, and Bertrand: An Experimental Economics Analysis

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ABSTRACT

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The purpose of this paper is to determine the effect that binge drinking has on economic performance in a standard Bertrand-style game. Results indicate that binge drinking, when paired with poor protective behavioral strategies, increases cooperative pricing in a Bertrand-style game, with this result persisting across various contextual frameworks. In the aggregate, this study contributes to the literature by being the first of its kind to evaluate the effect of observational binge-drinking meta scores on performance in a Bertrand-style game. To measure economic performance in the market, participants play the 2/3 average game and a standard Bertrand game with zero marginal cost, both implemented using z-Tree. By employing a targeted binge-drinking questionnaire (DBQ and PBS) and controlling for personality (AB5C and the NEO5-20), I isolate the effect of binge drinking on participants' performance in the two experimental games.

KEYWORDS: Experimental Economics, Bertrand Game, 2/3 Average Game, Binge Drinking on College Campuses, PBS, DBQ

JEL Classification: C73, C92, D91, and I12

Contents

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1 Introduction

So far, the literature regarding alcohol consumption and experimental games has been limited to studies on tangible intoxication, or studies in which experimenters manipulate intoxication in a lab. These studies often come to the conclusion that students behave differently, in experimental games, when they are consuming alcohol (Bregu et al. 2017; Corazzini et al. 2015) [15] [26]. While this result is interesting (and perhaps self-evident), I am more interested in determining whether these effects persist when students are *not* drinking, a concept I refer to as intangible intoxication. The only study that has examined intangible intoxication was conducted by Fielding, Knowles, and Robertson (2018) [43], in which they employ a standard dictator game to measure levels of altruism. While the results of their study show that individuals who score higher on alcohol-related metrics are less generous in their donations, they do not control for personality, an effect which may be biasing their estimations. Thus, there is currently a gaping hole in the literature, when evaluating the sustained effect that alcohol consumption has on economic performance. In this study, to fill this deficiency in the literature, I control for personality while simultaneously evaluating the effect of intangible intoxication on college students' performance in a standard Bertrand-style game. The experimental results indicate that binge drinking, when evaluated in conjunction with poor protective behavioral strategies, increases cooperative pricing, with this effect persisting across both contextual frameworks.

Additionally, agreeableness, rather than neuroticism, emerges as a distinct predictor of cooperative strategies. These are all unique contributions to the literature that extend beyond the scope of Fielding, Knowles, and Robertson (2018) [43].

2 Literature Review

Alcohol consumption is persistent, perplexing, and paradoxical. It is persistent because it has been America's drug of choice since the Constitution was ratified. In fact, the average colonial American in 1770 consumed double the amount of alcohol that the modern American does (Gershon 2016) [46]. Since then, alcohol has become an industry of immense economic growth. For instance, in 2022, the alcohol market was worth approximately 259.84 billion dollars in the United States alone (Conway 2023) [24]. Among college students, this number is 5.5 billion each year – almost double the amount that is spent on entertainment. In fact, in most college towns, consuming alcohol is its own form of entertainment (Refuel Agency 2018) [83]. The perplexing part of alcohol consumption is the developmental effect that it has on adolescents' brains. Lees et al. (2020) [61], for example, show that alcohol consumption among adolescents is "associated with poorer cognitive functioning on a broad range of neuropsychological assessments, including learning, memory, visuospatial functioning, psychomotor speed, attention, executive functioning, and impulsivity," all of which are linked to worse educational outcomes (Devaus & Vuik) [36]. This leads to the paradoxical nature of alcohol consumption; namely, its persistence among college students in spite of its deleterious health effects.

The preexisting literature regarding alcohol consumption among college students, in regard to economic games, up to this point, is split into three major categories:

(I) Psychology studies that examine binge drinking, typically by utilizing some configuration of an Alcohol Purchase Task (APT) in conjunction with standard economic demand theory.

(II) Experimental studies that examine participants' aptitude in a wide range of performative tasks – including economic games – while intoxicated (tangible intoxication).

(III) Experimental studies that examine participants' aptitude in a wide range of performative tasks based on reported alcohol consumption (intangible intoxication).

The latter category [III] coincides with the contents of this study. However, in order to ascertain the relationship between alcohol consumption and performance in experimental games, it is imperative to understand how personality impacts experimental economic games. Based on the specifications of this experiment, there are four more categories of literature that must be examined:

(IV) Psychology studies that examine the relationship between personality and alcohol, typically through surveys or observational data.

(V) Psychology studies that examine the relationship between personality and experimental economic games.

(VI) Repeated prisoner's dilemma games, specifically as they relate to experimental economic games.

(VII) The Bertrand oligopoly model, specifically as it relates to experimental economic games.

The National Institute of Health (and by extension, the National Institute on Alcohol Abuse and Alcoholism) defines binge drinking as a "pattern of drinking alcohol that brings blood alcohol concentration (BAC) to .08 percent...or higher" [74]. For males, this typically corresponds to five or more drinks over the course of two hours, and for females, four or more drinks over the course of two hours. Excessive binge drinking is categorized by consuming approximately ten drinks or more over the course of two hours, and a fairly large subset of binge drinkers, especially among college students, are simultaneously categorized as excessive binge drinkers. In many college demographics, binge drinking is the norm rather than the exception (Chauvin 2011) [20].

More generally, Bohm et al. (2021) [12], show that binge drinking has increasingly become a health risk for adults and that its prevalence is highest among adults aged 18-25, with this effect being most prevalent among men (Esser et al. 2014; Park & Grant 2005; Perkins & Wechsler 1996) [41] [79] [81]. Sacks et al. (2015) [86] show that excessive binge drinking cost Americans nearly $250 billion in 2010: "Two of every $5 of the total cost was paid by the government, and three-quarters of the costs were due to binge drinking." This effect is even more pronounced among college students. According to population data from the National Survey on Drug Use and Health, 27.4% of college students have reported binge drinking in the past month (2023) [74], which is aligned with the results of Keyes et al. (2020) [58] who find that 33% of surveyed college students had reported binge drinking during the past month. In class, binge drinking college students are six times less likely to perform adequately on a test (Presley & Pimental 2015) [82], and on the road, 30% of deceased drivers aged 15-20 years had consumed alcohol (The National Center for Statistics and Analysis 2017) [35]. Alcohol consumption, when paired with poor protective behavioral strategies, can have pernicious long-term effects.

There are four major reasons why binge drinking persists among college students. First, and for lack of a better term, binge drinking is *ecstatic*. More broadly, *ecstatic* encapsulates a wide variety of factors, including the neurological rush of increasing BAC, the positive social exaltation of belonging to the drinking crowd, and the deliberate indulgence of activities destigmatized while being intoxicated, such as unprotected sex. This is, in part and parcel, amplified by Greek Life, whose drinking characteristics are categorized as "hazardous" (Ortelli & Martinetti 2021) [78], as well as permissive cultural perceptions regarding alcohol consumption on college campuses (Perkins & Wechsler 1996) [81]. Second, and perhaps equally influential, are the *desolate* factors associated with drinking alcohol, such as neurological fixation (Lees et al. 2020) [61] and the stigma associated with disenfranchisement from the drinking crowd (Lui, Berkley & Zamboanga 2020; Tyler et al. 2016) [65] [95]. Third, are the *pernicious* factors, which include drinking to alleviate anxiety, depression, or stress – all of which are significantly amplified by a genetic predisposition for consuming drugs, as well as particular Big Five personality traits (see Section 2.1). Finally, there are the *societal* factors associated with binge drinking, which are the factors that we – governments, institutions, and organizations – contribute to the persistence of binge drinking among college students.

Society may not be able to control *ecstatic*, *desolate*, or *pernicious* factors, but it can certainly control *societal* factors, through deliberate coordination, effective cooperation, and strategic policy incorporation. Thus, an integral question is, "what *societal* factors are present?" And, equally important is, "how do we reduce the negative effects of preexisting *societal* factors?"

Typically, there are three substantial *societal* factors that influence alcohol consumption. As Wechsler et al. (2002) [96] and Weschler and Nelson (2008) [97] state, these factors include the degree of ease with which alcohol can be accessed, the location of a bar within a mile from campus, and the state's alcohol control policies. In Vermillion, South Dakota, the small-town geographical structure makes alcohol easily accessible to anybody over the age of 21, and the prevalence of fake IDs makes alcohol attainable for anybody under the age of 21. Further, nearly all bars are located within a mile from campus.[1] Finally, the state's alcohol control policies are laissez-faire at best, and non-existent at worst. The lack of "stop and identify" laws, in conjunction with the negligible repercussions placed on bar owners for harboring underage drinkers, make Vermillion, South Dakota the prime area for perpetuating underage drinking[2] – and more specifically, underage binge drinking. Fortunately, this also makes it the perfect population for an experimental economics study on alcohol consumption.

2.1 Personality and Binge Drinking

Numerous studies evaluate standard economic demand theory by utilizing some configuration of a hypothetical purchase task, or an alcohol purchase task (APT), which serves as a manipulation of the relative enforcing efficacy used in the standardized laboratory model (Murphy & MacKillop 2006) [72]. Gentile, Librizzi, and Martinetti (2012) [45] use this APT to estimate the effects of various academic constraints on alcohol consumption, finding that

[1] The Muenster University Center, the central hub for students, is located .8 miles away from the Charcoal Lounge, the most popular bar in Vermillion, South Dakota.

[2] In writing this paper, I reached out to a bartender at the Charcoal Lounge. According to this individual, approximately *75-90* percent of the individuals who frequent the Charcoal Lounge are underage.

alcohol consumption decreases as the rigor of one's academic requirements increase.[3] Naudé et al. (2020) [75] extend this concept, providing evidence that the combination of fake IDs and elevated alcohol demand on college campuses increases the risk of binge drinking and sexual victimization.[4]

A similar study uses a CPPT (Cup-Price-Purchase-Task) to determine how much alcohol college students would drink at various price points, given that their cup is, for all intents and purposes, always full[5] (Morrell, Reed & Martinetti 2021)[6] [69]. Their results indicate that, at low prices, students seek to minimize the sunk cost associated with alcohol consumption, which is corroborated by Thombs et al. (2009) [92]. Thus, an effective way to reduce alcohol consumption is to raise the price of alcoholic beverages or to offer easily accessible nonalcoholic alternatives, both of which are not adventitious for bars, the main proliferates of binge drinking on college campuses[7] (Morrell, Reed & Martinetti 2021; Thombs et al., 2009) [69] [92]. O'Mara et al.

[3]This is subject to P_{max}, which is measured using the formula derived by Murphy & MacKillop (2006) [72] Essentially, the elasticity of alcohol is elastic for college students; thus, as the price of alcohol increases, the quantity demanded decreases. This corresponds with the coefficient of $DBQ * PBS$ presented in Section 4.

[4]This helps justify, in Section 5.2, precisely *why* it is beneficial, for colleges and governments, to integrate the conclusions of this study into future policy decisions.

[5]"Always full" is indicative of binge drinking.

[6]In this study, O_{max}, which shows the price response to P_{max}, emerges as a unique indicator of alcohol consumption, beyond the results of Gentile, Librizzi & Martinetti (2012) [45] and the APT more broadly. This may indicate that high prices, which can be imposed through governmental taxes, may be sufficient in assuaging binge drinking on college campuses, especially in states with no 'stop and identify' laws.

[7]For all intents and purposes, bars are the ones who effectively control the rate of alcohol consumption. Therefore, ameliorating this situation is not as easy as identifying a proposed solution, which in this case is easily identifiable, but rather determining the best route for achieving the proposed solution. In many alcohol-related studies, redundant concepts are mathematicized and romanticized at the expense of unattractive solutions.

(2009) [77] corroborate this experimentally by measuring the cost of ethanol on multiple on-premise establishments and its relationship to BAC (Blood Alcohol Content). By incorporating this data into a multivariate model, they find that a 10-cent increase in the cost per gram of ethanol results in a 30% decrease in the probability that an individual leaves an on-premise establishment intoxicated. This makes sense, given the results of (Gentile et al. 2012; Morrell et al. 2021; Thombs et al. 2009; Ortelli & Martinetti 2021) [45] [69] [92] [78]. These studies provide a general framework for evaluating, and potentially ameliorating, binge drinking on college campuses, from the perspective of standard economic demand theory.

The Big-Five personality traits are consistently the best predictor of personality (Oliver, Laura & Christopher, 2008) [76], existing simultaneously as an amorphous yet precise indicator of adolescents more generally (McCrae & Costa, 2007).[8] Its relative counterpart, the Big Three Model (Tohver 2020) [93], is not utilized, partly because it is typically utilized in relation to a subset of unique factors[9], partly because it provides less control over personality, but mostly because it is less conducive to experimental economics research. Further, since I am attempting to ascertain the relationship between alcohol consumption and performance in various experimental economic games,

[8]The Big-Five personality factors consist of five dimensions: Agreeableness, Conscientiousness, Extraversion, Neuroticism, and Openness. These factors are an integral part of the developmental literature and serve as a general framework for evaluating personality (McCrae & Costa 1999; APA). [68]

[9]Mental health, addiction, and technology are the three main factors in the Big Three Model.

it matters which personality factors I am controlling for, and the degree to which each personality trait exists as a deterministic metric for alcohol consumption.[10]

More broadly, the Big-Five personality traits are a relatively germane predictor of substance abuse. Typically, alcohol misuse among adults is linked to individuals who are higher in extraversion, higher in neuroticism, and lower in conscientiousness (Hakulinen 2015; Turiano et al. 2012) [49] [94]. Additionally, while Turiano et al. (2012) [94] find that higher levels of openness and lower levels of agreeableness predict longitudinal abuse, Hakulinen (2015) [49] finds that this relationship only exists in terms of adhering to the status quo, and Jones et al. (2022) [57] finds no indication of this relationship whatsoever. Another factor that impacts alcohol consumption, that is worth diving into, is impulsivity, an effect amplified by antisocial features (Hahn et. al 2016) [48] and hopelessness (Hustad et al. 2014) [80], and directly linked to unconscientious disinhibition as well as disagreeable disinhibition[11] (Ibáñez et al. 2010) [54]. Among college students, these results remain relatively consistent. For students entering college, neuroticism, and specifi-

[10] Additionally, although certain components of the DSM-5 model are perhaps more equipped to encapsulate the various factors associated with alcohol misuse (Creswell et al. 2016) [29], it is costly and timely, and there is not sufficient evidence that it increases the validity in an experimental economics experiment any more than the NEO5-20 personality test.

[11] Disinhibition is, by definition, the antithesis of the big five personality traits. Thus, "unconscientious disinhibition" is synonymous with "not conscientious." In the context of this study, disagreeable disinhibition predicts alcohol consumption consistently throughout the week, whereas conscientious disinhibition is associated with significant alcohol use on the weekends.

cally the neuroticism-depression facet, is the greatest predictor of developing alcoholism, which is consistent with the previous findings of Martin, Benca-Bechman, and Palmer (2021) [67]. Yet, unlike (Hakulinen 2015; Turiano et al. 2012 [49] [94]), Martin, Benca-Bechman, and Palmer (2021) [67] find no relationship between conscientiousness and alcohol consumption among college students; additionally, Jones et al. (2022) [57] provide evidence that this relationship persists in adolescence and then dissipates during the transition into young adulthood.[12]

2.2 Tangible and Intangible Intoxication

The remainder of the literature, as it relates to this study, outside the scope of Bertrand or prisoner's dilemna, evaluates tangible intoxication or intangible intoxication while playing experimental economics games. Bregu et al. (2017) [15] conclude that intoxication (quantified as reaching a BAC of .08) does not affect performance in economic games but that the perception – and specifically overestimation – of one's BAC leads to more cooperation during the prisoner's dilemma. Corazzini et al. (2015) [26], after employing a series of six economic games, find that alcohol intoxication, while having no effect on subjects' risk tolerance, leads to increased impatience and

[12]It is worth noting that this study does not identify whether this relationship revitalizes during the later years of adulthood. However, this postulation would explain the apparent discrepancy between (Jones et. al, 2021; Martin, Benca-Bachman & Palmer 2021) [57] [67] and (Hakulinen 2015; Turiano et al. 2012) [49]. [94] It could very well be that social pressures, coupled with stress from school, cause even the most conscientious students to indulge in alcohol consumption.

less altruism, specifically in regard to humanitarian causes. This is corroborated by Hopthrow et al. (2007) [53] who show that experimental groups are significantly less likely to cooperate after drinking alcohol; however, while their study indicates that individuals do not cooperate independently, Au & Zhang (2016) [7] show that a moderate amount of alcohol consumption increases the ability to cooperate effectively in a bargaining game with adverse selection.[13] However, this effect does not persist in a public goods game (Zak et al. 2021) [99], an affect that may be amplified by intoxicated individuals proclivity towards lying (Au, Lim & Zhang 2022) [6].

Fielding, Knowles, and Robertson (2018) [43] – the only study that examine intangible intoxication in the lab – find that chronic alcohol dependency is associated with less generosity and lower levels of empathy in a "dictator game."[14] This result is consistent with the previous literature regarding tangible intoxication, indicating that there exists some crossover between tangible intoxication and intangible intoxication. However, while tangible intoxication can evaluate the effect of alcohol consumption on performance in economic games, it is incapable of identifying this relationship in the long run. For example, if the level of intoxication (BAC) is stretched well past

[13]This effect immediately appears to travel against the grain of the aforementioned literature. While this is not entirely false, three stipulations must be made. First, the increased endowments led to a higher average payoff for the intoxicated individuals. Second, this collaboration is most likely indicative of subjects' inherent reverberation towards "cursedness" (Eyster & Rabin 2005) [42]. Third, a bargaining game of this nature may not be generalizable beyond the scope of its initial parameters.

[14]Fielding, Knowles, and Robertson quantify this as a dictator game in their study, but in reality, it is a public goods game.

the legal limit of .08, to .2, for argument's sake, then the experimental delineation between the "control" and "experimental" group becomes laughable. Of course, binge-drinking college students are going to behave differently while they are intoxicated, especially in comparison to their sober peers. The question I seek to answer is whether this relationship persists when the binge-drinking college students are *not* intoxicated.

2.3 Experimental Economic Games and Personality

The literature regarding economic games and personality, while less abundant, draws similarities to the literature regarding personality and binge drinking. For example, lower neuroticism, lower extraversion, and higher openness to experience are associated with more prosocial behavior in the prisoner's dilemma (Brocklebank, Lewis & Bates 2011; Lönnqvist, Verkasalo & Walkowitz 2011) [17] [64][15] and increased contributions by the trustee in the trust game (Müller & Schwieren 2020) [71]. Similarly, low neuroticism is associated with less cooperation in a circular public goods game (Kurzban & Houser 2001) [59] and increasingly risk averse individuals in all games (Lauriola & Levin 2001) [60]. The Big-Five personality traits are, in the aggregate, the most concise metric for evaluating behavior, but for particular

[15] Hirsh and Peterson (2009) [51] broach the dangers of non-incentivized experiments, their results indicating that high values of neuroticisim and the enthusiastic aspect of extraversion lead to more cooperation in the prisoner's dilemma. This indicates that either I) the rest of the literature is incorrect, or II) there is a stark difference between incentivized experiments and non-incentivized experiments. I prefer the latter explanation.

games, particular metrics are more sufficient. For example, in the trust game, propensity to trust explains more of the variation in the trust process than the five factor model (Alacron et al. 2018), [1] and in dictator games, politeness – rather than altruism[16] – explain allocations of wealth (Zhao, Ferguson & Smillie 2016), [101] with higher allocations reported for men than women (Ben-Ner, Kong & Putterman 2003; Corazzini et al. 2015) [9] [26]. Throughout the literature, the parallel, between binge drinking, experimental games, and personality, is *neuroticism.*

2.4 Repeated Prisoner's Dilemma and Personality

While my experiment is not explicitly a repeated prisoner's dilemma game with a finite end, the literature regarding repeated prisoner's dilemma with a finite end is more abundant than the literature regarding the Bertrand oligopoly model, especially in regard to the contextual frameworks employed in this experiment (Section 3); and, from a firm perspective, prisoner's dilemma has fundamental similarities to the Bertrand oligopoly model.[17]

In repeated prisoner's dilemma games with a finite end, the critical question is cooperation[18]: that is to what extent it occurs, to what extent it is

[16]Deck and Jahedi (2015) [34] show that individuals deviate from classical economic assumptions, exhibiting too much risk aversion and impatience when making decisions. This is a common theme espoused ad nauseum in *Nudge* (Thaler & Sunstein, 2009) [91] and *Predictable Irrationality* (Ariely 2008). [5]

[17]Jiménez-Jiménez & Rodero-Cosano (2015)[55] consider this to be a generalization of the Bertrand oligopoly model.

[18]Specifically, one area of interest for me is whether high levels of tacit collusion persist in the experimental rounds, especially given that the final round is known, in advance,

influenced by outside factors, and to what extent it conforms with predicted Nash Equilibrium (NE) outcomes. Breitmoser (2015) [16] and Blonski, Ockenfels, and Spagnolo (2011) [11] find that individuals cooperate, but only when the specified discount factors breach a specific threshold.[19] This result is corroborated by Embrey, Fréchette, and Yuksel (2018) [40], who find that the contextual framework of the game plays an integral role in determining whether cooperation persists. Cox et al. (2014) [28] find that participants are more likely to converge toward cooperate strategies when they believe that their opponent will also play a cooperative strategy (tit-for-tat), an effect that may be amplified by Appelbaum and Katz's (2022) [4] guilt-based model,[20] the degree of risk aversion present in individual's preferences (Sabater-Grande & Georgantzis 2002; Lauriola & Levin 2001) [85] [60], the age of the participant (Blake et al. 2015) [10], and the gender of the participant (Blake et al. 2015; Colman, Pulford & Krockow 2018; Ben-Ner, Kong & Putterman 2003; Corazzini et al. 2015) [10] [23] [9] [26]. Colman, Pulford, and Krockow (2018) [23], using computerized methodology over the course of 300 rounds, find that, as the number of rounds expand, cooperation among

by the participant. In Section 6.1, the proof progresses by utilizing a prisoner's dilemma framework.

[19]The most common cooperative strategy, in this experiment, is the "Semi-Grim" strategy, which includes cooperating after mutual cooperation and defecting after mutual defection; essentially, it is a tit-for-tat strategy. An individual conforming to a tit-for-tat strategy defers to the last move made by their opponent. However, according to theory, cooperating is impossible without a known endpoint. In all of the subsequent studies, the end round is either known or randomized.

[20]The extent to which this model can be extrapolated to a more general prisoner's dilemma framework is not particularly well researched.

participants remains relatively stable, except toward the final rounds.

2.5 Bertrand Oligopoly Model

To my knowledge, the literature regarding the Bertrand oligopoly model as it relates to personality, and the literature more generally regarding economic games and alcohol, is nonexistent. Thus, categories [I-V] serve as a necessary prerequisite for evaluating category [VII].

Experimental markets are, in reality, much trickier than that of which theoretical markets may suggest. Alós-Ferrer, Ania and SchenkHoppé (2000) [2] show that under an evolutionary model with homogeneous products, all firms make positive profits in the long run which corresponds with the Walrasian hypothesis posited in Smith (1962) [89], given that costs are quadratic. Dechenaux and Mago (2019) [33] show that in a Bertrand duopoly game with randomly assigned and asymmetric costs, side payments do not result in the monopolization of the lower cost firm, but instead parallel the results of (AlósFerrer, Ania and SchenkHoppé 2000; Dugar & Mitra 2016) [2] [39]. This is aligned with Boone et al. (2012) [13], who show that more efficient firms ($c_i < C_i$) price at their marginal cost ($p_i = (MC - 1)_i$), and Dugar and Mitra (2016) [39], who show that cost asymmetry results in an increase in market price with a simultaneous decrease in the absolute difference between the two firms marginal costs. This is also aligned with Dufwenberg et al. (2007) [38], who show that subjects acting as firms consistently price over the NE (Bruttel 2009; Dufwenberg 2000) [18] [37], and Barthel and Hoffman (2019) [8], who show that these results persevere as the number of rounds expand. Nevertheless, in a group setting, too much population feedback prevents convergence of the NE, compared to isolated feedback from the subject's opponent (Bruttel 2009) [18], yet this effect is less pronounced in Bertrand markets than in Cournot markets (Davis 2011) [32]. Under a trade paradigm, there is evidence to suggest that homogeneous products will never take place under Bertrand competition and that firms will either "differentiate or get out" (Brander & Spencer 2015) [14].[21]

Experimentally, the way that subjects are primed can drastically alter the course of an experimental game (Levitt & List 2007) [63], and Bertrand games are no exception (Jiménez-Jiménez & Rodero-Cosano 2015) [55]. Jiménez-Jiménez and Rodero-Cosano (2023) [56] expand on this concept, showing that different contextual frameworks elicit different results, with evocative framing[22] eliciting results closer to theoretical predictions. The differences in the contextual framework, however, disintegrate as the number of rounds expand. Previous literature indicates that 10 rounds may not be enough, while 20 rounds may be too many (Dugar & Mitra 2016) [39]. However, in order to perceive the effects of tacit collusion – and to hedge against sub-optimal strategies utilized in early rounds – I extend the number of rounds

[21] In this experiment, product differentiation is not possible, and therefore the rational strategy would indeed be to "differentiate or get out," which is corroborated by Section 6.1.

[22] In this study, evocative framing is contextualized as "taking money from a fund." Thus, the Bertrand oligopoly model is simply an extension of the endowment game.

to 30 (Colman, Pulford & Krockow 2018) [23].

3 Methodology

For this experiment, I employ a generic Bertrand model.[23] I assume that there are two individuals in each market. Marginal cost equals 0 for all individuals in all markets; thus, the profit in each round equals p_i, where p_i is the price selected in each round. However, for each participant-pair, players only earn money if they price below their opponent. Theoretically, in a standard Bertrand model, individuals price at their marginal cost ($p = mc$). However, the expectation in this experiment is that rational individuals will price above their situational marginal cost ($p_i = 0$), to the point at which the profit they earn is at least equal to the value of the utility they derive from their time ($p_{rational} = mc_i + v_i$). Intuitively, this is aligned with the standard price-maximizing point of firms in a Bertrand oligopoly model, in which $p = mc$ encapsulates the factors of production. Traditionally, the NE is to price at 0, as shown in Jiménez-Jiménez and Rodero-Cosano (2023) [56]. Additionally, while Dufwenberg et al. (2007) [38] acknowledge the traditional NE, they allude to a "Luce" equilibrium that is implicitly generated from

[23]The Bertrand oligopoly model employed in this experiment is technically not "Bertrand" since there are no downward-sloping marginal costs. However, for the purposes of this experiment, it is "Bertrand" enough. Firms are represented by individuals. For the remainder of this paper, the Bertrand game and the 2/3 average game will both be referred to as Bertrand-style games, since beyond the contextual framework, there is no mathematical difference between the two games.

price choices. The issue with both of these selections, however, is that, in the context of this experiment, v_i represents the factors of production in each respective participant-pair "market." Without correcting for this inaccuracy, through the value of time function, any preselection of the NE will be corrupted. As I show in Section 6.1, the NE, in this experiment, is to show up to the experiment, take the cash, and leave immediately. The reason why this does not occur is due to the irrational components presented in (Levitt & List 2007) [63].

This experiment was conducted through z-Tree (Fischbacher, 2007) [44]. Two different versions of a Bertrand-style game are played, both utilizing the methods of Jiménez-Jiménez and Rodero-Cosano (2023) [56]. In the first game, participants play the two-third average game (also referred to at the beauty contest). In the second experimental game, participants are matched with a new partner. The framework in the second experimental game shifts from an individual perspective to a firm perspective. The exact format and display is shown in Section 6.9 and Section 6.12. Participants play 30 rounds with another participant before moving onto the next experimental game. The participant-pair does not change during any of the rounds; however, the participant-pair does change as the experimental game changes.[24]

[24]This section was written after conducting a successful pilot, but prior to conducting the actual experiment. All hypothesis were pre-registered with the Open Science Framework and can be found under the title of this paper, "Beer Bourbon, and Bertrand: an Experimental Economics Analysis." This obviates the very real issue of publication bias permeating experimental economics journals (Andrews & Kasy, 2017) [3].

Alcohol consumption, in terms of binge drinking, was measured by using the DDQ (Daily Drinking Questionnaire). The DDQ was first introduced by Cahalan, Cisin, and Crossley (1969) [19], then reintroduced by Collins, Parks, and Marlatt (1985) [22], and has been utilized by Morrell, Reed, and Martinetti (2021) [69] and Gentile, Librizzi, and Martinetti (2012) [45].[25] Alcohol consumption, in terms of risky behavior, was measured by using the PBS (Protective Behavioral Strategies)[26] (Martens et al. 2007; Moylett & Hughes 2017)[66] [70]. Personality was controlled for by using the Goldberg's NEO 5-20 (1999) [47] IPIP representation [50] of Costa and McCrae's Big 5 personality metrics (1992) [27]. Additionally, convergent personality metrics were controlled for by utilizing a subset of the 45 ABC5 facets constructed by Hofstee, Raad, and Goldberg (1992) [52]. Specifically, I use the Impulse-Control facet, which is supported by Rosenström et al. (2017) [84], Creswell et al., (2016) [29], and Ibáñez et al. (2010) [54]; also, I use the Introspection/Private Self-Consciousness facet, an important metric to control for, given that each sample consists primarily of college students.[27] In total, participants answered 113 questions.

Participants were recruited from various classrooms across the University of South Dakota. Section 6.7 shows the recruiting script, Section 6.6 shows

[25]Qualitative questions were not used in the analysis.

[26]Scores on the PBS were calculated by taking the average of the 20 questions asked. No questions were omitted.

[27]Given that the ABC5 facets were ultimately insignificant, both practically and statistically, I removed them from Table 2. However, I show the regression output, with these convergent personality metrics, in Section 6.5.

the recruiting flyer, and Section 6.8 shows the pre-screening form as well as the corollary dispersion of responses. Based on the pre-screening results, participants were chosen for one of the four experimental sessions, of which there was approximately a 75% attrition rate. The experiment itself was conducted in the Ellis Finance and Analytics Labs in the Beacom School of Business. Before the experiment was conducted, participants verbally consented to participate, as shown in Section 6.10. The experiment was then conducted, following the script presented in Section 6.12. Finally, participants filled out a questionnaire consisting of 88 questions; the output of the first three pages is shown in Section 6.11.

In developing my scientific hypothesis, I build off the fundamentals of Czibor, Jiménez-Gomez, and List (2019)[28] [30], Levitt and List (2007)[63], and Levitt and List (2008)[62]. In Section 6.2, I provide the mathematical derivation of the hypothesis. Four experimental samples ($n = 59$ [One observation was dropped due to an omission of the Gender variable]) are used, in order to induce proper replication, specifically statistical replication, which "has the ability to fix sampling errors or insufficient power" (Czibor, Jimenez-Gomez & List, 2019) [30]. As Zhang and Ortmann (2013) [100] allude to in their study, there is a dearth of power analysis in experimental economic journals. To assuage this, I conduct reverse power analysis[29] to calculate the margin

[28]This is, perhaps, the most comprehensive review of the experimental economics literature, especially from a statistical perspective.

[29]The power of a study is the probability that, given a specific sample size and a specified level of confidence, the study will detect the true effect of capturing the difference between

or error that can be tolerated in the study (Serdar et al., 2021) [87].

Preemptive sample selection (and by extension, power analysis) requires three things: specification of alternative and null hypothesis, specification of statistical test, and specification of margin of error and confidence level (Czibor, Jiménez-Gomez & List, 2019) [30]. The null hypothesis in this game is that there is no difference in pricing in a standard Bertrand-style game, regardless of participants' predilection for alcohol (see Section 6.2). The alternative hypothesis is that individuals with a predilection for alcohol will price different than individuals without a predilection for alcohol (see DBQ in Table 2). Multiple linear regression and random effects estimation are used to analyze the data. Due to budgetary restrictions, the sample size is fixed at $n = 59$, and the margin of error is consequently variable. Through preemptive power analysis, I calculated that the margin of error is approximately .06, which is satisfactory for statistical purposes (see Section 6.4), especially since the study induces statistical replication. Clearly, the hypothesis is not altered when the game changes – mathematically, the strategy in both games is identical: price at the point $p_{rational} = mc_i + v_i$ (see Section 6.1).

Table 1: Summary Statistics

	mean	sd	min	max
Guess	40.7069	32.53076	0	100
Agreeableness	.2312182	.1561087	-.1428571	.5
Conscientiousness	.2383466	.1921596	-.3333333	.4444444
Extraversion	-.0481356	.2861109	-.67	.33
Neuroticism	-.1211426	.264985	-.5	.5
Openness	.2685199	.1721416	-.25	.5
Age	19.84746	1.955839	18	29
Gender	.5762712	.4942207	0	1
DBQ	14.85048	9.308823	1	36.25
PBS	3.924224	1.107479	1.785714	6
Business	.3050847	.4605106	0	1
Economics	.0508475	.2197182	0	1
STEM	.3559322	.4788648	0	1
Lagged_Guess	41.33285	32.35244	0	100
Lagged_Opponents_Guess	41.30158	32.34398	0	100
Session	.5	.5000731	0	1

4 Results

In Table 1, all descriptive statistics are provided for all the variables used in subsequent regressions. *Agreeableness*, *Conscientiousness*, *Extraversion*, *Neuroticism*, and *Openness* represent the five components of the NEO5-20. *Contextual Game* (contextual framework) is a categorical variable representing the current experimental session.[30] *Guess* is the guess (2/3 average game) or price (Bertrand game) that each participant made in each of the 30 rounds, over the two *Contextual Games*. *Lagged Guess* and *Lagged Opponent's Guess* then, represent a one-period lag for the participant's guess and opponent's guess, respectively. *DBQ* is the aggregate binge-drinking meta score, where higher scores represent tendencies indicative of binge drinking. *PBS* is the aggregate protective behavioral strategies meta score, where higher scores represent more efficient protective behavioral strategies.[31] *Business*, *Economics*, and *STEM* represent three categorical constructions of college students' majors, with all other majors as the base.

From Figure 1,[32] the general trend of participants' guesses over 60 rounds is elucidated. Participants' guesses initially start high, average out around

the experimental and control groups; the higher the power, the lower your probability becomes of making a type II error.

[30] *Contextual Game* = 1 represents the 2/3 average game. *Gender* = 1 represents females. For one of the observations, *Gender* was neither female or male, which was the impetus for dropping it from the model.

[31] A score of 6 represents an individual who has never drank alcohol before, or a individual who has only consumed alcohol in an incredibly controlled environment.

[32] *Average Guess* is the average guess of all participants in a round, dispersed over the 60 rounds; the same holds true for *Average Profit*.

round 10, and then drop precipitously immediately before the *Contextual Game* ends. In the Bertrand game, participants' guesses are consistently higher than their previous guesses in the 2/3 average game. I believe this has to do with the contextual framework of the game, as shown in Figure 6 and Figure 4.

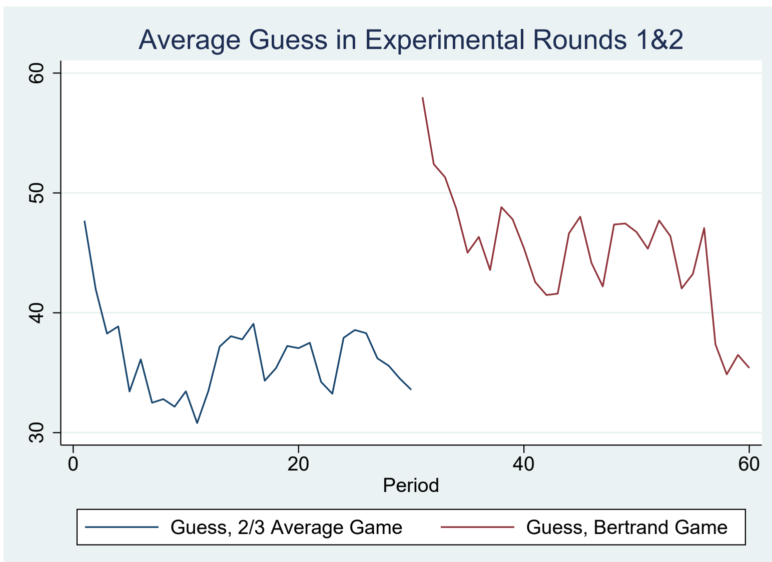


Figure 1: Average Guess Over 30 rounds in Two Experimental Games

In Figure 6, I adjust the second contextual framework by a 2/3 multiplier, in order to account for the otherwise irrational occurrence between participants' guesses across the two *Contextual Games*. This occurence is likely due to the anchoring bias (Thaler & Sunstein 2009) [91], which states that priming can skew participants' choices, even under mathematically identical circumstances, a predictably irrational occurence. When this adjusment is made, participants' guesses are slightly lower in the second *Contextual Game*.

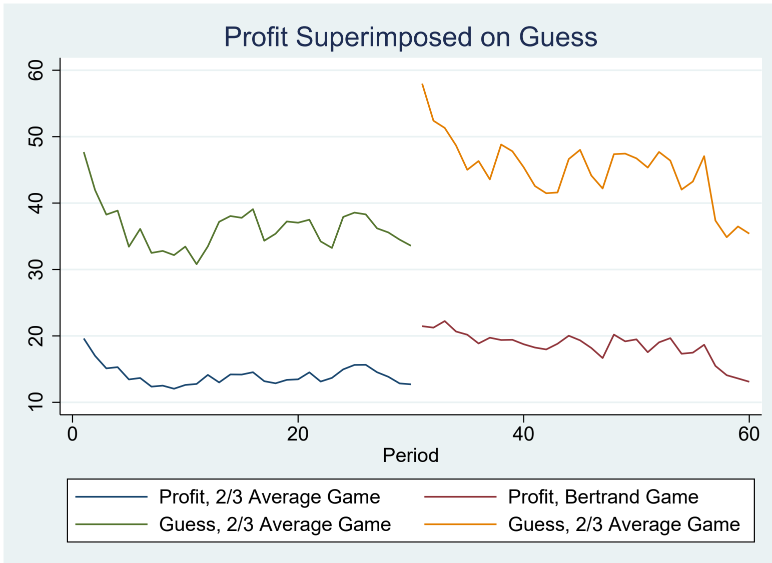


Figure 2: Average Guess and Average Profit over 30 rounds in Two Experimental Games

From Figure 5 and Figure 6, there appears to be a consistent trend among the various experimental sessions. Graphically, the only outlier is in the fourth experimental session during the first *Contextual Game*. In this session, participants asked significantly more questions than any of the participants in the previous experimental sessions, which could explain why their guesses were higher – on average, they were more informed of the optimal strategy. Overall, Figure 5 and Figure 6 reveal that the data is functioning, more or less, in precisely the way theory would predict. In Figure 3, I adjust *Guess* by the probability of winning – which should, hypothetically, be .5. The adjustment is made under the assumption that participants are implicitly adjusting for their probability of winning. Assuming this – and under the assumption that the minimum wage is a sufficient proxy for participants' value of time function – Figure 4 shows that participants' profit approximates the minimum wage, which supports the hypothesis in Section 6.1 and explains why participants do not outright leave the experiment, the postulated NE in this experiment (see Table 6).

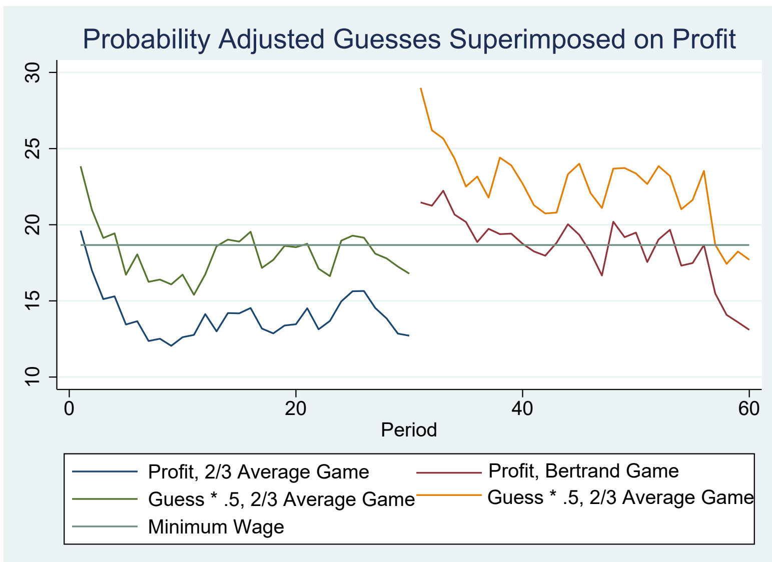


Figure 3: Average Probability-Adjusted Guess and Average Profit over 30 rounds in Two Experimental Games

In Table 2, I use multiple linear regression (OLS) and random effects estimation to analyze the experimental results. The OLS estimation is generated

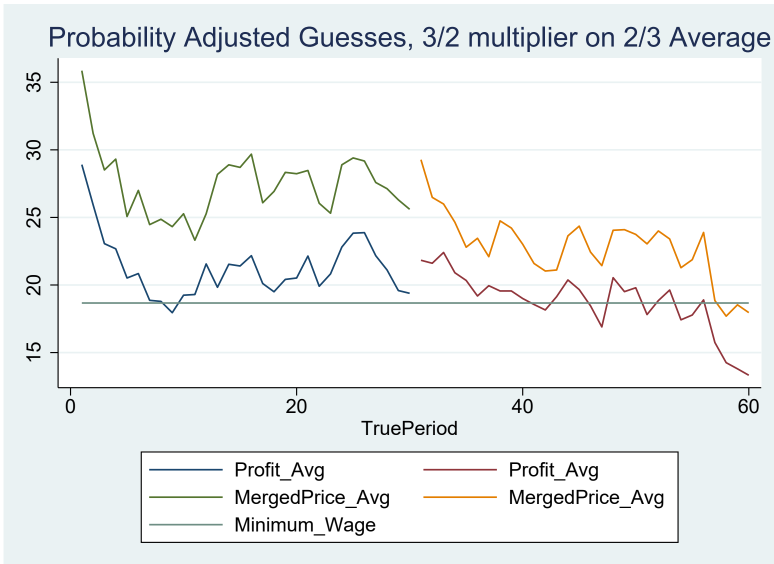


Figure 4: Average Probability-Adjusted Guess and Contextual-Framework Adjustment over 30 rounds in Two Experimental Games

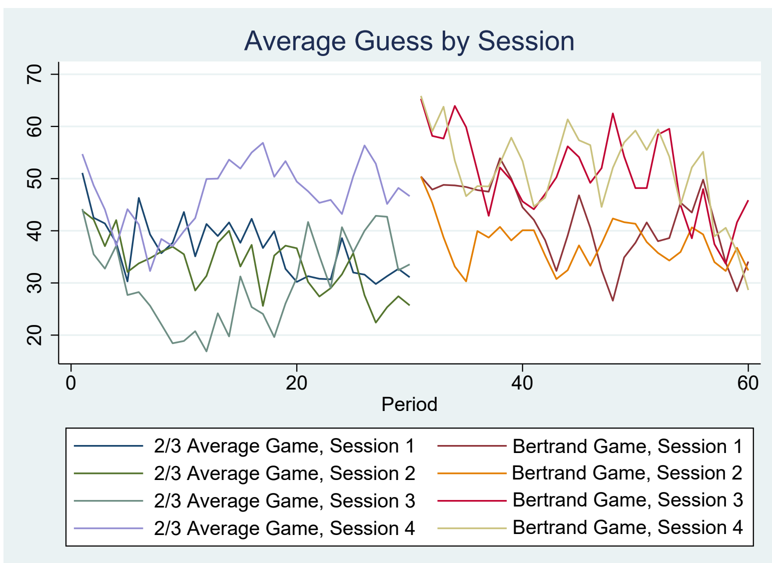


Figure 5: Average Guess over 30 rounds in Two Experimental Games

Table 2: Multiple Linear Regression and Random Effects Estimation

	(1) OLS DBQ	(2) OLS Guess	(3) OLS Guess	(4) OLS Guess	(5) OLS Guess	(6) RE Guess	(7) RE Guess
Agreeableness	-5.394*	19.44*	6.019+	6.404*	6.203+	6.404+	6.203+
	(1.017)	(3.511)	(3.150)	(3.169)	(3.186)	(3.731)	(3.639)
Conscientiousness	9.514*	3.353	-0.876	-0.300	0.167	-0.300	0.167
	(0.738)	(3.108)	(2.182)	(2.187)	(2.223)	(3.067)	(3.015)
Extraversion	-2.009*	2.098	-1.366	-2.214	-2.536+	-2.214	-2.536
	(0.548)	(2.263)	(1.462)	(1.476)	(1.487)	(2.289)	(2.338)
Neuroticism	10.29*	-10.27*	-1.754	-2.609	2.969	-2.609	2.969
	(0.550)	(2.624)	(1.678)	(1.670)	(3.252)	(2.545)	(4.380)
Openness	-11.66*	16.08*	0.528	0.856	0.184	0.856	0.184
	(0.781)	(3.274)	(2.064)	(2.060)	(2.077)	(3.975)	(3.988)
Age	0.764*	-1.139*	0.0297	0.138	0.103	0.138	0.103
	(0.0743)	(0.267)	(0.184)	(0.185)	(0.183)	(0.286)	(0.292)
Gender	-0.876*	-10.96*	-3.502*	-1.914*	-2.128*	-1.914	-2.128
	(0.339)	(1.181)	(0.864)	(0.902)	(0.894)	(1.381)	(1.363)
DBQ		0.176+	-0.0294	0.608*	0.610*	0.608*	0.610*
		(0.0928)	(0.0632)	(0.201)	(0.200)	(0.275)	(0.269)
PBS		-0.755	-0.690	0.971	1.250+	0.971	1.250
		(0.750)	(0.568)	(0.744)	(0.759)	(0.973)	(1.021)
Business			-0.980	-1.220	-0.654	-1.220	-0.654
			(1.060)	(1.062)	(1.084)	(1.284)	(1.381)
Economics			-1.874	-1.632	-1.441	-1.632	-1.441
			(1.334)	(1.355)	(1.354)	(2.533)	(2.507)
STEM			0.568	0.682	1.155	0.682	1.155
			(0.908)	(0.911)	(0.954)	(1.512)	(1.614)
Lagged Guess			0.464*	0.458*	0.456*	0.458*	0.456*
			(0.0203)	(0.0204)	(0.0204)	(0.0351)	(0.0351)
Lagged Opponent's Guess			0.382*	0.380*	0.380*	0.380*	0.380*
			(0.0194)	(0.0193)	(0.0193)	(0.0255)	(0.0256)
Contextual Game			-1.187	-1.261+	-1.276+	-1.261	-1.276
			(0.721)	(0.721)	(0.720)	(0.878)	(0.878)
PBS*DBQ				-0.168*	-0.172*	-0.168*	-0.172*
				(0.0489)	(0.0490)	(0.0718)	(0.0710)
(PBS*DBQ) * Neuroticism					-0.0899*		-0.0899
					(0.0435)		(0.0637)
Constant	3.446*	59.64*	9.524*	-1.034	-1.004	-1.034	-1.004
	(1.568)	(5.107)	(4.175)	(5.068)	(5.060)	(8.581)	(8.416)
N	3540	3540	3422	3422	3422	3422	3422
R^2	0.174	0.067	0.610	0.611	0.612		

Robust standard errors in parentheses
"Reg, robust" $\Longrightarrow$ Regressions 1-5
"Xtreg, vce cluster(ClientNumber)" $\Longrightarrow$ Regressions 6-7
+ p<0.10, * p<0.05

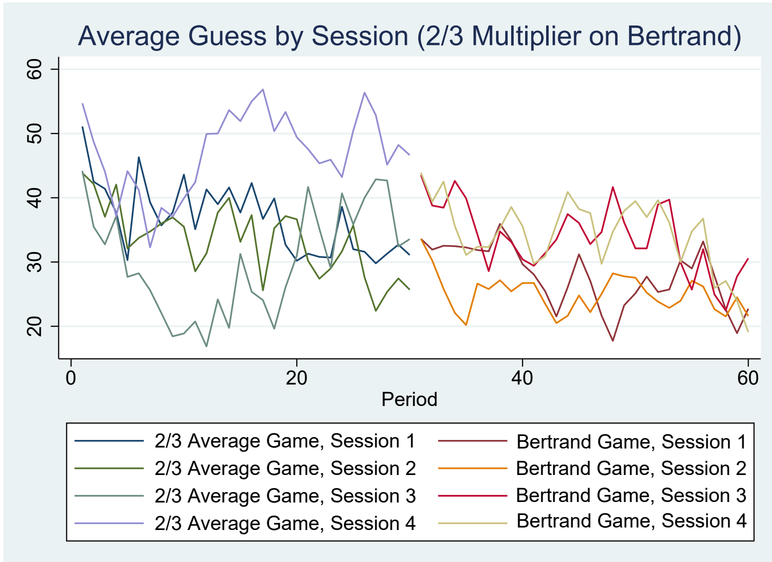


Figure 6: Average Guess over 30 rounds in Two Experimental Games, Stratified by Session

from the following model,

$$\begin{aligned}\widehat{Guess}_{it} &= \beta_1 * Agreeableness_i + \beta_2 * Conscientiousness_i + \beta_3 * Extraversion_i \\ &+ \beta_4 * Neuroticism_i + \beta_5 * Openness_i + \beta_6 * Age_i + \beta_7 * Gender_i + \beta_8 * DBQ_i \\ &+ \beta_9 * PBS_i + \beta_{10} * Business_i + \beta_{11} * Economics_i + \beta_12 * STEM_i \\ &+ \beta_{13} * Lagged\_Guess_i + \beta_{14} * Lagged\_Opponent's\_Guess_i + \varepsilon. \end{aligned} \tag{1}$$

The random effects estimation is sufficient in cases where the following assumption holds: $\alpha_i = \alpha$, the unobserved effect, has zero mean and is uncorrelated with the explanatory variable in all time periods. Typically, fixed effects estimation eliminates α_i; however, since I control for individual-level effects in the experiment, a transformation method that eliminates α_i results in inefficient estimators. By utilizing random effects, the intercepts of each observation are drawn from a common distribution. Therefore, the random effects estimation can be generated from the following model,

$$\begin{aligned}\widehat{Guess}_{it} = {} & \beta_1 * Agreeableness_i + \beta_2 * Conscientiousness_i + \beta_3 * Extraversion_i \\ & + \beta_4 * Neuroticism_i + \beta_5 * Openness_i + \beta_6 * Age_i + \beta_7 * Gender_i \\ & + \beta_8 * DBQ_i + \beta_9 * PBS_i + \beta_{10} * Business_i + \beta_{11} * Economics_i \\ & + \beta_1 2 * STEM_i + \beta_{13} * Lagged\_Guess_i + \beta_{14} * Lagged\_Opponent's\_Guess_i \\ & + \alpha + \varepsilon_{it} + \mu_i,\end{aligned} \quad (2)$$

where α, the expected value of each of the unobserved effects, is now a constant (across all panel units and across all time periods), μ_i represents the variation in the unobserved effect around the mean, $t = 60$ is the total number of panels, and $i = 59$ represents the total number of people in each of the panels. Wooldridge (2020)[98] shows that, under the set of assumptions presented in Section 6.3, random effects estimation is more efficient than any statistical alternatives, an extrapolation of quasi-demeaned data on each variable.

In the first regression,[33] I regress DBQ on the personality variables. Most of the personality variables are moving in the expected direction, including

[33] In all regressions, robust standard errors are used to correct for heteroskedasticity.

a positive effect of *Conscientiousness* and *Neuroticism* on *DBQ*, and a negative effect of *Agreeableness* and *Openess* on DBQ, which corresponds with the results of Hakulinen (2015), Turiano et al. (2012), and Martin, Benca-Bechman, and Palmer (2021) [49] [94] [67]. The only difference is the negative effect of *Extraversion* on *DBQ*, although this effect could be explained by a low coefficient of determination. In Regressions 2-7, I use participants' guesses as the dependent variable.[34]

The fourth regression introduces an interaction term between *DBQ* and *PBS*, which is statistically significant at the five percent significance level; additionally, *DBQ*, in itself, becomes statistically significant at the five percent significance level. Both of the coefficients on *DBQ* and *PBS* are positive, while the interaction term $DBQ * PBQ$ is negative. Initially, the coefficient of *DBQ* is surprising, as it indicates that binge drinking is increasing participants' guesses. However, closer examination of Regression 3 shows that *DBQ* and *PBS*[35] are negative before the interaction term is added. Therefore, $DBQ * PBS$ is altering the direction of the coefficient of *DBQ* and *PBS*. I believe this indicates that binge drinking, in and of itself

[34]In Table 9, I incorporate *Profit* as the dependent variable. These results do not show the same significance shown in Section 4. *Openness* is the only variable that has statistical significance. The reason for this, I believe, is that individuals who score higher on metrics of *Openness* are more likely to collude, thereby increasing their profit. The reason why other variables are not statistically significant is that *Profit* is a deterministic variable, rather than an arbitrary one.

[35]*PBS* regressed on Guess also reveals that the coefficient is negative. However, in almost every regression, *PBS* is statistically insignificant, indicating that protective behavioral strategies, in and of themselves, do not have an effect on pricing in a standard Bertrand-style game.

(as proxied by DBQ), does not necessarily decrease participants' guesses, at least among college students. However, when binge drinking is paired with variations of protective behavioral strategies (as proxied by PBS), it induces more cooperative pricing, an effect that persists across both *Contextual Games* (as shown by the negative coefficient of $(DBQ * PBS)$). This is a unique result that positively contributes to the preexisting literature.

Table 3: Interaction Evaluation

Change in $Guess$

	$DBQ = 30$ (+)	$DBQ = 1$ (-)
$PBS = 2$ (+)	10.10	N/A
$PBS = 6$ (-)	-6.17	5.43

Average values: DBQ = 14.85 & PBS = 3.92 $\implies \triangle Guess = 3.06$.
"N/A" is an individual who does not drink, but has good protective behavioral strategies while drinking, an inherent contradiction. This individual does not exist.

Specifically, the marginal effect of DBQ, as shown in Regressions 4 and 6, is

$$\frac{\partial Guess}{\partial DBQ} = .608 - .168 * PBS. \tag{3}$$

The marginal effect of PBS, as shown in Regressions 4 and 6, is

$$\frac{\partial Guess}{\partial PBS} = .971 - .168 * DBQ. \tag{4}$$

Plugging in the average values from Table 1 indicates that the marginal effect of DBQ is actually positive. Table 3 shows an evaluation of the interaction term in a *2 X 2* matrix. Binge drinking with poor protective behavioral strategies increases participants' guesses by 10.10. Further, zero alcohol consumption – which implies good protective behavioral strategies – also increases participants' guesses by 5.43. On average, participants' guesses increase by 3.06, as a result of their DBQ and PBS scores. However, binge drinking with good protective behavioral strategies decreases participants' guesses by 6.17. There are multiple plausible explanations for this result, although I do not assert that any of these are necessarily causal in nature. In Fielding, Knowles, and Robertson (2018) [43], their results show that individuals who drink more exhibit less generosity. Extrapolated to this study, it is plausible that individuals who score high on the DBQ and low on the PBS[36] are less generous in their guesses – and by consequence, less likely to cooperate – compared to their high scoring PBS counterparts. However, this does not fully explain why individuals who score low on both metrics are more likely to cooperate. Additionally, I controlled for *Agreeableness* in the experiment, thereby cirumventing the "cooperation argument." Instead, there is likely something specific to high DBQ and low PBS participants – perhaps in their brain chemistry – that causes significant alterations in the way they price. Alternatively, or perhaps contemporaneously, an individual

[36]When I reference low PBS, I specifically mean an individual with poor protective behavioral strategies, or an individual who scores high on the PBS.

who scores high on the DBQ and low on the PBS may be less naive than their low DBQ and low PBS counterparts, thereby causing them to decrease their $Guess$. The precise way that the causality runs is not integral to this study; rather, knowing that this relationship exists, in the long run, is the result I was hoping to identify.

In the fourth regression, *Agreeableness* is statistically significant, which is consistent with Turiano et al. (2012) [94]. $Neuroticism$ is not statistically significant in Regressions 3-7, although the direction of the coefficient is moving in the right direction. Regression 5 adds a second interaction term, $(DBS * PBS) * Neuroticism$, which provides evidence that $Neuroticism$ likely has an affect on Binge Drinking, in some capacity, which is supported by Brocklebank, Lewis and Bates 2011, Lönnqvist, Verkasalo, and Walkowitz (2011), and Kurzban & Houser 2001 [17] [64] [59], although this effect dissipates in Regression 7.[37] *Age* is statistically insignificant in all regressions, and *Gender* is statistically significant in Regressions 3-5, with this effect dissipating, once again, under random effects estimation. *Lagged Opponent's Guess* and *Lagged Guess* are statistically significant in every regression, which is to be expected, given participants' guesses are a direct response to what occurred in the last round. The effect of *Contextual Game* is ambiguous. As

[37] In Regressions 5 and 7,

$$\frac{\partial Guess}{\partial Neuroticism} = 2.969 - .0899 * PBS * DBQ. \quad (5)$$

Plugging in average values indicates that the marginal effect ($\triangle Guess = -2.26$) is negative.

shown in Figure 5, when *Bertrand* is adjusted by 2/3 – which is the difference in the contextual framework (see Section 3 – the graphs equalize.

5 Conclusion

5.1 Limitations

The results of this paper indicate that binge drinking, when paired with poor protective behavioral strategies, increases cooperative pricing in a standard Bertrand-style game, with this result persisting among various contextual frameworks. Because the sample is limited to college students, the results cannot be generalized to any population outside of college students.[38] Given the diverse group of people sampled, I believe the results can be generalized to college campuses. However, there needs to be some degree of homogeneity in the college campus population structures to elicit identical results. For example, this trend will likely hold at South Dakota State University, but may disintegrate when extrapolated to Ivy League Colleges.[39] Future replication could attempt to integrate a proxy for *Ability*, which would procure generalization among different college campus population structures, although ability is notoriously difficult to successfully proxy, and is not controlled for in Fielding, Knowles, and Robertson (2018) [43]. Additionally, the sample size

[38] See Czibor, Jiménez-Gomez & List (2019) [30] and Jones et al. (2022) [57] for the dangers of extrapolating results beyond the local group sampled.

[39] At the very least, a subsequent study needs to be run in order to ascertain where this trend persists across schools of differing ability.

is slightly lower than I would have procured under idealistic circumstances. However, as shown in Section 6.4, the margin of error is sufficiently low for experimental results, especially since the data was collected over 60 rounds.

During the experiment, after the instructions were read aloud, examples were shown to every group; the examples were not built into the experiment, thereby inadvertently manufacturing a priming mechanism that could have altered experimental results. Additionally, there were a handful of participants who filled out the questionnaire prior to conducting the experiment, while waiting for the experiment to begin, which could have, once again, inadvertently primed the individuals. However, as shown in Figure 5, participants' guesses were relatively stable among the four experimental sessions, indicating that any inadvertent priming did not bias the experimental results. To surmise, while certain components of the experiment were flawed, the distribution of participants' guesses by experimental session (Figure 5) and the implementation of literature-backed control tests (see Table 7 in Section 6.5) suggest that these flaws did not distort the experimental results.

5.2 Future Research

There are multiple avenues for future research, based on the results of this paper. While my study cannot conclude that high DBQ low PBS individuals are more likely to cooperate in a real market, it does suggest that this relationship may exist. Future research could use lab experiments in conjunction with randomized control trials (RCTs) to determine whether reported alcohol consumption increases binge drinking in a bargaining game. For instance, suppose that a predictive relationship exists between high DBQ low PBS individuals and cooperation in a standard bargaining game. If the customer data is saturated enough, companies could integrate these results into algorithmic targeting. Amazon, for instance, uses a conglomeration of miniaturized experimental pricing methods in conjunction with machine-learning (ML) algorithms to predict the elasticity of pricing for individual shoppers (Cooprider & Nassiri 2024; Chen, Mislove & Wilson 2016) [25] [21]. By preemptively integrating – into ML algorithms – the knowledge that binge drinking individuals with poor protective behavioral strategies price more cooperatively in the market, Amazon[40] could market distinct products to specific individuals. For example, suppose that Amazon knows that an individual is college aged, and based off recent purchases of college supplies (dorm supplies, class supplies, etc.) and drinking supplies (clothing brands, drinking supplies, alcohol, etc.), they conclude that an individual is a binge drinker.[41] If they can also conclude that an individual utilizes poor protective behavioral strategies,[42] they would be able to preemptively adjust for coop-

[40]While Amazon dominates the e-commerce community, there are a number of corporations, with large databases of aggregate consumer data, for which this could be beneficial.

[41]Note that, in order for this to be a profitable strategy for Amazon, they do not need to predict this with perfect accuracy, but rather within a predetermined interval of acceptance.

[42]While more difficult to quantify, my inclination is that some of the same components that could be tracked to binge-drinking college students could also be tied to poor protective strategies among those college students. For example, suppose that a college student orders 1000 solo cups and ten ping pong balls. This would imply a high probability of binge

erative pricing in their algorithms. Clearly, this linkage is not proven in this paper, but future research could elucidate the true extent of this relationship.

This study contributes to the literature by evaluating the effect of observational binge-drinking meta scores on performance in a Bertrand-style game, building off the results initially presented in Fielding, Knowles, and Robertson (2018) [43]. Recapitulated, the results of this paper indicate that binge drinking, when paired with poor protective behavioral strategies, increases cooperative pricing in a Bertrand-style game, with this result persisting among various contextual frameworks.

drinking *and* poor behavioral strategies. This information could be used to improve price targeting. Doing this preemptively, rather than as a consequence of time-based purchases, could generate profit over time.

6 Appendices

6.1 Appendix A: Nash Equilibrium Derivation

Proposition. *Assume that there are two individuals in each market, where* I *represents the total number of players in all markets, and* $i, j \in I$ *represents all possible participant-pairs in* I*. Additionally, assume that there are* n *total rounds in each experimental game and* N *total rounds overall, both of which are known by both participant-pairs in all markets. Assume* $MC = 0$ *(that is, that the marginal cost,* mc_i *of all individuals in the market is equal to zero), individual players assume the role of firms, and* $t = time > 0$*. Therefore, the NE for player* i *is to set* $p = 0$*, where profit,* $\pi_i, = 0$*. Now, assume that the value of time, for player* i*, is* $u(t)_i > 0$*, where utility is a function of time; also, assume that there is necessarily a bijective function,* z_i *that exists from* $u(t)_i$ *to* c_i*, where the corollary output* $v_i = c((u(t)_i)_i$ *(the value of time function) is a cost function that is dependent on* $u(t)_i$*.*

Proof. $u(t)_i$ implies that there is a utility function for player i that is dependent on time. By the law of diminishing marginal utility, we know that, for all $t \in \mathbb{R}^+$, there exists a unique output for $u(t)_i$. Further, this unique output has a discrete cost associated with it, c_i. We[43] note that cost is an arbitrary metric with no units, but when actualized, it takes on a definite value.

[43] The change in the point of view to "we" is conducive to mathematical proofs.

Suppose, for an arbitrary player i, there exists a unique $x \in \mathbb{R}^+, y \in \mathbb{R}^+$ such that $u(x)_i = a$ and $u(y)_i = b$. Further, assume that $z(a)_i = z(b)_i$, which implies that $c(a)_i = c(b)_i$, and as such, $a = b$. However, by the law of diminishing marginal utility, if $a = b$, then $x = y$, a clear contradiction, given that we assumed x and y are unique. Hence, z_i is injective.

Next, let C be the collection of all outputs from c_i. By definition, all $x \in \mathbb{R}^+$ since $t' > 0$, which implies that $u(t')_i = e$ and $e \notin C$. Since $e \notin C, e \in C^+ \subseteq \mathbb{R}^-$. This is absurd, since $t' \in \mathbb{R}^+$. Thus, z_i is surjective.

Hence, z_i is necessarily bijective, defined as $z_i = v_i = c((u(t)_i)_i : u(t)_i \rightarrow c_i$. This definition will be important as we proceed. $\square$

Theorem. *Under these parameters, the NE is to set $p_{rational} = mc_i + v_i$ which is, by definition, greater than zero.*

Proof. Suppose, for the sake of contradiction, that $p = mc_i$ is the NE. Thus, no player i can be made better off by altering their strategy, which is to set $p = 0$. Recall that $t > 0$, since it exists in the context of the value of time function, $u(t)_i$. Yet, for any arbitrary player, their utility is not optimized by offering free labor. Assume that there are two players i and j competing against one another. Additionally, assume that the value of time functions for all participants are relatively homogeneous; thus, $v_i \approx v_j$.

From Table 1, we can see that the NE is $(p = mc_i + v_i, p = mc_i + v_i)$.

Table 4: Value of Time Function Compared to Strict Marginal Cost

Player i

		$p = mc_i = 0$	$p = mc_i + v_i$
Player j	$p = mc_j = 0$	$(0, 0)$	$(0, \underline{v_i})$
	$p = mc_j + v_j$	$(\underline{v_j}, 0)$	$(\underline{\frac{v_j}{2}}, \underline{\frac{v_i}{2}})$

Underlined utility outcomes imply best strategies.

Now, suppose that player i can price at $p = x > mc_i + v_i$ and player j can price at $p = y > mc_j + v_j$ and suppose that $x > y$. From Table 2, we see that the NE is $(p = mc_i + v_i, p = mc_i + v_i)$, the same as Table 1.

Without loss of generality, $y > x$ gives us the same NE.

Table 5: Value of Time Function Compared to all Prices Above it, $x > y$

Player i

		$p = mc_i + v_i$	$p = x > mc_i + v_i$
Player j	$p = mc_j + v_j$	$(\underline{\frac{v_j}{2}}, \underline{\frac{v_i}{2}})$	$(\underline{v_j}, 0)$
	$p = y > mc_j + v_j$	$(0, \underline{v_i})$	$(0, y)$

Underlined utility outcomes imply best strategies.

The final case $y = x$, gives us slightly different results. From Table 3, we can see that their are two NE: $(p = mc_i + v_i, p = mc_i + v_i)$, $(p = y >$

$mc_j + v_j, p = x > mc_i + v_i$). In itself, this case is statistically unlikely. However, as a product of tacit collusion, this becomes a factor of interest.

Table 6: Value of Time Function Compared to all Prices Above it, $x = y$

		Player i	
		$p = mc_i + v_i$	$p = x > mc_i + v_i$
Player j	$p = mc_j + v_j$	$(\underline{\frac{v_j}{2}}, \underline{\frac{v_i}{2}})$	$(v_j, 0)$
	$p = y > mc_j + v_j$	$(0, v_i)$	$(\underline{y}, \underline{x})$

Underlined utility outcomes imply best strategies.

□

Definition. *Technically, v_i is simply an extension of mc_i; economically, $v_i = mc_i$. Marginal cost, in a firm setting, integrates all of the inputs of the factors of production. Extrapolated to an individual, in this specific setting, the designated "marginal cost" is not the actual marginal cost. Therefore, $p_{rational}$ is simply an extension of the NE presented in Nash (1951) [73].*

In all of these scenarios (except for the tacit collusion outcome in Table 3), the conclusion is absurd: the NE is to leave the experiment. If the value of time for an individual i is v_i and the NE is to price at $\frac{v_i}{2}$, a rational agent would leave the market. However, this assumes that payout streams are transparent, individuals are acting rationally in accordance with these payout streams, sustained tacit collusion is not possible, and individuals are able to correctly denominate the value of their time in juxtaposition with their price selection – assumptions we do not have the luxury of making in this experiment. Consider the model presented in Levitt and List (2008) [62]: $U_i(a, v, n, s) = M_i(a, v, n, s) + W_i(a, v)$, where:

$$\begin{cases} W_i \text{ is a wealth function for an individual } i \\ U_i \text{ is a utility function for an individual } i \\ a \text{ is a single action choice that an individual } i \text{ is placed with} \\ v \text{ is the value of the game} \\ n \text{ are the social norms against action } a \\ s \text{ is the level of scrutiny in the lab} \end{cases}$$

In the context of this irrational framework, interpreting $p_{rational}$ becomes increasingly cogent. Anonymity has greatly reduced the effect of n and s, and as long as the effect of n is not attenuated, the proposed model remains salient. Both n and s explain why individuals fail to conform to the NE. Extrapolated to the aforementioned model, $p_{rational} = v_i = c((u(t)_i)_i = c((w(t)_i + m(a, v, n, s)_i)_i$. Any discrepancies between the participants' value of time function and π_i must subsequently be explained by $(m(a, v, n, s)_i)_i$.

6.2 Appendix B: Hypothesis Derivation

Assume that there is a finite set of control metrics for player i, $F = f_1, f_2 ... f_x$, where $x \in \mathbb{N}$. Let BD_i (BD_i = Binge Drinking index) be the predilection for alcohol for a College Student $i \in \mathbb{N}$, and let BD_j be the predilection for alcohol for a College Student $j \in \mathbb{N}$, where the predilection for alcohol is the conglomerate of the measures in the DDQ. In the set F, let there exist an element f_y such that $f_y = BD_i$ and $y \leqslant x$ for some $y \in \mathbb{N}$, which is the predilection of alcohol for a individual $i \in \mathbb{N}$. This element can be used to determine the specific hypothesis (Section 3).

Proposition. *Assume that there is a clear ordering preference such that* $BD_i \geqslant BD_j$ *for all* $i \in \mathbb{N}$ *and* $j \in \mathbb{N}$.

Proof. Assume, for the sake of contradiction, that there exists an element $BD_k \in F$ for some individual $k \in \mathbb{N}$ such that $BD_k > BD_i$. This implies that the predilection for alcohol for some individual k is greater than the predilection for alcohol for some individual i. Yet, we assumed that $BD_i \geqslant BD_j$. This violates the well-ordered principle, namely that $BD_i \geqslant BD_k$, and as such, we have arrived at a contradiction. □

Let S_m be the collection of all elements BD_i and K_n be the collection of all elements BD_j, for all samples $m \in \mathbb{N}$ and $n \in \mathbb{N}$, where $m = n$ is necessarily true. I will treat every element collected from each experimental sample as unique, regardless of overlap (note that the overlap of elements does not necessarily constitute an equivalent relationship).

Proposition. *Let O_i be the collection of all elements z_i, and suppose that T_m, $L_n \subseteq O_i$. Now, suppose that there exists a bijective function $b_i : S_m \to T_m$, $d_i : K_n \to L_n$ such that $x \in b_i$ and $y \in d_i$ is a unique participant-pair.*

Proof. This follows trivially from the definition of a bijective function. □

The specific hypothesis then, are:

$$\begin{cases} H_O : \quad T_n = L_m \\ H_A : \quad T_n \neq L_m \end{cases}$$

which is expanded on in Methodology.

6.3 Appendix C: Random Effects Estimation Derivation

Random effects requires that the unobserved effects are drawn from a common distribution, which remains constant over time. First, consider the generalized panel model,

$$\widehat{Guess}_{it} = \beta_i * X_{it} + A_i * Y_{it} + \varepsilon_{it}, \tag{6}$$

where A_i (which is a matrix, as all subsequent variables in this model are)[44] contains the theoretical values for all variables that have an unobserved effects, Y_{it} contains the actual population values for those unobserved effects, X_{it} contains the set of independent variables, β_i is the actual population value for each of the independent variables, ε_{it} is the error term, i is an index representing the number of panel units, and t is an index representing the number of time periods. Now, consider the generalized fixed effects model,

$$\widehat{Guess}_{it} = \beta_i * X_{it} + D_{it} * \kappa_i + \varepsilon_{it}, \tag{7}$$

where D_{it} is a dummy variable for the the unobserved effect, and κ_i is the population values for the unobserved effects. Under this model, the $Var(X_i, \kappa_i) \neq 0$, and thus the inclusion of $D_{it} * \kappa_i$ (a matrix of $\delta \in \mathbb{R}$

[44] $\beta_i * X_{it} = X_{it} * \beta_i$ is needed for the matrices to confirm to matrix multiplication. All subsequent matrices confirm to the principles of matrix multiplication, although the number of rows in the unobserved effect

unknown unobserved effects) introduces a group-specific effect that counteracts the omitted variable bias circumventing the unobserved effects that are inherently immeasurable ($A_i * Y_{it}$). Now, given that I am controlling for the unobserved effects, by conducting an experiment, the assumption that $Var(X_i, \kappa_i) \neq 0$ is not necessarily true. In fact, for random effects, I will assume that the $Var(X_i, \kappa_i) = 0$ (or is marginally close to zero, juxtaposed to the variance of the other variables). (A complaint could be levied that the omission of *Ability* violates this assumption. However, given that this effect is measurable, at least in theory, it is more likely to be encapsulated in ε_i. Further, suppose, for argument's sake, that *Ability* is correlated with the regression variables. Even in this case, it is unlikely that this covariance is larger than the variance of the individual regression variables.) Therefore, I can assume that the unobserved effects are distributed around a common mean, and that this value is constant across all time periods, or that $\mathbb{E}(A_i * Y_{it}|X_i) = \alpha$ (as defined in Wooldridge [2020] [98]). Therefore, the random effects equation becomes

$$\widehat{Guess}_{it} = \beta_i * X_{it} + A_i * Y_{it} - \mathbb{E}(A_i * Y_{it}|X_i) + \mathbb{E}(A_i * Y_{it}|X_i) + \varepsilon_{it}, \quad (8)$$

where $\mathbb{E}(A_i * Y_{it}|X_i) = \alpha$, or the time-invariant value distributed across a common mean, by definition, and $A_i * Y_{it} - \mathbb{E}(A_i * Y_{it}|X_i) = \mu_i$, or the variation of the unobserved effects around the mean. Therefore,

$$\widehat{Guess}_{it} = \beta_i * X_{it} + \mu_i + \alpha + \varepsilon_{it}, \tag{9}$$

or the value previously derived (see [Date 2022] [31] for inspiration). Therefore, random effects provides efficient estimators, given that the $Var(X_i, \kappa_i) \approx 0$, an assumption that holds in my paper. In Fielding, Knowles, and Robertson [43], they estimate their regression using a Tobit regression model. This makes sense, given the truncated dependent variable. However, once panels are introduced, using Tobit estimation – or even OLS estimation – results in inefficient estimators [88]. This is shown in Table 2, in which the random effects estimates appear to be more precise, compared to their OLS counterparts.

6.4 Appendix D: Power Analysis Derivation

Suppose that α = confidence level = .9,[45] which implies that the corresponding Z-statistic, $z = 1.65$.[46] Let the population proportion, $p = .5$. Now, I use the equation

$$n = \frac{z^2 \cdot p \cdot (1-p)}{e^2} \tag{10}$$

which implies that

$$n = \frac{1.65^2 \cdot /5 \cdot (1-.5)}{e^2}, \tag{11}$$

and subsequently $e_m \approx .11$. To reduce this number, there are two possible options: reduce the confidence level or increase the sample size, both of which are infeasible solutions. However, the selection of the initial p assumes that the results are generalizable to a larger population. This is clearly fallacious. I will assume that the results will only be locally generalizable; thus, I can assume that $n = 59 \in N \subseteq$ *College Students*. Under this assumption, the population proportion can be reduced dramatically, and treated almost as a variable indicator. In a survey conducted by the National Survey on Drug Use and Health, 7% of college students are categorized as frequent and heavy binge drinkers [90]. This is a sufficient proxy for the population proportion. Given the parameters of the study, and the preselected confidence level, I will assume that this number has increased since 2021 and generously set $p = .1$.

[45] Altering the confidence level to .95 only changes the margin of error (MOE) by 1 percent (MOE = .66).

[46] Preemptive power analysis can be sufficiently conducted by using the z-statistic as a proxy for the t-statistic. This does not precipitate a statistical dilemma.

Under this condition, $e_m \approx .06$, which is a tolerable amount of error for the experiment, especially since statistical replication mitigates power analysis concerns.

6.5 Appendix E: Additional Graphs

Table 7: Selected Interaction Terms as a Quality Check

	(1) DBQ	(2) DBQ	(3) DBQ	(4) PBS	(5) Gender
PBS	-3.069*				
	(0.0420)				
PBS*DBQ	0.230*				
	(0.00146)				
Impulse Control		34.09*			
		(1.283)			
DBQ*Impulse Control		-2.275*			
		(0.0636)			
Gender		-0.753*	-0.766*	-0.0199*	
		(0.305)	(0.310)	(0.00834)	
Age		0.531*	0.708*	0.00446*	-0.0258*
		(0.0659)	(0.0728)	(0.00225)	(0.00294)
Agreeableness		-0.264	-6.805*	-0.195*	-1.868*
		(0.840)	(1.137)	(0.0221)	(0.0541)
Conscientiousness		6.347*	7.765*	-0.0547+	0.161*
		(0.705)	(0.631)	(0.0287)	(0.0213)
Extraversion		-2.890*	-2.989*	-0.0220	-0.190*
		(0.494)	(0.504)	(0.0174)	(0.0130)
Neuroticism		6.064*	29.36*	-0.0973*	0.0857*
		(0.558)	(1.019)	(0.0151)	(0.0178)
Openness		-7.846*	-10.64*	-0.0433*	-0.125*
		(0.719)	(0.686)	(0.0205)	(0.0266)
Neuroticism*DBQ			-1.173*		
			(0.0686)		
Introspection				-6.083*	
				(0.0468)	
PBS*Introspection				1.651*	
				(0.00744)	
Gender*Agreeableness					2.845*
					(0.0250)
_cons	15.18*	5.401*	5.883*	3.642*	1.156*
	(0.206)	(1.426)	(1.594)	(0.0515)	(0.0623)
N	3540	3540	3540	3540	3540
R^2	0.943	0.315	0.298	0.965	0.740

Robust standard errors in parentheses
"Reg Robust" used for all regressions
+ p<0.10, * p<0.05

Table 8: Multiple Linear Regression and Random Effects Estimation: Including Introspection and Impulse-Control Facets

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	OLS	OLS	OLS	RE	RE
	DBQ	DBQ	Guess	Guess	Guess	Guess	Guess
Introspection	-10.14*	-19.23*	5.337	4.253	3.667	3.611	3.667
	(1.095)	(0.899)	(4.415)	(3.112)	(3.111)	(3.126)	(5.197)
Impulse_Control	-8.006*	-3.573*	-9.877*	1.726	1.127	2.914	1.127
	(0.791)	(0.710)	(3.196)	(2.495)	(2.504)	(6.048)	(3.567)
Agreeableness		-4.692*	22.08*	5.306+	5.855+	5.824+	5.855
		(1.073)	(3.555)	(3.077)	(3.107)	(3.105)	(3.919)
Conscientiousness		10.61*	5.663+	-2.028	-1.218	-1.433	-1.218
		(0.672)	(3.160)	(2.316)	(2.328)	(2.184)	(3.183)
Extraversion		-7.512*	2.307	-0.00523	-1.073	-1.101	-1.073
		(0.624)	(2.698)	(1.630)	(1.647)	(1.655)	(2.798)
Neuroticism		8.146*	-13.00*	-1.351	-2.349	-2.442	-2.349
		(0.606)	(2.854)	(1.930)	(1.933)	(1.935)	(2.906)
Openness		-8.007*	15.61*	0.279	0.652	1.000	0.652
		(0.725)	(3.339)	(2.083)	(2.079)	(2.248)	(4.010)
DBQ			0.219*	-0.0331	0.591*	0.594*	0.591*
			(0.0933)	(0.0626)	(0.202)	(0.201)	(0.272)
PBS			-0.262	-0.938	0.740	0.685	0.740
			(0.802)	(0.604)	(0.788)	(0.820)	(0.990)
Age			-0.919*	0.0673	0.172	0.175	0.172
			(0.289)	(0.192)	(0.193)	(0.194)	(0.297)
Gender			-11.51*	-3.422*	-1.897*	-1.862*	-1.897
			(1.184)	(0.855)	(0.894)	(0.903)	(1.378)
Business				-1.284	-1.501	-1.628	-1.501
				(1.173)	(1.175)	(1.210)	(1.254)
Economics				-2.312	-2.019	-2.121	-2.019
				(1.418)	(1.437)	(1.410)	(2.658)
STEM				0.331	0.491	0.405	0.491
				(0.908)	(0.913)	(0.917)	(1.447)
Lagged Guess				0.463*	0.458*	0.458*	0.458*
				(0.0203)	(0.0204)	(0.0204)	(0.0348)
Lagged Opponent's Guess				0.383*	0.380*	0.380*	0.380*
				(0.0194)	(0.0193)	(0.0193)	(0.0258)
Contextual Game				-1.185	-1.259+	-1.263+	-1.259
				(0.722)	(0.722)	(0.722)	(0.880)
PBS*DBQ					-0.164*	-0.169*	-0.164*
					(0.0492)	(0.0509)	(0.0708)
(PBS*DBQ) * Impulse Control						-0.0331	
						(0.0996)	
Constant	19.87*	27.14*	47.28*	8.256+	-2.157	-1.746	-2.157
	(0.669)	(0.642)	(6.865)	(4.961)	(5.822)	(5.932)	(10.31)
N	3540	3540	3540	3422	3422	3422	3422
R^2	0.048	0.210	0.070	0.610	0.611	0.611	

Robust standard errors in parentheses
"Reg, robust" $\implies$ Regressions 1-5
"Xtreg, vce cluster(ClientNumber)" $\implies$ Regressions 6-7
+ p<0.10, * p<0.05

Table 9: Multiple Linear Regression and Random Effects Estimation: Profit as the Dependent Variable

		(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	RE	RE
DBQ	0.167*	0.0621	0.106	0.105	0.106	0.105
	(0.0613)	(0.0499)	(0.165)	(0.165)	(0.216)	(0.217)
PBS	0.631	0.606	0.720	0.561	0.720	0.561
	(0.534)	(0.458)	(0.615)	(0.640)	(0.771)	(0.862)
Agreeableness	7.583*	0.369	0.395	0.509	0.395	0.509
	(2.543)	(2.278)	(2.271)	(2.273)	(3.243)	(3.239)
Conscientiousness	5.081*	2.225	2.264	1.999	2.264	1.999
	(2.197)	(1.888)	(1.886)	(1.915)	(2.144)	(2.059)
Extraversion	-0.761	-0.678	-0.737	-0.554	-0.737	-0.554
	(1.545)	(1.283)	(1.290)	(1.300)	(1.355)	(1.376)
Neuroticism	-6.768*	-1.424	-1.483	-4.665	-1.483	-4.665
	(1.866)	(1.546)	(1.562)	(2.866)	(1.854)	(3.681)
Openness	14.12*	5.602*	5.624*	6.004*	5.624*	6.004*
	(2.269)	(1.997)	(1.997)	(2.039)	(2.573)	(2.525)
Age	-0.848*	-0.223+	-0.215	-0.195	-0.215	-0.195
	(0.171)	(0.134)	(0.138)	(0.136)	(0.157)	(0.151)
Gender	-3.649*	-0.0826	0.0277	0.149	0.0277	0.149
	(0.841)	(0.737)	(0.756)	(0.761)	(1.004)	(0.984)
Business		0.161	0.145	-0.177	0.145	-0.177
		(0.855)	(0.853)	(0.916)	(1.057)	(1.103)
Economics		1.355	1.372	1.259	1.372	1.259
		(1.121)	(1.124)	(1.137)	(1.425)	(1.447)
STEM		0.445	0.453	0.185	0.453	0.185
		(0.814)	(0.818)	(0.865)	(1.019)	(1.000)
Lagged Profit		0.408*	0.408*	0.408*	0.408*	0.408*
		(0.0198)	(0.0198)	(0.0199)	(0.0211)	(0.0211)
Lagged Opponent's True Profit		0.466*	0.465*	0.467*	0.465*	0.467*
		(0.0195)	(0.0195)	(0.0195)	(0.0214)	(0.0216)
Contextual Game		-0.486	-0.491	-0.481	-0.491	-0.481
		(0.575)	(0.576)	(0.576)	(0.777)	(0.775)
PBS*DBQ			-0.0115	-0.00962	-0.0115	-0.00962
			(0.0411)	(0.0413)	(0.0546)	(0.0546)
(PBS*DBQ)*neuroticism				0.0514		0.0514
				(0.0366)		(0.0502)
Constant	22.83*	0.650	-0.0836	-0.102	-0.0836	-0.102
	(3.464)	(3.174)	(4.112)	(4.109)	(5.382)	(5.342)
N	3540	3540	3540	3540	3540	
R^2	0.943	0.315	0.298	0.965	0.740	

Robust standard errors in parentheses
"Reg, robust" $\Longrightarrow$ Regressions 1-5
"Xtreg, vce cluster(ClientNumber)" $\Longrightarrow$ Regressions 6-7
+ p<0.10, * p<0.05

6.6 Appendix F: Recruiting Flyer

6.7 Appendix G: Recruiting Methods

Howdy! My name is Noah, and I'm a senior majoring in Mathematics and Economics at the University of South Dakota. As part of my honors thesis, I'm running an experimental economics study, and I'm here to recruit students for a study I'll be conducting at the Beacom School of Business.

The purpose of this study is to determine the effect that drinking alcohol has on performance in a standard economic game. Participants will play a series of games which will take approximately 30 minutes to complete. Participants will then fill out a questionnaire that will take approximately 15 minutes to complete. Finally, participants will receive monetary compensation based on their performance in the experiment. Participants will receive monetary compensation based on their performance, which could range from $7.50 (show-up fee) to $67.50. Expected compensation is approximately $20 but could be lower or higher based on the specificities of the experiment.

The study will take place in the Ellis Finance and Analytics Labs #309 (Bloomberg Terminals), in the Beacom School of Business on (date to be determined).

All data and responses will be kept confidential and anonymized. You will be assigned a unique eight digit code immediately upon entering. There is no way to trace the unique identifier to your name, so there is no legal risk to participants.

Everyone here is invited to participate in the study. A pre-screening link is listed on the sheet provided to you. If you are interested in participating in the study, please fill out the link. It should take less than 1 minute to complete.

Are there any questions, remarks, or concerns?

Thank you for your attention and consideration. Please feel free to reach out to me at @Noah.Dixon@coyotes.usd.edu (listed on the questionnaire sheet) if you have any additional questions.

6.8 Appendix H: Pre-Screening Form Results

**Note that the following information contains pre-screening results for *everyone* who filled out the form, regardless of whether they participated or not.

WARNING
This study will ask various questions about alcohol use and drug use. You can't be held liable for any answers that you make, either in this survey, or in subsequent questionnaires. This includes admissions to underage drinking or illicit drug use. There could be psychological risk associated with completing this experiment.

ATTENTION
You will be compensated for your participation in this experiment. You will earn $7.50 for showing up, and can earn an additional $0-$60 based on your performance in the experimental games.

I can physically attend the experimental session at the Ellis Finance and Analytics Labs #309 (Bloomberg Terminals) at one of the following times (please choose ONE answer only)

○ Times Listed Here

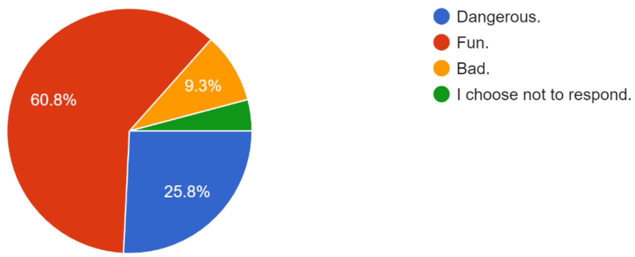
Please enter in your *phone number,* if you choose to participate in the study.

Your answer

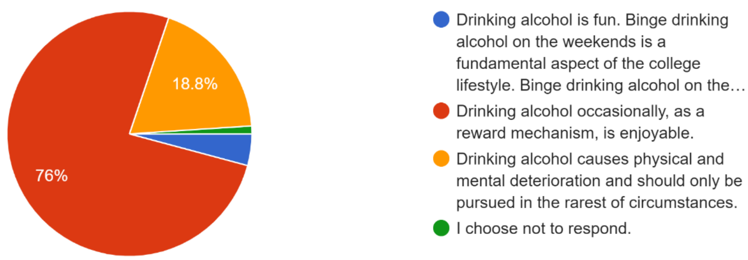
Please enter in your *school email,* if you choose to participate in the study.

Your answer

Fill in the blank that best describes your attitude towards alcohol. Drinking alcohol can be ____.
97 responses



Select the following that best applies to your thoughts regarding alcohol consumption:
96 responses

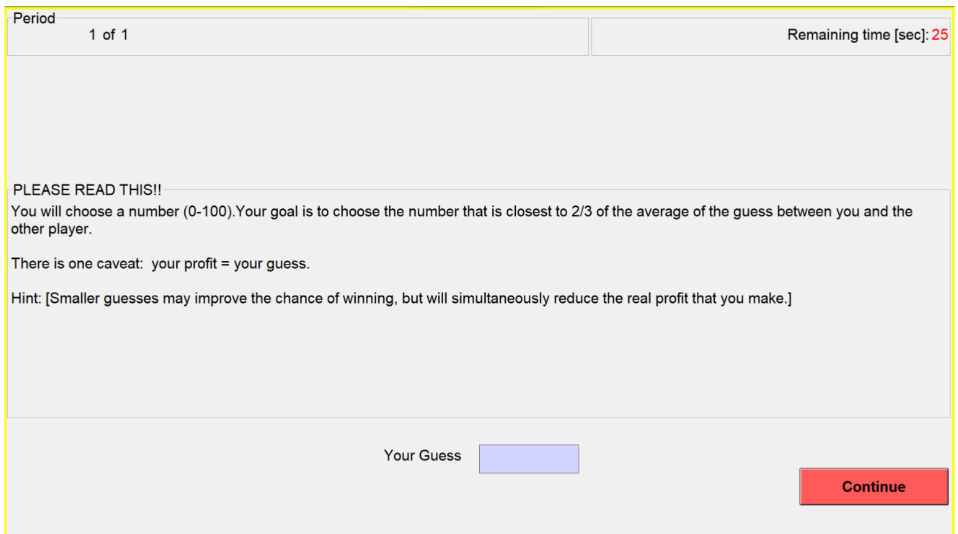


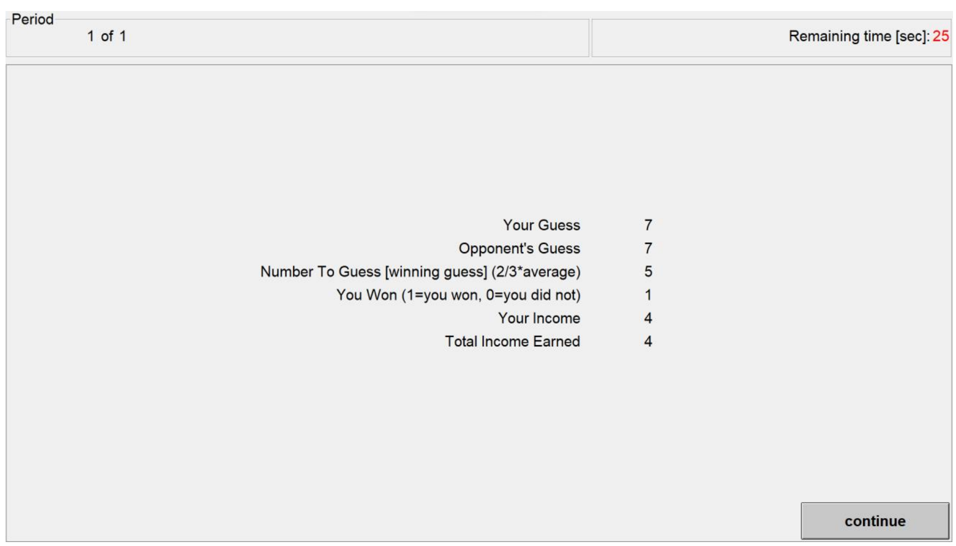
IMPORTANT

Please note that if you are selected to be a part of the study, you will be sent an informed consent form. Please read the informed consent before arriving at the study. (You will have the chance to read it again during the study.) Your choice to participate in this study is completely voluntary, and the consent form alerts you of any risk associated with this study.

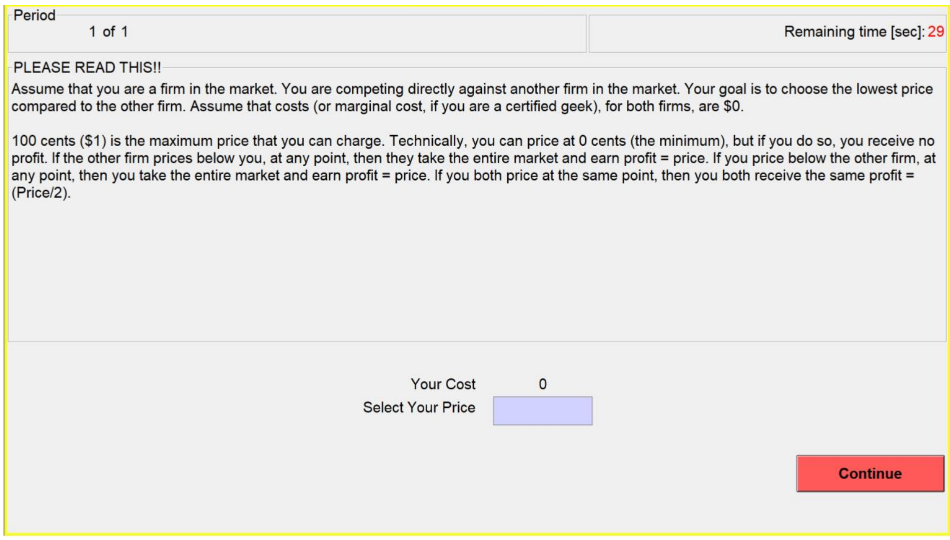
6.9 Appendix I: z-Tree Display Prompt

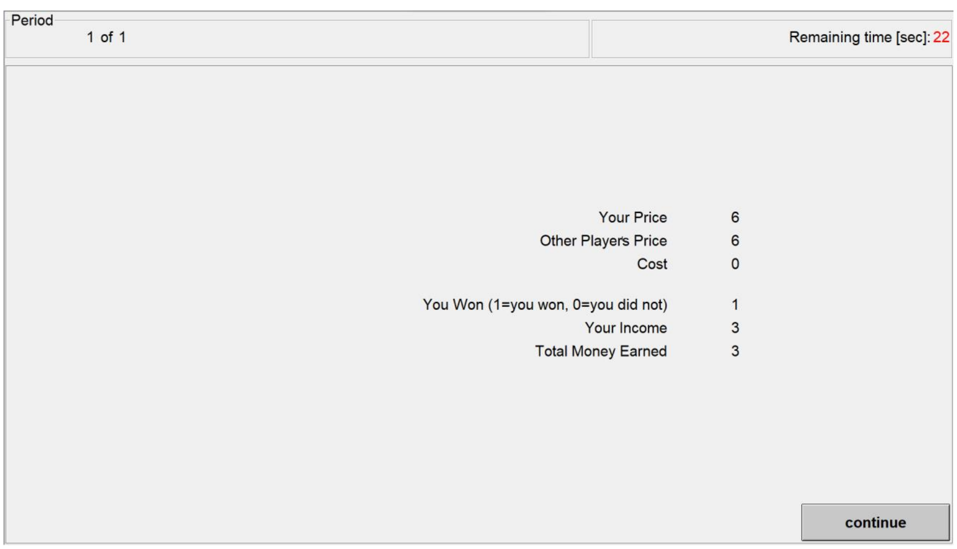
2/3 Average Game:





Standard Bertrand Game:





6.10 Appendix J: Informed Consent

CONSENT FORM TO PARTICIPATE IN A RESEARCH STUDY
The University of South Dakota

TITLE:	*Beer, Bourbon, and Bertrand: An Experimental Economic Analysis*
PRINCIPAL INVESTIGATOR:	*Dr. Sebastian Wai* *sebastian.wai@usd.edu*
DEPARTMENT:	*Division of Economics and Decision Sciences.*

Invitation to be Part of a Research Study

You are invited to participate in a research study. In order to participate, you must be over the age of 18. Taking part in this research project is voluntary. Please take time to read this entire form and ask questions before deciding whether to take part in this research project.

What is the study about and why are we doing it?

The purpose of this study is to determine how reported alcohol consumption and personality traits relate to performance in a Bertrand game. This is a game in which there are two "firms" in a market and each firm sets a price. The "firm" that sets the lowest price wins the entire market and receives a profit based on the price set. How you play the game will affect how much compensation you receive. Up to 100 people will participate in this research study.

What will happen if you take part in this study?

If you agree to take part in this study, you will be asked to complete multiple rounds of several different experimental games. After the games, you will complete a questionnaire. Your total participation time is expected to last one hour.

You will be assigned a code number to link your game data to your questionnaire data, however this code number will not be linked to your name or any other identifying information. The questionnaire will ask about your drinking habits and also includes questions to measure certain personality traits.

What risks might result from being in this study?

The survey in this study asks about drinking alcohol, and you may be worried about admitting to underage drinking. We have minimized this risk by assigning you a unique number which has no ties to your identity. The answers you give to underage drinking, or alcohol consumption, will not be able to be traced back to you, and we hope that you will answer questions honestly and truthfully. Other questions might make you self-conscious or uncomfortable, but these questions come from standardized measures and answering them should not place you at any significant risk. If you would like to talk to someone about your feelings regarding this study, please contact the Student Counseling Center at 605-658-3580, which provides counseling services to USD students at no charge.

What are the potential benefits from this study?

Although you will not directly benefit from being in this study, others might benefit because it will give researchers insight into the way that individuals who consume alcohol, or have a predilection towards alcohol, behave in a short-term oriented economic game. You might benefit from being in this study because it will give you an insight into the way an experiment is run.

How will we protect your information?

The records of this study will be kept confidential to the extent permitted by law. Any report published with the results of this study will not include any information that could identify you. We will protect the confidentiality of the research data by not keeping track of any personal identifiers.

It is possible that other people may need to see the information we collect. These people work for the University of South Dakota, and other agencies as required by law or allowed by federal regulations.

How will my information be used after the study?

After this study is complete, your deidentified data may be stored indefinitely in secure cloud storage and shared with other researchers through an open access repository without asking for additional consent from you. Your deidentified data will NOT include your name or other personal information that could directly identify you.

How will we compensate you for being part of the study?

You will be given $7.50 merely for showing up. You will receive additional cash for playing the experiment based on your performance in the game of $0 to $60.

Your Participation in this Study is Voluntary

It is up to you to decide whether to be in this research study. Even if you decide to be part of the study now, you may change your mind and stop at any time. You do not have to answer any questions you do not want to answer.

Contact Information for the Study Team and Questions about the Research

The researchers conducting this study are Dr.Wai and Noah Dixon. You may ask any questions you have now. If you later have questions, concerns, or complaints about the research please contact Noah Dixon at 605-929-4428 or noah.dixon@coyotes.usd.edu. You can also contact Dr. Wai at sebastian.wai@usd.edu.

If you have problems, complaints, or concerns about the research, questions regarding your rights as a research subject, or if you want to talk with someone independent of the research team, you may contact The University of South Dakota Office of Human Subjects Protection at irb@usd.edu or (605) 658-3743.

Your Consent

Before agreeing to be part of the research, please be sure that you understand what the study is about. Keep this copy of this document for your records. If you have any questions about the study later, you can contact the study team using the information provided above.

6.11 Appendix K: Categorical Questionnaire Results

**Note that the following information contains questionnaire results for 70 people, which includes 10 from the pilot and 60 from the actual experiment. The actual data only utilizes the results from the 60 people who completed the actual experiment.

ATTENTION

Read the following before continuing!

At any point in this study, you are free to leave. You don't have to provide an explanation for leaving, and there will be *absolutely* <u>no</u> repercussions if you decide to leave.
Please note that the following questions can *only* be traced to an arbitrary number that *can't* be traced back to you. You can't -- and won't -- be held liable for any answers that you make in this questionnaire. However, you have complete autonomy in deciding to answer -- or to not answer -- questions. When answering questions, please answer them truthfully and honestly, to the best of your ability. Failure to do so will hinder research efforts -- research efforts which may used to sculpt future policy decisions.

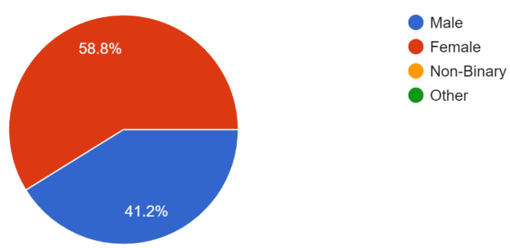
Unique 8-digit Code (PLEASE ENTER ACCURATELY; TYPE IN A NUMBER ONLY)

CATEGORICAL

Please answer the following questions to the best of your ability.

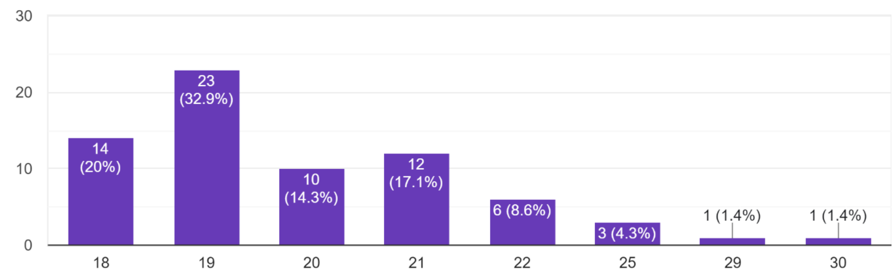
Gender:

68 responses



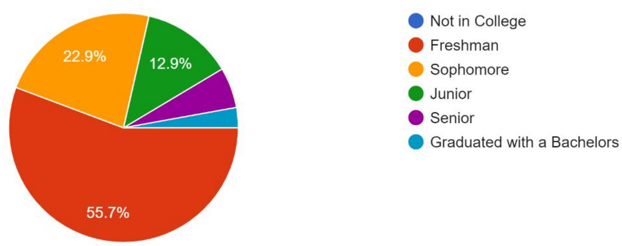
Age (number only):

70 responses



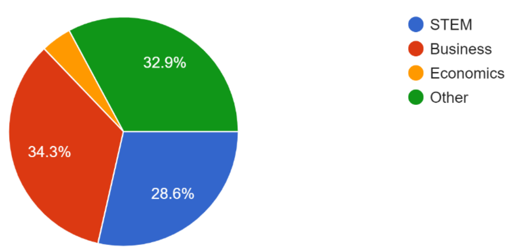
Education Level (current):

70 responses



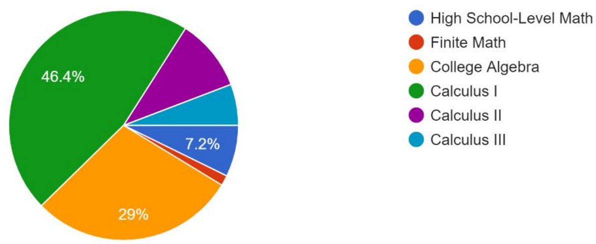
Major:

70 responses



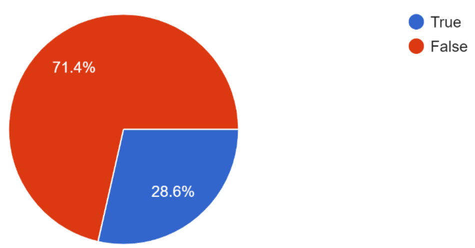
Highest math class taken:

69 responses



Participated in an experiment before?

70 responses



6.12 Appendix J: Experimental Instructions

Good Evening,

I want to extend a warm welcome to all of you, and I appreciate your participation in today's experiment. Your involvement is vital to the success of our research, and we are genuinely grateful for your time and cooperation.

The purpose of this study is to determine whether a predilection towards alcohol (or alcohol-related tendencies) produces deficiencies in a standard economic game.

Each one of you plays a crucial role in helping us achieve these objectives. Your participation involves playing a standard economic game and filling out a questionnaire. Your contributions will help us gain valuable insights into the branch of behavioral economics associated with personality.

I want to assure you that your participation will be kept strictly confidential. Any data we collect is anonymized from the onset and used solely for research purposes.

Before we proceed, I want to emphasize that your participation is entirely voluntary. If, at any point, you feel uncomfortable or wish to withdraw, you are free to do so without any consequences. We have obtained your informed consent, but it remains your right to withdraw if you choose to. You are paid

$7.50 for showing up, and you will receive additional monetary compensation based on your performance in the game.

Next, I will provide you with clear and detailed instructions on how to complete the tasks involved in this experiment. Please listen carefully and feel free to ask any questions if you require clarification.

Throughout the experiment, our team will be available to answer any questions or provide assistance as needed. Please do not hesitate to reach out to us if you encounter any issues or uncertainties.

The experiment is expected to take approximately an hour. We will strive to keep it as efficient and enjoyable as possible.

Let's now proceed with the instructions and tasks. Once again, if you have any questions, please do not hesitate to ask. Thank you for being here, and let's get started.

****Experimental Instructions****

Direct your attention towards the screen. Please look at your screen and your screen only.

You are playing directly against another player. You will choose a number between 0 and 100. Your goal is to choose the number that is closest to 2/3 the average of the guess between you and the other player. That other player is somewhere in the room, although the location of the other player is unknown. There is one caveat: your profit = your guess. HINT: smaller guesses may improve your probability of winning, but they simultaneously reduce the real profit you earn.

You will play 12 rounds of this game. At the end of this game, we will move onto the second experimental game. Does anybody have any questions?

You have successfully completed the first part of the experiment. Now, we will begin the second experimental game. Please look at your screen and only your screen.

Assume that you are a firm in the market. You are competing directly against another firm in the market. Your goal is to choose the lowest price compared to that of other firms. Assume that costs (or marginal costs, if you are a certified geek), for both firms, are $0. $1 is the maximum price that you can charge. You can choose any price between 0 and 100 cents. However, if you price at $0, you make no profit. If the other firm prices below you, at any point, then they take the entire market and earn profit = price. If you price below the other firm, at any point, then you take the entire market and earn profit = price. If they both price at the same point, then you both receive half of the profit which is equivalent to price divided by 2. You will repeat this process 12 times. Does anybody have any questions?

Questionnaire

The experimental part of the procedure is now complete. Please turn your attention to the sheet titled questionnaire. This is a QR code that you can scan; you can also type the link in. Fill out all the information to the best of your ability. We cannot trace any of the information to you because of the 8 digit unique identifier. However, this makes it incredibly important that you enter in the 8 digit-code correctly; otherwise, there is no way to trace the results of the game back to the questionnaire. If you cannot access the google form, please raise your hand. Once you are finished, please come to the front with your 8-digit code. You will be paid based off your performance in the game. After that, you are finished with the experiment, and are free to leave. Please refrain from talking about the contents of this experiment with anybody that will be participating in the experiment in the future.

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