TEMPORAL DISCOUNTING IN SOCIAL DRINKERS: IS THERE A SUBSTANCE-SPECIFIC RELATIONSHIP?

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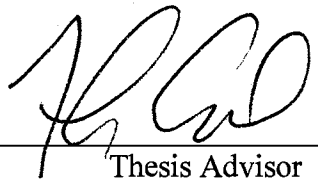

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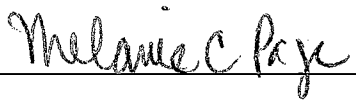

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PREFACE

This study was conducted to provide new knowledge regarding temporal discounting and the effects of varying commodities on discounting behavior. Temporal discounting has been applied to the field of substance abuse to more clearly understand how use is modified by varying the value of present and delayed rewards. Within this theory, a larger, delayed reward is chosen over a smaller, immediately available reward. Behavioral choices are modified by the value of both rewards and type of commodity. Specific objectives of this research were (a) to replicate existing research on discounting behavior by examining money now, money later choices, (b) to extend existing literature by examining alcohol now, alcohol later choices, and (c) to extend existing literature by examining choices between commodities, including money now, alcohol later and alcohol now, money later. Data was analyzed to examine both within and between commodity choices. Implications for treatment of alcohol abuse are indicated.

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NOMENCLATURE

AAAI	Annual Absolute Alcohol Index
AA	alcohol now, alcohol later
AM	alcohol now, money later
K	indicates the rate of discounting; small values are slower rates, large values are faster rates
MA	money now, alcohol later
MM	money now, money later

TEMPORAL DISCOUNTING IN SOCIAL DRINKERS: IS THERE A SUBSTANCE-SPECIFIC RELATIONSHIP?

INTRODUCTION

With nearly 14 million Americans meeting diagnostic criteria for alcohol use disorders (Grant, Harford, & Dawson, 1994) and approximately half of all adults in the United States knowing someone with a drinking problem (NIAAA, 1998), alcoholism has become a national concern. Each year, economic costs to society are estimated at $167 billion for alcohol alone (NIAAA, 1998). One hundred and five million people report drinking alcohol and 45 million report binge drinking (five or more drinks on the same occasion and at least one time in the past month; NIAAA, 1998). Although many individuals maintain drinking behavior in moderation, an estimated 74 percent of male drinkers and 71 percent of female drinkers exceed moderate drinking guidelines at least once a year (USDA/DHHS, 1995).

Alcohol use and abuse is associated with increased risk for high blood pressure, stroke, heart disease, liver damage, accidents, violence, suicides, birth defects, and overall mortality (Grant et al., 1994; NIAAA, 2000). In 1992, 107,440 people were designated to have alcohol-related causes of death (NIAAA, 1996) and of the 96.5 million emergency room visits in 1995, 2.6 million (2.7%) were related to alcohol abuse (Li, Keyl, Rothman, Chanmugam, & Kelen, 1998). In addition, alcohol is a factor in approximately half of all fatal traffic crashes among persons 18-24 years of age (Perkins & Berkowitz, 1991).

Despite these risks, many individuals begin drinking at a young age and continue to drink throughout their young adult and adult years. Research has indicated continuity in alcohol intake, smoking and drug use from adolescence through early adulthood, (Lewinsohn, 1999) and early reports of smoking and alcohol use have been shown to be predictive of heavy alcohol use in young adulthood five years later (Poikolainen, Tuulio-Henriksson, Aalton-Setala, Marttenun, & Lonngvist, 2001). Fifty-one percent of Americans ages 12 and over have reported consuming at least one drink per month, with 15 percent being binge drinkers (CDC, 1997). Studies have demonstrated that people who begin drinking before the age of 15 have a 4 times greater likelihood of developing an alcohol use or abuse problem compared to individuals who begin drinking at age 21 (Grant & Dawson, 1997). These patterns of use put individuals at an even greater risk for developing major health problems associated with heavy and prolonged alcohol use.

Of special importance are college drinkers. Driving under intoxication has been reported by more than 60 percent of college men and almost 50 percent of college women who binge drink at least three times in a two-week period (Wechsler, Davenport, Dowdall, Moeykens, & Castillo, 1994). Eighty percent of college students reported drinking alcohol and over one-third reported binge drinking (Bennett, Miller, & Woodall, 1999). Over 20 percent of college drinkers drink on more than 10 occasions each month (Wechsler, 1998).

Studies have reported frequent binge-drinking and alcohol-related problems associated with students under age 21 (Presley, Meilman, & Lyerla, 1995). Rates of binge-drinking have also been shown to vary by type of college and make-up of the student population (Presley et al., 1995; Wechsler et al., 1994). Presley et al. (1995)

reported binge-drinking percents in college students over the previous 2-week period for the following groups: Caucasian students at 43 percent, Native American students at 40 percent, Hispanic students at 31 percent, Asian students at 22 percent, and African-American students at 22.5 percent. Rates are especially high for college students in sororities and fraternities, with 81 percent reporting binge-drinking (NIAAA, 1995). These results demonstrate the high rate of college drinkers and the necessity to understand patterns of drinking in this high-risk group. By more closely investigating patterns of drinking and choices about drinking made by college students, intervention programs can be developed to better target students with drinking patterns that may contribute to long-term behavioral, economic, and cognitive problems associated with prolonged alcohol consumption.

One manner of investigating drinking patterns in college students is by using temporal discounting. Temporal discounting refers to the degree the value of a reinforcer is influenced by time delay (Ainslie, 1992). Specifically, a person will find waiting for something less valuable than getting something now. Individuals who abuse alcohol tend to choose the immediate reward of using the drug (using alcohol) over waiting for the larger, delayed reward (studying and doing well on an exam). By choosing the immediate reinforcer more often than waiting for a larger delayed reinforcer, a substance abuser often foregoes valuable rewards that may be delayed. Vuchinich and Tucker (1998) suggest that understanding how and to what extent a person devalues a delayed reward could identify ways to increase the value of this delayed reward. By increasing the delayed value, a person may choose the delayed reward and limit immediate

consumption of the drug. Therefore, combining temporal discounting with substance abuse may identify important ways to modify treatment programs and limit relapse.

The present paper examines temporal discounting in college students who consume alcohol. Specifically, this paper serves to more closely understand how temporal discounting and alcohol use/abuse interact and how discounting of future rewards is affected by choices about alcohol and money. This paper closely examines temporal discounting for alcohol, money, and choices between alcohol and money. Higher levels of drinking behavior have been shown to increase rate of temporal discounting when using monetary values (Vuchinich & Simpson, 1998); however, it is unclear how increased alcohol consumption is related to discounting behaviors for alcohol choices and choices between alcohol and money. The following review will begin with an overview of discounting theory and its relationship to behavioral economic theory. Specific application of temporal discounting theory is then given to explain situation and commodity-specific choices between immediate and delayed rewards. Further, the research on substance abuse and decisions about hypothetical monetary rewards will be summarized. Finally, a study is presented that integrates research on temporal discounting theory and substance-specific decisions for alcohol use.

LITERATURE REVIEW

Behavioral economics, or behavioral choice theory, has applied consumer demand theory to the experimental analysis of behavior (Hursh, 1993). In general, consumer demand theory states that the behavior of an individual is an equilibrium between the supply of a commodity and consumer demand (Hursh, 1980). This law of demand states

that as the cost of a commodity goes up, consumption will go down (Samuelson & Nordhaus, 1985). Consumer demand theory has been applied to a variety of drugs using many different environmental contingencies (e.g., Carroll, 1987; Bickel, DeGrandpre, & Higgins, 1993; Bickel, Higgins, & Hughes, 1991).

Understanding how the reinforcing properties of a drug are influenced by environmental contingencies in behavioral economics can best be explained by three principles (Epstein, 1998). First, choosing an alternative depends on the behavioral cost. According to such a principle even consumption of very reinforcing substances can be modified by an increase in cost. Cost can be increased by both increasing the price to engage in a behavior or by reducing the availability of a substance (Bickel & DeGrandpre, 1995; Bickel, DeGrandpre, & Higgins, 1993). In the present study, the delay of the reinforcer in varying amounts can be viewed as a decrease in access or an increase in price.

A second principal is that choice and reinforcing value of a substance are modified by the availability of alternatives. This principal has been demonstrated in various substances (Higgins, 1997; Carroll, 1996) and is predicted to be present when alcohol and money choices are made. Choice can also be modified by presenting an alternative. In addition, the value of the alternative is not static, but may change over time or with alternatives present.

A third principle is that choice depends on the delay between choosing and receiving alternatives. As the delay is increased, even in a valued reinforcer, a person will choose the immediate commodity over the delayed commodity. As such, temporal

discounting is viewed as part of the larger choice theory and integral in understanding decision-making.

Within substance use, an understanding of temporal discounting allows conceptualization of particular acts as both immediate situations and how these situations relate to the larger behavior-environment interaction (Vuchinich & Tucker, 1998; Vuchinich, 1999). Vuchinich and Tucker (1998) discuss the importance of temporally extending the view of the environment and indicate that addictive behavior is best represented over a period of time to demonstrate development, stability, recovery and relapse. Variability over time is encompassed in this and helps to understand patterns of drug usage. By temporally extending the view of behavior, these characteristics become evident in drug-related activities. Research has further indicated that temporal discounting is better representative of choices that occur in the natural environment, especially for abused substances (Vuchinich, 1999) and the temporal changes in value are critical controlling variables of behavioral allocation (Simpson & Vuchinich, 2000a). Vuchinich and Tucker (1998) also indicate that the temporal perspective of drug use/abuse is influenced by the availability of other reinforcers. Such alternative reinforcers can modify patterns of drug usage and are critical to understanding how these factors are influential over time for consumption of various drugs.

The present study serves to combine both traditional choice theory and temporal discounting by temporally extending the choice between two reinforcers. Adding alcohol as an alternative choice will modify the reinforcing value of the money and will likely change the subjective value of the delay. Thus, within similar time delays, the presence of an alternative will demonstrate to what extent alcohol and money are influenced by

alternative reinforcers. By incorporating these two ideas, it can be evaluated to what extent alcohol and money are valued within the specific time delays. Although separate temporal discounting functions will be calculated for alcohol and money, the present study will examine what value money has in relation to a delayed hypothetical reward of alcohol and what value alcohol will have when presented with a delayed reward of money. Such an evaluation will help to understand the delayed value for substance users in both the socially accepted monetary reward and the reinforcer of choice, alcohol.

Temporal Discounting Theory

Temporal discounting is defined as the decrease in value of a reinforcer as a function of time delay (Myerson & Green, 1995). In general, temporal discounting posits that a smaller, more immediate reward may be chosen because the value of the larger, more delayed reward is discounted and, therefore, its present value may be less than that of the more immediate reward (Myerson & Green, 1995). Traditional views to explain discounting of delayed rewards focus on the discounted value of the future reward because of the risk involved in waiting for it (Samuelson, 1937). Further extension of this view suggests that choosing the smaller, more immediate reward is a normal outcome of an adaptive process where the subjective value of reward decreases in relation to the time of its receipt. The decrease in value as a reward is increasingly more delayed has been attributed to an "implicit risk" (Green, Fry, & Myerson, 1994). This risk suggests that the delayed value is decreased because the receipt is less certain than one that is received immediately. When viewed through the perspective of animal research, such discounting of future rewards could be seen as adaptive in the natural environment

(Kagel, Green, & Caraco, 1986). In general, choosing a sooner reward, despite the value of a later reward characterizes a general principle of human behavior. However, with societal influence, individuals are encouraged to consider future consequences. Consider investing money in a bank. Despite the general view that people will take the immediately available reinforcer, people also tend to plan for the future by investing their money. This behavior is inconsistent with immediate gratification and suggests that certain individuals will wait for a larger, delayed reward.

An additional method of viewing the choice of an immediate reward over those that require waiting, focuses on the human decisions involved in making choices. Such views examine decisions to choose between a smaller sooner reward and larger later rewards with these decisions representing more or less impulsive choices (Vuchinich & Simpson, 1998). An individual that displays a lack of impulse control would tend to choose the sooner reward and not take into account the increased value of the reward obtained with the delay. Behavior which involves choosing the more immediate reward could be viewed as maladaptive, or impulsive, when such choices may result in less total reward being earned in the long run (Green et al., 1994). How the reward is devalued across time can be understood by examining several differing discounting functions.

Functions of Temporal Discounting

Understanding the function of the subjective value changes is important to clearly delineate what changes are occurring over successive time delays in the choices of an individual. Two models of explaining the nature of this relationship have been postulated (Green, Myerson, & McFadden, 1997). The exponential model of temporal

discounting, suggests that people make their decisions about future amounts based on constant hazard rates. Specifically, an exponential model anticipates that as time increases to the receipt of a reward, the chances that something will happen to prevent the acquisition of this reward stays at a constant rate. This model predicts that the relative value of two delayed rewards is increased or decreased at equal rates and will remain the same over time. Therefore, a decrease in discounting is in a constant proportion to the amount of time until the reward. In addition, the exponential model predicts that consistent preferences will be chosen over time. Thus, a person will choose one reward over another and that decision will remain constant across time with no reversal of preference to another reward. The only discounting function that results in various choices between immediate consequences and delayed consumption differ from the exponential functions and are characterized by hyperbolic functions.

A second hypothesis, in contrast to exponential model is the hyperbolic model (Myerson & Green, 1995). The hyperbolic model suggests that discount rates do not remain constant, but rather, an individuals' relative preference between an immediate reward and a later reward changes (Kirby & Herrnstein, 1995). When both rewards are far off in the future, the individual will prefer the larger, delayed reward. However, as the time to a delayed reward increases, a person's preference switches from the larger, delayed reward to the smaller, immediate reward. The switch can be explained by the delay making the larger reward much less valuable. When the person is choosing the larger, delayed reward it is more valuable until the switch occurs to the present reward in which the value of it has surpassed that of the delayed value.

This switch produces consistent patterns specific to choices in temporal discounting. One characteristic of temporal discounting according to the hyperbolic model is the preference reversal phenomenon (Green et al., 1997). The preference reversal phenomenon occurs when a person reverses their decision from the delayed reward to the immediate reward. For example, the preference reversal phenomenon would occur if an individual chooses $1000 in one year over $500 now, and then changes their preference when time is added to the receipt of the reward, to include a choice of $500 now rather than $1,000 in three years. Such reversals in decisions about future and immediate rewards are used in calculating the subjective value of a reinforcer at a particular time within temporal discounting. Preference reversal can also occur between two difference substances. One study indicated that preference reversal can occur between two substances with immediately available reinforcers (Bickel & Madden, 1999), although its applicability to temporally extended preference reversal is unknown.

Green et al. (1997) suggests that understanding preference-reversal can explain impulsive decisions. Impulsivity is suggested when the larger, delayed rewards are chosen in situations where delays to both rewards are brief, however, the individual quickly changes their preference to the smaller, immediate reward as the time delay increases. This choice suggests that impulsivity may be a characteristic of the choice situation as much as a characteristic of the choice. Therefore, even an "impulsive" person may temporarily demonstrate self-control and choose the larger reward when both rewards are briefly delayed, even though the larger reward is more delayed than the smaller. Such an implication is important for understanding relevant factors in

substance-specific decisions and situation-specific decisions that may be critical in decisions to drink alcohol.

Both the exponential and hyperbolic models use functions to demonstrate response patterns over time. Rate of discounting can vary for both models. Rapid discounting occurs when the value of the delayed reward is greatly devalued as time passes. The rapid discounting function shows a very steep drop initially and a faster leveling as the delay increases. In contrast, a slow discounting function shows a more gradual decline in the subjective value of the reward as the time delay increases. In the exponential function, the rate of discounting does not result in a switch of preference. Rather, when the discounting of the larger later reward is high, this value is decreased to such an extent that the value of the present reward is always higher in value regardless of time delay.

The hyperbolic model is frequently supported as indicative of temporal discounting within the literature as a better representation of human decision-making over the exponential model. Some research has concluded that the hyperbolic function provides a better description of the relation between subjective value and delay than the exponential function (Green et al., 1997). This has been corroborated by other researchers using both animal and human models under a variety of environmental contingencies (e.g., Kirby, 1997; Madden, Petry, Badger, & Bickel, 1997; Vuchinich & Simpson, 1998). The hyperbolic function has also been shown to exhibit high reliability across sessions (Simpson & Vuchinich, 2000b). Therefore, it appears that the hyperbolic function best fits patterns of responding in discounting behavior.

Green et al. (1997) have described the equation used to calculate the hyperbolic function. The hyperbolic model is given the following equation:

$$V(A) = A/(1 + kAD)$$

Where V(A) is the subjective value of a future reward in the amount of A, D is the delay to its receipt, and kA represents the parameter describing the rate of the decrease in value. The k value is used to indicate the rate of discounting, with smaller values being indicative of slower rates of discounting and larger k values representing steep discounting curves.

Factors Influencing Temporal Discounting

One factor influencing discounting behavior is the magnitude of the reward. Specific analyses of the rate of discounting have demonstrated that larger rewards are discounted less steeply than smaller rewards, or the magnitude effect (Myerson & Green, 1995; Raineri & Rachlin, 1993; Loewenstein & Prelec, 1992; Chapman & Elstein, 1995). Specifically, discount rates are lower for large-magnitude outcomes. Therefore, decisions about large-magnitude outcomes will decrease at a lower rate than those made about small-magnitude outcomes. For example, a person may choose $2,000 in one year over $1,500 now and choose $75 now over $100 in one year. Although the same percentage exists between the two values, the larger amounts hold greater value and are chosen differently than the smaller values.

Green et al. (1997) examined specific characteristics of the discounting function. Their results suggest that the rate of discounting decreased in a negatively accelerated fashion as the amount of the future reward increased from $100 to $25,000. However,

when the delayed rewards were extended out to $25,000 and $100,000, no further decreases were produced. It appears that temporal discounting occurs most rapidly when monetary amounts are small, and levels when the amounts become sufficiently large. The authors further concluded the values that most closely localize the point at which individuals' choice decisions level off is $25,000. Specifically the rate of discounting, as measured by the k value, were compared using a non-linear regression to determine where k decreases were no longer significant. Results suggest that after $25,000 the rate of discounting failed to decrease to a significant extent. Consistent with views about the hyperbolic model, the amount-dependent discounting implies that larger rewards are associated with lower hazard rates than smaller rewards. The present investigation will use these modified values based on values in Green et al. (1994).

Temporal discounting is also influenced by time to the delayed reward. The longer the delay to the receipt of the reward, the lower its subjective value. Specifically, the larger value will be chosen until the delay is increased and reaches a point where that delayed value is no longer above the immediate value. At this point, the immediate value is chosen. In addition, this delay effect suggests smaller discount rates for long delays (Chapman, 1996; Chapman & Elstein, 1995). The hyperbolic model suggests this rate decreases rapidly and levels off as the time to the delay increases. At 25 years, the present value of the delayed reward is decreased to 10-40% of the initial value (Vuchinich & Simpson, 1998). Across several other studies the present values at 20 years for the delayed rewards ranged from 5-30% of its initial value (e.g. Green et al., 1997; Ostaszewski, 1996; Richards, Zhang, Mitchell, & deWit, 1999; Green et al., 1994).

Taken together, it appears that at 25 years the delay is sufficiently large to produce a substantial decrease in present subjective value as to allow the delay effect to be evident.

Overall, it appears that temporal discounting curves exhibit consistent patterns that are influenced by delay and magnitude of the reinforcer. Such effects have been noted in the literature and the present study intends to incorporate factors used frequently and that appear to give the most stable representation of temporal discounting.

Application of Temporal Discounting Theory

Temporal discounting has been used to explain a variety of situations and decisions. Increasing contingencies on available rewards has given way to a greater understanding of what values are considered important to wait for, versus those that are more valuable if taken immediately (Kirby, 1997; Green et al., 1997). Varying environmental contingencies have been applied to decisions about money, health, age, and vacations (e.g. Green, Myerson, Lichtman, Rosen, & Fry, 1996; Chapman, 1996; Lennings & Berns, 1998). Further, temporal discounting has been used to understand decisions related to drug-taking (e.g., Madden, Patry, Badger, & Bickel, 1997; Bickel, Odum, & Madden, 1999; Petry & Casarella, 1999; Odum, Madden, Badger, & Bickel, 2000) and alcohol use (Vuchinich & Simpson, 1998). The majority of studies have focused on discounting decisions related to money (real and hypothetical values) and how the participants' responses relate to broader decision-making patterns. Although most studies have examined participants' responses to hypothetical choices about money, some research suggests that temporal discounting varies based on the subjective value of the reinforcer, and this subjective value is influenced by the type of reinforcer and individual

differences in preference (Tustin, 2000). Therefore, individuals may value money and other substances differently and discount more or less based on their value of that substance, making the generalizability of money-only choices limited. The present study examines the relative value of both alcohol and money both separately and together to understand how choices about these commodities influence each other.

One area of controversy is the importance and applicability of real versus hypothetical rewards. Some research has suggested that results from hypothetical choices about rewards do not represent actual outcomes (Bickel & Marsh, 2001) and therefore their generalizability is questionable. While this concern is valid, the question of generalizability exists in much research conducted in a laboratory. Further, the feasibility of presenting the large rewards used in research and temporally extending empirical examinations to an extent that accurately represents choices made in real-life is limited (Vuchinich, 1999; Critchfield & Kollins, 2001). As such, studies employing real rewards have indicated similar hyperbolic discounting patterns (Richards, Zhang, Mitchell, & de Wit, 1999; Crean et al., 2000). Therefore, the present study will use hypothetical rewards to examine choices about alcohol and money.

The application of temporal discounting theory has frequently looked at its relationship to impulsivity and self-control in decision-making about delayed rewards (i.e., Crean et al., 2000; Monterosso & Ainslie, 1999; Grace, 1999). Impulsivity has been viewed instrumental in the types of choice patterns seen in temporal discounting. Specifically, the decisions seen in the hyperbolic function involve switching from one choice to another. The more quickly a person switches from choosing the larger, delayed reward to the smaller, immediate reward, the more impulsive that individual has been

viewed. Understanding which factors influence the level of impulsivity between and within individual choice behavior has been a topic of focus. It has been suggested that certain people act impulsively in some situations and demonstrate significant self-control in other situations. Dickman (1990) has distinguished between functional and dysfunctional impulsivity. Functional impulsivity is defined as the tendency to engage in rapid, error-prone information processing when such a strategy is considered optimal to what the person wants and their other personality traits. Dysfunctional impulsivity is the tendency to engage in rapid, error-prone information processing because of an inability to use a slower, more methodical approach under certain circumstances. These results suggest that an individual could distinguish between situations that are advantageous for a particular situation, or not, and make decisions accordingly. Thus, impulsive decisions about alcohol may be made in a particular situation (a party) but not others (time to study). Such decisions would reflect functional impulsivity. However, a person that is more globally impulsive or dysfunctionally impulsive, would perhaps drink in situations that are not advantageous. Therefore, in light of the present study, a person that can be functionally impulsive may be more likely to delay gratification for money, but make decisions about alcohol much more impulsively. Thus, they would show a faster discounting function for alcohol in relation to money. A person with overall dysfunctional impulsivity may choose the immediate choice more often across situations. It is likely that the heavy drinkers will display more dysfunctional impulsivity over the light drinkers.

Despite the concept that money is a universal commodity for many individuals, the influence of the subjective value of money has shown to be influential in temporal

discounting. Green et al. (1996) found that individuals matched on age and income showed differential rates of discounting. Results show similar discounting rates by adults with similar income levels. However, different discounting rates were demonstrated by adults of similar age, but different income levels. Specifically, the lower income group (<$10,000 per year) of older adults demonstrated more discounting than either of the upper income groups ($40,000 - $50,000 per year; >$50,000 per year). Within the upper income groups, there were no significant age differences in rates of discounting. Such results are inconsistent with previous research demonstrating that rates of temporal discounting decrease with age (Green et al., 1994).

Green et al. (1994) found that across the life span, delayed discounting was most extreme for the children and less impulsive choices were made as the participants aged. The older adults exhibited the lowest discounting rates in general. However, for both college students and the older adults, the value for the delayed reward continued to decrease until 10 years of delay and beyond. In contrast, the children "bottomed out" at approximately 5 years of delay. It appears that delayed reinforcers are less valuable to younger adults and children. However, the basic discounting function, best fit by a hyperbolic function, is representative across all ages. Therefore, choosing between immediate and delayed hypothetical monetary rewards has been shown to be qualitatively similar across the life span at both the group (Green et al., 1994) and individual levels (Green, Myerson, & Ostaszewski, 1999), with discounting rate decreasing with age.

In light of the conflicting research, it may be that older individuals learn to make less impulsive choices as they age. Those individuals with lower income may not have learned to delay choices to the same extent as the higher income individuals of the same

age. These individuals may exhibit a pattern of responding that maximizes short-term gain and is less focused on long-term benefit. Taken together, these findings (Green et al., 1996; Green et al., 1994) suggest a possible interaction between age and income, however, it appears that income more accurately controls for varying discounting functions than does age. These results demonstrate the need to more fully understand individual discounting rates in relation to personal factors and suggest that the subjective value of money may be difficult to determine when used as a standard in and of itself. In the present study, comparing money and alcohol within individuals is expected to show preference for a particular reinforcer and the influence for each individual.

Chapman and Elstein (1995) found that individuals showed different discounting functions when asked about health, money and vacations. Health, money and vacations showed within domain consistency and similar patterns for their discounting functions. Such patterns included a tendency for the rates to level off with increased time delay, the larger magnitude outcomes were discounted less overall than the smaller outcomes, and higher discounting rates for short delays. However, discount rates were significantly higher for health (124%) than for money (99%) and results for vacations were between those for health and money (115%). Health and money domains were not well correlated within individuals. Within-domain correlations had an overall mean value of $r = .64$ and between-domain correlations had a value of $r = .18$ for health and money, $r = .31$ for health and vacations, and $r = .27$ for money and vacations. All results were significant. These results persisted across several experiments using differing magnitudes across domains. The authors concluded that individuals tend to show different temporal discounting rates for different domains.

Chapman (1996) extended this work examining only health and money. Within-domain correlations for health ($r = .64$) and money ($r = .82$) differed significantly from across-domain correlations ($r = .11$). Results suggesting that health and money produce different discounting rates existed even when participants were matched on their utility or exchangeability of health and money. Therefore, it appears that health, money and vacations do not have similar discounting rates, indicative of commodity-specific discounting.

Chapman and Elstein (1995) suggest that if health, money and vacations were viewed as easily tradable then perhaps the same discount rate would be employed. These considerations are especially salient in the present study when comparing alcohol and money decisions. It is likely that patterns of responding within-domains will be well correlated for both alcohol and money, while those across-domains will not be well correlated. This substance-specific discounting in drug-dependent participants provides further evidence for the differing value of reinforcers and its effect on temporal discounting across individuals.

Several studies on discounting behavior for monetary amounts have examined specific populations. Some research has indicated discounting occurs at a significantly higher rate for substance users with gambling problems over substance users without gambling problems (Petry & Casarella, 1999). Further, both substance user groups demonstrated higher rates than controls. In individuals with opioid dependence, those that shared needles showed higher rates of discounting over non-needle sharing opioid individuals (Odum et al., 2000). Additional work with an outpatient psychiatric population has indicated those patients with diagnoses labeled impulsive, including those

with substance abuse, borderline personality disorder, and bipolar disorder demonstrated significantly higher rates of discounting and impulsivity than patients with a diagnosis of a mood disorder or anxiety disorder (Crean et al., 2000).

Madden et al. (1997) investigated temporal discounting in opioid-dependent patients for both the drug of choice (heroin) and money. When compared to non-drug-using controls, the opioid-dependent patients discounted money to a greater extent. In addition, the drug users discounted heroin to a greater extent than they did money. The opioid-dependent participants tended to choose the smaller, immediate rewards for both money and drug conditions before the controls. Specifically, opioid-dependent particiants valued money delays at 5 years to the same extent that the controls valued a 25 year delay.

Bickel et al. (1999) assessed discounting rates for both cigarettes and money in smokers, ex-smokers, and non-smokers. Results indicated smokers showed higher rates of discounting for money over the other two groups. Further, smokers exhibited higher rates of discounting for cigarettes than for money. Ex-smokers and non-smokers did not differ in their discounting of delayed money.

Several limitations are important to recognize in Madden et al. (1997) and Bickel et al. (1999). Decisions about drug use and money were not directly compared within individual choices. The control participants were not asked about heroin / cigarette use and the substance users were asked separately about drug use and money. Thus, directly comparing drug use and money may provide an explanation for the significantly different discounting functions for these commodities. In addition, Madden et al. (1997) used retrospective perceptions of drug use and these were compared to present judgments

about money. Therefore, the present study will ask about alcohol and money using similar time frames to control for differing discounting rates from time perspective.

Madden et al. (1997) also showed moderate rates of correlation for discounting and other impulsivity measures. The drug users exhibited more disinhibition than would be expected for someone of their age group based on previous studies using similar age ranges. These results further demonstrate the need to closely examine differential rates of discounting across substances and drugs of abuse. Such investigation may lead to an understanding of how choices about drugs are influenced by choices about other reinforcing substances in the environment and personality traits.

Vuchinich and Simpson (1998) examined temporal discounting rates about money for college drinkers. Participants labeled as heavy drinkers demonstrated greater hyperbolic discounting rates for hypothetical money rewards than the light drinkers, suggesting that they discounted the value of future rewards to a greater extent and in a steeper fashion than participants without drinking problems. Specifically, the heavy drinkers took the immediate reward over the larger delayed reward at an earlier point in decision-making than the light drinkers. In addition, problem drinkers showed significantly stronger sensation-seeking tendencies, a more present-oriented viewpoint, and less consideration of future consequences. Although temporal discounting rates were steeper with greater alcohol consumption, hypothetical choices were made only between immediate and delayed hypothetical monetary rewards. As previously mentioned studies have revealed, it is likely that individuals with high alcohol consumption would vary in their responses to hypothetical questions dealing with alcohol in relation to their responses to money. Therefore, the present study intends to evaluate discounting for

alcohol and money in participants who use alcohol to varying degrees. To further understand how decisions for alcohol and money vary, combining choice theory and temporal discounting becomes important. Determining the value for alcohol and money in college drinkers requires an understanding of traditional choice theory and its relation to temporal discounting.

THE PRESENT STUDY

The preceding review of the literature suggests that individuals make hypothetical decisions based on the subjective value of the reinforcer in relation to the magnitude of the reinforcer, personal characteristics, and alternative commodities. Within substance use/abuse, these factors become especially salient and are critical for determining how drug use is maintained and modified. Understanding both immediate and delayed choices about money and alcohol may suggest how these two reinforcers interact and are influential in alcohol consumption over time.

The present study closely investigated college drinkers and their patterns of temporal discounting. College drinkers were expected to vary on their discounting rate for money as their drinking habits varied. Specifically, the more a college student drinks, the more likely they were expected to discount at a faster rate in relation to the lighter drinkers. Overall rates of discounting for alcohol were expected to be higher than those for money. Discounting for alcohol and other consumable goods appears to hold less value over time and this was expected in the present study. In addition, heavier alcohol consumption was expected to predict even higher discounting for alcohol. The rates of

discounting in heavier drinkers were anticipated to produce rapid decreases in discounting in relation to monetary rates.

The present study intended to show that the value of alcohol did not extend when given at a long time delay. Specifically, alcohol was expected to be valued only in immediate situations because the reinforcing value of alcohol tends to be from the immediate effects. Waiting for the alcohol was expected to increase the cost of the reinforcer, and at longer delays, it was likely that alcohol not maintain a high value, regardless of the amount of drinking. Based on traditional choice theory, it was expected that the value between the choices of alcohol and money change as the time or price increased. Thus, when participants were asked about money now versus alcohol later, the delayed receipt of the alcohol was expected to make it much less reinforcing than money. Because all participants were expected to not want to wait to get the larger amount of alcohol, the delayed value of alcohol was expected to be discounted very quickly for all participants. Therefore, the steepest rate of discounting for all levels of drinking was expected to occur when money was the immediate reinforcer and alcohol was the delayed reinforcer.

The discounting rate for immediate alcohol choices was predicted to be greatly influenced by drinking level. Higher alcohol consumption should have increased discounting of the delayed money more than the lighter drinker who would be expected to wait for the money in light of getting the alcohol now.

The influence of choice on temporal discounting was examined by comparing discounting curves for an individual participant for only money, only alcohol and the choice situations with alcohol and money together. Further, the present value of alcohol

in relation to money was obtained by comparing the discounting functions of money now and money later with alcohol now and money later. In addition, by examining alcohol now and alcohol later decisions with money now and alcohol later, a value for the delayed alcohol was determined. In this manner a monetary amount for the value of alcohol at both immediate and delayed conditions was obtained.

As is consistent with previous studies on drug use and temporal discounting, it was anticipated that the pattern of choices by the participants would be best represented by a hyperbolic function. Thus, the majority of the discounting was expected to occur in the shorter time delays and level off with increases in time to the receipt of the hypothetical reinforcer.

HYPOTHESES

Hypothesis 1: Because both heavy and light drinkers were expected to discount the delayed value of alcohol, it was anticipated that the Money Now - Alcohol Later Condition would show the highest rate of discounting (high k values) compared to the other three conditions (i.e., Money Now - Money Later, Alcohol Now - Alcohol Later, Alcohol Now - Money Later Conditions). Similarly, because alcohol was hypothesized as having reinforcing properties only when immediately available, both the Alcohol Now -Alcohol Later and the Alcohol Now - Money Later Conditions were expected to also demonstrate higher rates of discounting (high k) than the Money Now - Money Later Condition.

Hypothesis 2: Because it was anticipated that heavy drinkers discount at higher rates than lighter drinkers, higher rates of discounting (high k) were expected to be

positively associated with higher rates of drinking in the Money Now - Money Later Condition. Such results for the Money Now – Money Later Condition were based on previous research examining discounting rates for money in social drinkers. In addition, previous research examining discounting rates for opioid use suggested that the Alcohol Now – Alcohol Later Condition would also show high discounting rates for higher levels of drinking.

Hypothesis 3: It was anticipated that higher rates of drinking would be positively associated with higher rates of discounting (high k) in the Alcohol Now - Money Later Condition, because heavier drinkers would find the reinforcing properties of immediate alcohol sufficient to discount the delay of a later and less reinforcing stimulus (money).

Hypothesis 4: Rates of discounting were anticipated to vary as a function of both drinking rate and stimulus condition. Specifically, it was anticipated that rate of drinking be unrelated to rate of discounting (k) for both the Money Now - Alcohol Later and Alcohol Now – Alcohol Later Conditions. This was predicted because neither heavy or light drinkers should be anticipated to perceive delayed alcohol as a reinforcer.

Hypothesis 5: Although it was anticipated that rate of drinking be positively associated with rate of discounting (k) for both the Money Now - Money Later and Alcohol Now - Money Later Conditions, it was anticipated that this association would be greater in the Alcohol Now - Money Later Condition. Thus, whereas heavy drinking was expected to be associated with increased discounting under synchronous conditions (Money - Money Conditions), these participants were expected to discount at an even higher rate when alcohol was presented as the immediate reinforcer and was paired with the later money.

METHOD

Participants

Students (N=70; 35 men, 35 women) were recruited from undergraduate classes. Participants from undergraduate classes received extra course credit for their participation in the study. An initial screening of all undergraduate students was performed and a range of students' drinking patterns were chosen. Participants that denied any alcohol use were excluded from the study, as were participants that indicated they drank fewer than 5 beers each week. Specifying that participants consume beer was done to enhance the likelihood that the beer choices would be logical to all participants. All participants were told that their participation was voluntary and withdrawal from the study at any point was permissible.

Measures

Before beginning the procedure, all participants were asked to fill out basic demographic information. General information was collected about their health status, levels of alcohol and drug use, and decision making in general.

The Khavari Alcohol Test (KAT; Khavari & Farber, 1978) and the Michigan Alcoholism Screening Test (MAST; Selzer, 1971) were used to assess the participants' typical drinking patterns and drinking problems. The KAT (Khavari & Farber, 1978) is a well-validated measure in the literature that has been shown to appropriately distinguish between alcoholics and non-alcoholics. The KAT (Khavari & Farber, 1978) produces an Annual Absolute Alcohol Index (AAAI) by assigning numeric values for frequency of alcohol use, amount consumed and the percentage of alcohol in each drink.

Further, participants were asked to fill out several forms measuring impulsiveness. Consistent with measures used in Vuchinich and Simpson (1998), participants completed The Sensation Seeking Scale, Form V (SSS-V; Zuckerman, 1979; Zuckerman, 1996) to determine scores for Thrill and Adventure Seeking, Experience Seeking, Disinhibition, and Boredom Susceptibility; and the Lethal Behaviors Scale (LBS; Thorson & Powell, 1987) to determine engagement in potentially dangerous or lethal behaviors. The SSS-V (Zuckerman, 1996) is a revised form of the original scale that has been widely used in the literature to investigate personality characteristics and yields various correlates of sensation-seeking behavior. The LBS (Thorson & Powell, 1987) has been demonstrated to positively correlate with Thrill and Adventure Seeking subscales from the SSS-V, and provides a multidimensional measurement of danger and violence, adventure, and thrill-seeking (Thorson & Powell, 1989).

Procedure

Individuals from the initial screening who met criteria for the study were called and asked to participate. A time was scheduled for them to come to the laboratory individually. They were told that they were involved in a study investigating factors that influence decision-making. They were not told they were involved in a study to investigate drinking patterns associated with their decisions.

All participants were tested for approximately three hours in a quiet room containing a table and two chairs. All self-report measures were completed following informed consent prior to beginning the discounting procedure. The procedure was modeled after that used in Green et al. (1994), and involved students making a series of

choices regarding hypothetical amounts of money and alcohol, one being available immediately and the other available after a specified delay. Participants were asked about choosing money now or later, alcohol now or later, alcohol now versus money later, and money now versus alcohol later. The various amounts for both alcohol and money were presented on 4 X 6 laminated index cards, which were attached to a two-ring binder. The participant made choices about whether to take the commodity now or later by pointing to the card that was most appealing to them.

Participants were read the following instructions before they began the procedure:

> The purpose of this experiment is to see how you make decisions concerning imaginary amounts of money and alcohol. Two amounts of money or alcohol will be presented to you on cards in front of you. The cards on your left will offer you an amount of money to be paid right now or alcohol to be received right now. This amount will vary from card to card. On the card on your right, the amount will be either $100 or $1,000, but its payment will be delayed. Please look at the example cards at this time. It will be your job to choose between the two cards presented and to point to the card that you would prefer. You will be given four practice trials before you begin, and the experimenter will turn the cards for you. Once the trials begin, the experimenter will no longer be able to answer your questions. Therefore, please ask for clarification if you do not understand the procedure at this time.

All delayed and immediate values were modeled after those used in Green et al. (1996). The possible values of the delayed amounts were $100 or $1,000. There were eight possible delays at which there were two amounts that could be obtained: 1 week, 1 month, 6 months, 1 year, 3 years, 5 years, 10 years, and 25 years. The values on the immediate-amount cards varied depending on the delayed amount with which it was compared. When the delayed amount was $1,000, the 30 possible values of the immediate amounts will be: $1, $5, $10, $20, $40, $60, $80, $100, $150, $200, $250, $300, $350, $400, $450, $500, $550, $600, $650, $700, $750, $800, $850, $900, $920, $940, $960, $980, $990 and $1,000. When the delayed amount was $100, all above values were multiplied by .10 (10 cents, 50 cents, $1, $2, $4, $6, $8, $10, $15, $20, $25, $30, $35, $40, $45, $50, $55, $60, $65, $70, $75, $80, $85, $90, $92, $94, $96, $98, $99, $100.

For the alcohol condition, participants were told that 1 beer equals $1. Values for the beer conditions were modified based on pilot data suggesting that beers were better conceptualized in numbers of cases rather than individual beers. Values of the beers were converted into the nearest one-half case. All steps were at least one-half of a case different from the previous and subsequent steps, except at the lowest values where the choices were modified into 1 beer, a 6 pack and one-half case. The delayed values for the beers at the 1,000 beer condition were as follows: 1 beer, 6-pack, ½ case, 1 case, 1 ½ cases, 2 ½ cases, 3 cases, 3 ½ cases, 4 cases, 6 cases, 8 cases, 10 cases, 12 cases, 15 cases, 17 cases, 19 cases, 21 cases, 23 cases, 24 cases, 27 cases, 29 cases, 31 cases, 33 cases, 35 cases, 37 cases, 38 cases, 39 cases, 40 cases, 40 ½ cases, 41 cases, 41 ½ cases. The values for the beers at the 100 beer condition were as follows: 1 sip, ½ beer, 1 beer, 2

beers, 4 beers, 6 beers, 8 beers, 10 beers, 15 beers, 20 beers, 25 beers, 30 beers, 35 beers, 40 beers, 45 beers, 50 beers, 55 beers, 60 beers, 65 beers, 70 beers, 75 beers, 80 beers, 85 beers, 90 beers, 92 beers, 94 beers, 96 beers, 98 beers, 99 beers, 100 beers.

All participants first received one of the delayed amounts presented with every possible value of the appropriate immediate amounts given in both ascending and descending order. This procedure was followed for each of the delayed values and for all conditions (money vs. money, alcohol vs. alcohol, money vs. alcohol, alcohol vs. money). All participants were randomly assigned to the order for presentation of the conditions and the order of the delayed amount ($1,000 or $10,000) was counterbalanced. Each participant was given the delays in the same order, beginning with the shortest (one week) to the longest (25 years).

The procedure for determining the subjectively equivalent immediate amounts for each fixed amount followed that used in Green et al. (1994). Thus the equivalence points were calculated by averaging the value of the immediate reinforcer when the participant switched preference from the immediate to the delayed rewards for the descending order, and the value at which the participant switched preference from the immediate reward to the delayed rewards for the ascending order. These values represented the point at which the delayed amount was subjectively equivalent to the immediate amount.

RESULTS

Overall Strategy:

The current study included two primary analytic strategies. The first involved examining differences in rate of discounting (k) between the four group conditions (MM,

MA, AM, AA). This was conducted using a 2 X 2 within-subjects, repeated measures ANOVA. The two conditions were present reinforcer and delayed reinforcer. The analyses allowed determination of substance-specific discounting for money and alcohol and allowed comparison of discounting behavior when comparing within and between commodities. These analyses were conducted with the average k value for each condition by averaging the high and low levels for each condition. Additionally, to determine the effect of high and low levels for each condition, a 2 X 2 X 2 within-subjects, repeated measures ANOVA was conducted. This analysis included both high and low levels for the present and delayed conditions. In the event of a significant interaction, simple effects tests or Tukey tests were conducted to determine group differences.

The second analytic strategy involved examining the discounting rate (k) for each condition (MM, MA, AM, AA) in relation to the participant's level of drinking. Rate of drinking was measured as the annual absolute alcohol intake (AAAI). The relationship between discounting rate and rate of drinking was determined using a hierarchical regression. This involved eight separate hierarchical regression equations (both levels of the four conditions). Gender was entered into step 1, self-report measures of sensation seeking (SSS-V) and engaging in lethal behaviors (LBS) were entered into Step 2 and, rate of drinking (AAAI) was entered into Step 3.

Preliminary Analyses

Determining the Rate of Discounting: Rate of discounting was determined using a hyperbolic model. Numerous authors have demonstrated the adequacy of the

hyperbolic model over the exponential model (i.e., Chapman & Elstein, 1995; Vuchinich & Simpson, 1998). A series of non-linear regressions using the hyperbolic equation were conducted for each participant to calculate a k value. Eight separate non-linear regressions were conducted for each participant at both levels of the four conditions using the hyperbolic formula. The hyperbolic formula is as follows: $v_p = V/(1 + kD)$ and this formula is commonly used in determining k value (i.e., Ainslie, 1992; Rachlin, Raineri, & Cross, 1991). Using this formula, v_p is defined as the discounted value of the delayed reward or the present value of the delayed reward. The present value of the delayed reward (V_p) was calculated by averaging the chosen present value with the value preceding it. Specifically, the preference reversal point occurs when the current reward is viewed as more valuable than the larger later reward. For example, if the larger, delayed value was $1,000 and the participant chose the present $900 over the later $1,000, the average of the previous choice of $850 would be averaged with $900 to give that participant a present value of $875. Under circumstances where the delayed value was always chosen, the value of the delayed reinforcer was entered for V_p and no average was calculated. In the present study, the V_p for ascending and descending values were averaged to determine the present value at each of the eight delays (1 week, 1 month, 6 months, 1 year, 3 years, 5 years, 10 years, 25 years). K, in the preceding formula, is defined as a constant that is proportional to the degree of discounting. The present value of the delayed reward varies inversely with k and is used to understand the level of discounting. Therefore, a higher k value suggests that the value of the delayed reward decreases at a faster rate and is less valuable. V is defined as the non-discounted

subjective value of the reward (i.e., $1,000) or the larger the delayed value. D is defined as the delay (i.e., 1 year).

A separate database was established for each participant at each condition and was used to calculate k. Therefore, each participant had eight separate k values corresponding to each condition at both high and low levels. These k values were then translated to t-scores to determine if the k value was an adequate fit for the equation. A t-score was calculated by dividing the k value by the asymptotic error. This t-score was then coded as significant if $\alpha \leq .10$. The value of $\alpha \leq .10$ was used rather than $\alpha \leq .05$ due to the high rate of participant exclusion. A disproportional number of participants were excluded from further analysis in conditions that have not previously been examined (MA, AM). By including participants with k values that had a significant t-score with $\alpha \leq .10$ the number of participants used for continued analyses increased from $n = 23$ to $n = 41$. These 41 participants were used for the continued analyses.

Research has suggested that using all participants, regardless of k-significance, does not significantly influence the outcome of the discounting behavior. Given the increase in power and perceived limited risk in negatively impacting the results of the present study, additional analyses were conducted using all of the participants ($N = 59$) whose data allowed calculation of k-values for each of the four conditions. Both sets of analyses are presented for comparison. Eleven participants were removed from all analyses due to one or more k-values that could not be calculated. Examination of the eleven participants removed from data analyses indicated inconsistent choices between immediate and delayed reinforcers. Data that did not follow a consistent pattern indicate

the participants' choices did not approximate the normal decline in the present value of the delayed reward with an increase in delay.

Descriptive Statistics: Descriptive statistics were computed for participant characteristics. Demographic data are presented for both the 41 and the 59 participant groups in Tables 1 and 2. Participants did not differ significantly by age ($p = .98$). Discounting values for the 59 participant group are presented in tables 3 and 4. Drinking rate represented a wide variety of drinking patterns. Examination of Figures 1 and 2 representing the ANOVAs for both 41 and 59 participant groups indicate that the higher participant number in the second analysis did not change the overall pattern of responses, but rather it appears that it magnified a pattern existing with the smaller participant group. Therefore, inclusion of the additional participants indicated that discounting was most rapid for the MA condition. It appears that the significant interaction was due to an increase in power. As such, only those analyses for the 59 participant group are presented in the body of the text. Analyses and results produced for the 41 participant group are presented in Appendix A.

TABLE 1

41 SUBJECT GROUP DESCRIPTIVE STATISTICS
26 MEN / 15 WOMEN

	MEAN	STD. DEV.	RANGE
AGE	**19.90 years**	**2.15**	**18 - 29**
BEER ANNUAL VOLUME (OUNCES)	**10852.43**	**7466.15**	**790 - 32760**
AAAI (OUNCES)	**648.16**	**398.74**	**64.58 – 1664.10**

TABLE 2

59 SUBJECT GROUP DESCRIPTIVE STATISTICS
30 MEN / 29 WOMEN

	MEAN	STD. DEV.	RANGE
AGE	**19.96 years**	**1.98**	**18 – 29**
BEER ANNUAL VOLUME (OUNCES)	**10969.07**	**7191.44**	**790 - 32760**
AAAI (OUNCES)	**679.99**	**393.13**	**64.58 – 1664.10**

TABLE 3

DISCOUNTING VALUES (K)
59 PARTICIPANTS

NOW – LATER	MEAN	STD. DEV.
Money – Money	.1392	.483
Money – Alcohol	2.0794	3.193
Alcohol – Money	.1527	.570
Alcohol – Alcohol	.6445	2.795

TABLE 4

DISCOUNTING VALUES (K) BY LEVEL
59 PARTICIPANTS

NOW – LATER	MEAN	STD. DEV.
Money – Money Low	.141	.399
Money – Money High	.138	.611
Money – Alcohol Low	1.134	2.035
Money – Alcohol High	3.024	5.175
Alcohol – Money Low	.279	1.108
Alcohol – Money High	.00263	.00962
Alcohol – Alcohol Low	.563	1.833
Alcohol – Alcohol High	.726	4.087

FIGURE 1:
41 Subject Group ANOVA
with total values

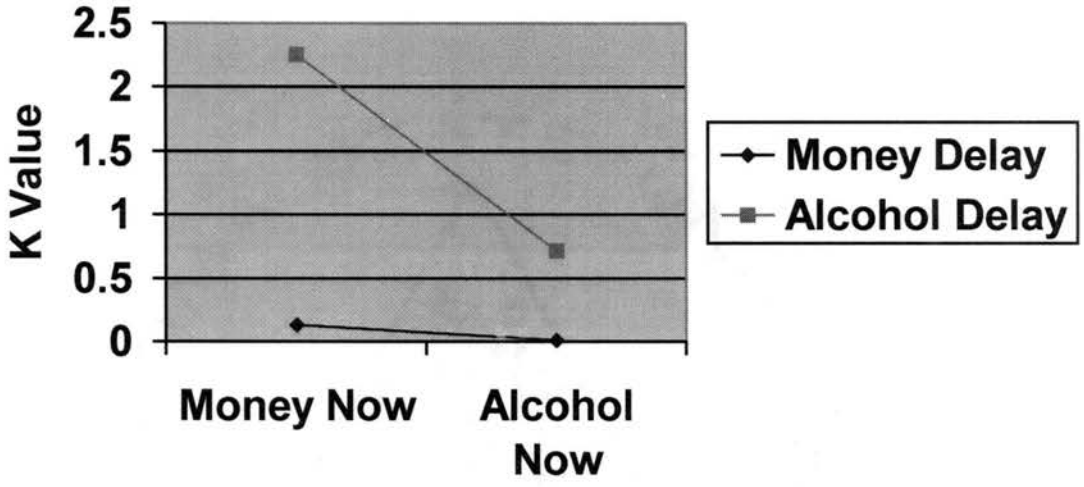
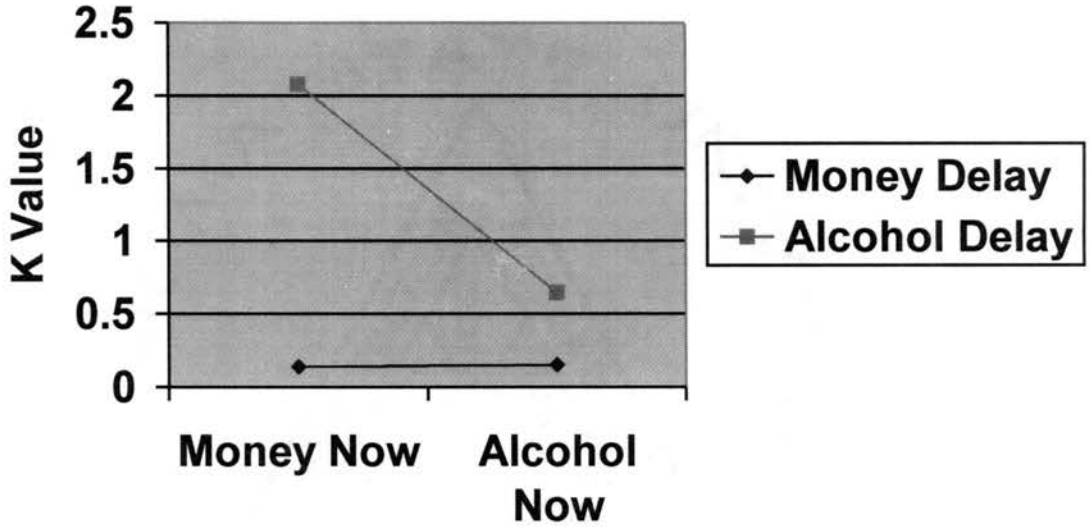


FIGURE 2:
59 Subject Group ANOVA
with total values



Within-Subjects Repeated Measures Analysis of Variance:

Hypothesis 1: Hypothesis 1 predicted that the Money Now – Alcohol Later (MA) condition would show the highest rate of discounting, defined as a higher k value, over the other three conditions. The MA condition should show the highest rate of discounting regardless of rate of drinking since it is expected that delayed alcohol would not be valued as a reinforcer. Similarly, the Alcohol Now – Alcohol Later (AA) condition was expected to demonstrate a high rate of discounting in relation to the Alcohol Now – Money Later (AM) condition and the Money Now – Money Later (MM) condition, although lower than the MA condition. Further, Hypothesis 1 also predicted that both the Alcohol Now –Alcohol Later (AA) and Alcohol Now – Money Later (AM) conditions should demonstrate higher rates of discounting with a higher k value than the Money Now – Money Later (MM) condition.

A within-subjects, repeated measures 2 X 2 ANOVA was conducted. These analyses were conducted on the type of reinforcer presented immediately or delayed. Specifically, groups were divided by the reinforcer given immediately and the reinforcer given at a delay. By separating groups by which commodity was given as the immediate reward and which was given as the delayed reward, effects across conditions and any interactions between commodities could by determined. A significant immediate reinforcer X delayed reinforcer interaction was found, $F(1, 58) = 6.624$, $p < .01$, indicating that discounting behavior was dependent on both the immediate and delayed reinforcers. Significant main effects were found for present, $F(1, 58) = 6.660$, $p < .01$, and delayed, $F(1, 58) = 19.805$, $p < .001$. Tukey post-hoc tests were conducted to

determine group differences for the interaction and indicated only the MA group was different from the other three groups (MM, AA, AM; $p < .01$). None of the other groups were significantly different from each other. Figure 2, p. 42, presents these values.

Within-Subjects Repeated Measures Analysis of Variance including Level

An additional 2 X 2 X 2 within-subject, repeated measures ANOVA was conducted. These analyses indicated a significant Level X Immediate X Delayed interaction, $F(1,58) = 4.38$, $p < .05$. Simple effects tests indicated that the three-way interaction was accounted for by changes in the high level of the MA condition ($p < .001$). A significant interaction was indicated for Present X Delay, $F(1, 58) = 6.62$, $p < .05$, for Level X Delay, $F(1, 58) = 9.58$, $p < .01$, for Level X Present, $F(1, 58)$, $p < .01$. Significant main effects were noted for Level, $F(1, 58) = 6.51$, $p < .05$, for Present, $F(1, 58) = 6.66$, $p < .05$, and for Delay, $F(1, 58) = 19.81$, $p < .001$). Figure 3 presents the results of this ANOVA with level and demonstrates the significantly higher k-value for the money now, alcohol later condition for the high values.

FIGURE 3:
59 Subject Group ANOVA
with level

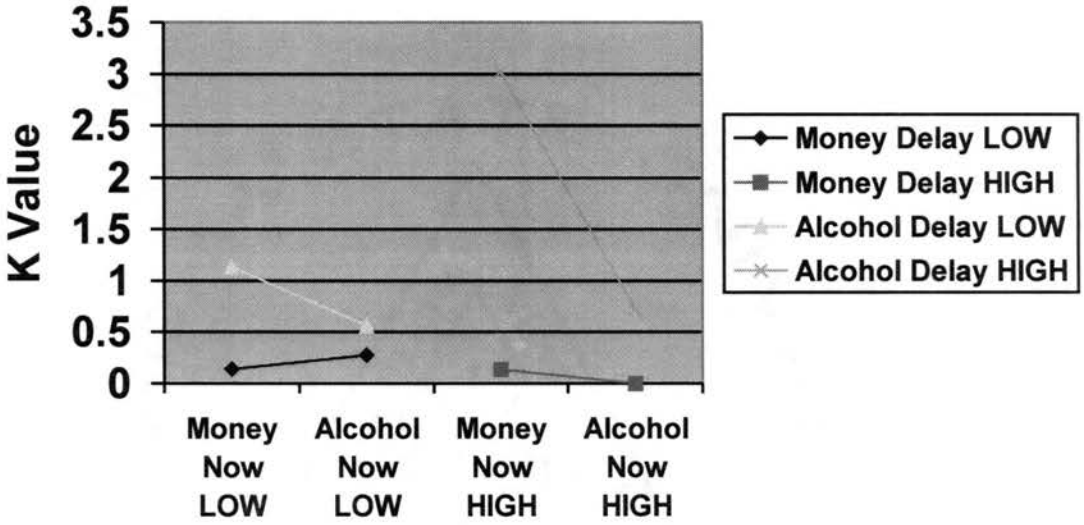
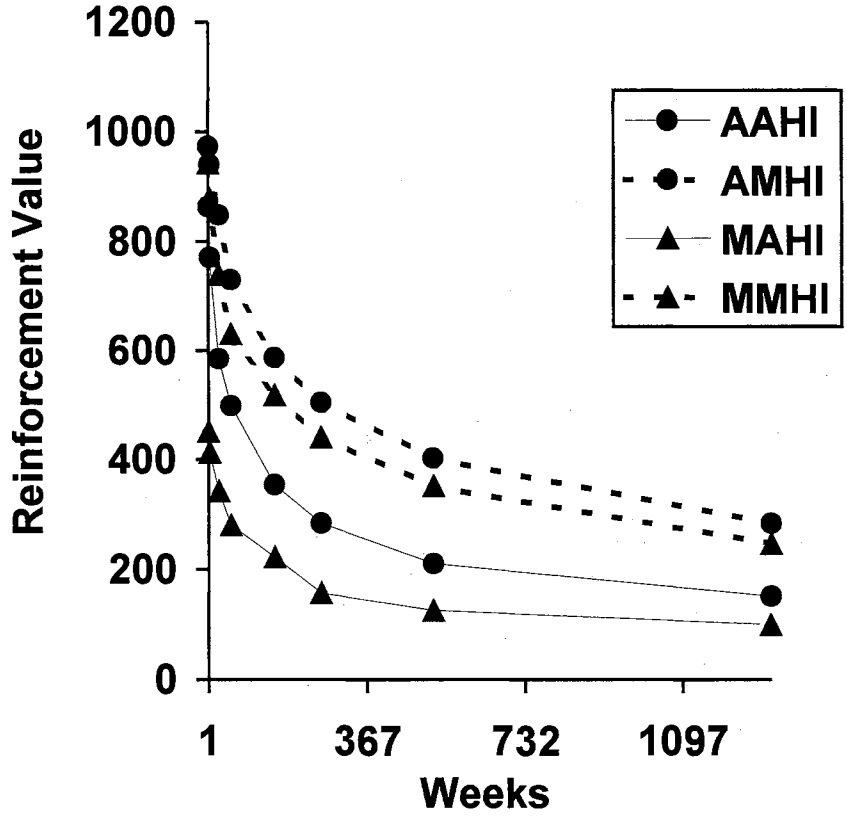


Figure 4 presents the discounting curves for the high level of each condition. The presented values are equivalence points of reinforcement value, determined by the average of the preference reversal value for each subject at each condition. This picture is for descriptive purposes, as it does not provide the k-values in this representation. Therefore, the value of delayed alcohol was discounted most for the high level when money was presented first. Level appeared to have no significant effect on the other three conditions. These results are in contrast to previously observed discounting indicating that larger amounts of a given commodity are discounted less than smaller amounts (i.e., Myerson & Green, 1995; Chapman & Elstein, 1995). Given these results, it would be hypothesized that the high level would show less discounting than the low level for all conditions. While none of the other conditions (MM, AM, AA) exhibited significant changes in discounting for level, the MA condition exhibited a pattern of response opposite to what previous research has indicated.

Therefore, Hypothesis 1 was partially confirmed. It appears that no differences exist between levels or delays for MM, AA, and AM conditions. The only condition that exhibits significant discounting is the MA condition. This rapid devaluing of the delayed reward is accounted for primarily by the high levels of the MA condition.

FIGURE 4:

59 Subject Group High Level Discounting Curves



Regression Analyses

Hypotheses 2-5: Eight separate hierarchical multiple regression equations were constructed to examine the effects of rate of drinking (AAAI) on discounting rate for each of the four conditions at both high and low levels. In each equation, gender was entered on Step 1, SSS-V scores and LBS scores were simultaneously entered into Step 2 and rate of drinking was entered into Step 3. Results revealed that rate of drinking was not significantly correlated with any of the four conditions at either high or low levels. No significant predictors were indicated in the conducted analyses for the low level of AA (F cha = 1.87, p = .18), the high level of AA (F cha = .38, p = .54), the low level of AM (F cha = 2.11, p = .15), the high level of AM (F cha = 3.33, p = .07), the low level of MA (F cha = .001, p = .97), the high level of MA (F cha = .67, p = .42), the low level of MM (F cha = 1.40, p = .24), and the high level of MM (F cha = 1.31, p = .26). Table 5, p. ?? presents the group values.

Hypotheses 2 through 5 were not confirmed. These hypotheses stated that higher rates of drinking would be associated with higher rates of discounting on the MM condition. These hypotheses were based on previous research (Vuchinich & Simpson, 1998) indicating that heavy social drinkers discount monetary amounts more than light social drinkers. The AM condition was also anticipated to show higher rates of discounting for heavier drinkers, as the present value of alcohol would be more reinforcing than the delayed value of money. Further, the AA condition was anticipated to show higher rates of discounting for heavier drinkers. This was based on the premise that for heroin and cigarettes, users tended to discount the drug commodity to a greater extent than monetary amounts (Madden, et al., 1997; Bickel, et al., 1999). Finally, it was

anticipated that for conditions with delayed alcohol there would be no association with drinking rate, as the delayed alcohol would not be reinforcing for either light or heavy drinkers. While it appears that this hypothesis was confirmed, the previous results indicate that delayed alcohol is indeed valued to a similar extent as delayed money except when money was given as an immediate reinforcer.

DISCUSSION

The present study served to replicate existing research on discounting behavior and to extend this literature with examination of several novel conditions. Specifically, the present study was an extension of existing literature examining money now, money later choices to examine discounting behavior. It also served to further research on choices between drug now, drug later choices. By examining both money now, money later choices and alcohol now, alcohol later choices for the same participants, the hypothesis that discounting for drug commodities is higher than that for money could be empirically tested. Further, by extending the choices to allow for both within commodity choices (money now, money later; alcohol now, alcohol later) and between commodity choices (money now, alcohol later; alcohol now, money later), a more thorough understanding of the effects of varying commodity on discounting behavior could be examined. While no existing research has examined the effects of choosing between commodities, treatment implications frequently hypothesize that choices about money now, money later and the determined discounting data may predict drug use after completion of treatment. However, a person with a drug addiction would be more likely to be presented with choices between the drug now and money later, or other valuable

delayed non-drug reinforcer. Therefore, the present study used the alcohol now, money later choices to empirically examine how these choices varied from choices about money now, money later. The present study also examined the effects of level on both money and alcohol choices to determine the relative effect each has on discounting behavior. Finally, the present study was interested in whether rate of drinking would affect discounting for all of the presented conditions.

The original hypotheses were partially confirmed. It appears that discounting varied as a function of the commodity (alcohol or money) and whether it was presented as the immediate or the delayed reward. Specifically, the money now, alcohol later choices produced the highest rate of discounting and was significantly different from the other three choice combinations (money now, money later; alcohol now, alcohol later; alcohol now, money later). The money now, alcohol later choice showed the highest rate of discounting at the high level. None of the other choice differed from each other or demonstrated an effect for level. These results indicate that future alcohol is valued the least when the present alternative is money. The value of delayed alcohol was largely maintained when alcohol was the present commodity and was discounted rapidly when money was the present reinforcer. While it was anticipated that the money now, alcohol later condition would show the highest rate of discounting, the examiners hypothesized that both conditions with delayed alcohol (alcohol now, alcohol later & money now, alcohol later) would exhibit similar rates of discounting. However, the alcohol now, alcohol later condition showed rates similar to the money now, money later and alcohol now, money later conditions. The value of delayed money did not appear to differ based

on the present commodity. Therefore, delayed alcohol does indeed maintain reinforcing value, but this value is dependent on the immediately available commodity.

Examination of level indicated that higher discounting for the money now, alcohol later condition was largely due to the rapid drop in value for higher amounts of alcohol in the future when money was presented immediately. Therefore, very high values of delayed alcohol were rapidly discounted, while the lower values of delayed alcohol did not demonstrate such a dramatic decline in value. This level effect was not shown for the money now, money later choices, the alcohol now, alcohol later choices, or the alcohol now, money later choices. These results further suggest that the use of similar or different commodities in the discounting procedure did not affect discounting behavior, but rather the value is dependent on a combination of both the delayed and immediate commodity.

The present study also indicated that rate of drinking is not correlated with discounting behavior on any of the four choices. While this study maintained a high rate of variability for drinking level across participants, it appears that the differences in discounting behavior were largely due to the effects of choosing between money now and alcohol later rather than differences among participants' rate of drinking. Further, it appears that rate of discounting was not influenced by levels of impulsivity, sensation seeking or engaging in dangerous behavior.

Commodity - Specific Discounting

It was hypothesized that the reinforcing properties of alcohol would be present only when immediately available. Therefore, it was proposed that both choices with

delayed alcohol (money now, alcohol later; alcohol now, alcohol later) would show similar rates of discounting. The current study indicated that delayed alcohol maintained value when the immediate reinforcer was alcohol, but this value was rapidly lost when the immediate reinforcer was money. So it appears that delayed alcohol is indeed valuable; however, when money was presented immediately, this value is rapidly lost. This effect is largely due to the rapid discounting for the high level of the money now, alcohol later choices, with high levels of delayed alcohol being even less reinforcing than lower levels when given the choice for immediate money. This level effect was not noted for the alcohol now, alcohol later choices, where individuals consistently waited for the larger amount of alcohol over taking a smaller immediately available amount of alcohol.

Existing research has indicated conflicting information as to the relationship between level of reinforcer and rate of discounting. Studies (e.g., Green et al., 1997) have indicated that with money now, money later choices, as the value of the delayed reward increases, discounting shows a negatively accelerated pattern. This exists until the delayed reward reaches $25,000 at which point this pattern is no longer indicated. Research on college social drinkers (Vuchinich & Simpson, 1998); however, did not show this effect. Results from Vuchinich & Simpson (1998) are similar to the present study findings in that for higher reinforcer values, discounting occurred more rapidly than for lower values. However, Vuchinich and Simpson indicated this pattern of rapid discounting behavior for higher values of the reinforcer in their choices for money now, money later. This is in contrast to results from the present study, as it failed to exhibit the level effect on any condition except the money now, alcohol later condition. This lends evidence to the idea that high levels of alcohol lost value at a very high rate when the

participant was given immediate money. While it is unclear to the reasoning behind this effect, it is hypothesized that a social factor may be influencing choices. Perhaps large amounts of delayed alcohol, when presented with smaller amounts of immediate alcohol, could be used for "throwing a large party", while the smaller immediate amounts did not seem valuable as they would more likely be associated with solitary consumption. When money was given in the context of waiting for a large amount of alcohol, this social factor was removed, giving the person a choice to obtain a monetary reward individually. It may also be that large amounts of alcohol are not reinforcing, except when presented with the option of immediately available alcohol.

The present results suggest that choices between and within commodities are determined by both the immediate and delayed choices and are therefore not dependent on the commodity itself. This is in contrast to existing data. Other studies (Chapman & Elstein, 1995; Chapman, 1996) have indicated that discounting is related to the commodity itself across normal participants with different discounting rates for health, money, and vacations. Further, studies (Madden, et. al, 1997; Bickel, et al., 1999) have indicated that the discounting for drug reinforcers is higher than that for money when compared to drug now, drug later choices in participants who are or were substance users. These results are demonstrated for opioids and cigarettes. For the present results, the delayed reinforcement value of alcohol was maintained when alcohol was immediately available and was done so at rates consistent with money now, money later and alcohol now, money later choices. These results suggest that regardless of how much alcohol is consumed by the person, smaller amounts of immediate money are chosen over larger amounts of delayed alcohol, while a person is willing to wait for a larger amount of

alcohol when a small immediate alcohol choice is presented. The present results may conflict with previous data for several reasons. Specifically, these previous studies were done on individuals with a long history of use / abuse. The longest use rate for the current study was 3 years, while the previous work suggested an average of 9 years use for heroin and 5 years of smoking history. Further, the mean age for the present study was 19 years, compared to 35 years for the other studies. The combination of younger age and shorter abuse history may account for the lack of discounting changes between money now, money later choices and alcohol now, alcohol later choices. While many individuals in the present study had very high rates of drinking, their level of dependence was not directly assessed, making it difficult to know the contribution of these effects. It is important to note that a measure of problem behaviors associated with drinking (i.e., trouble at work, fights when drinking) was correlated with higher rates of drinking. While no differences were found between money now, money later choices and alcohol now, alcohol later choices, these participants were able to differentiate between the subjective value of money and alcohol as shown in the money now, alcohol later choices. The rapid decline in value for the delayed alcohol, when money was present, may be accounted for by the ability to forego the drug reinforcer given their shorter history of use. These results suggest that college students are able to make appropriate choices when presented with alcohol now and money later regardless of their rate of drinking. This may indicate a greater likelihood that college students could forgo alcohol consumption when they are presented with a more valuable delayed reinforcer, despite current high rates of drinking.

Rate of Drinking

It was anticipated that rate of drinking would be positively associated with discounting rate for all conditions except those with delayed alcohol, as this was not expected to be valued by either high or low drinkers. Specifically, individuals with higher rates of alcohol consumption were expected to demonstrate higher rates of discounting for both the money now, money later choices and the alcohol now, alcohol later choices. Further, it was anticipated that heavier drinkers would value the reinforcing properties of alcohol to a greater extent than lighter drinkers, making the alcohol now, money later choices exhibit higher rates of discounting for higher rates of drinking. The present results indicated that for all choices, rate of drinking was not associated with discounting rate. However, the effect for the money now, alcohol later choices existed despite a large variation in drinking patterns, suggesting that even for high drinkers, preference for immediate money existed when given the choice of a large amount of delayed alcohol. Results from the alcohol now, alcohol later choices indicate that the larger delayed reward remained valuable when both immediate and delayed choices are alcohol.

The finding that rate of drinking was not associated with higher rates of discounting is contrary to previous research examining discounting behavior for social drinkers (Vuchinich & Simpson, 1998). This previous research indicated that higher rates of drinking were related to higher discounting for money now, money later choices. However, rates of drinking from this previous research appeared to be categorized into very high rates of drinking and those with very low rates of drinking. The present study, while employing a high range of variability in participants' drinking rate, used a more

homogenous group. It is to be expected that using a largely polarized sample would produce differences in discounting. These previous results, however, do not appear to generalize to the present study, suggesting that rate of drinking is not a good discriminator for discounting behavior in a more homogenous sample of college-aged drinkers. Specifically, in the present study, even in individuals with high rates of drinking, their discounting behavior was not affected. Further, while this previous work examined only money now, money later choices, the present study incorporated choices between money and alcohol with no change in discounting based on rate of drinking for any of the combinations of choices. It appears that for a sample more representative of a college population, they are able to make choices about present and future commodities that are not affected by their rate of alcohol consumption.

Self-Report Measures

Several self-report measures were used in the present study and indicated unexpected results. In the present study, measures of thrill and adventure seeking, experience seeking, disinhibition, and boredom susceptibility as measured by the Sensation Seeking Scale (SSS-V; Zuckerman, 1979), engagement in potentially dangerous or lethal behaviors as measured by the Lethal Behaviors Scale (LBS; Thorson & Powell, 1987) were not correlated with discounting values. This lack of a relationship between rate of drinking and discounting behavior may partially be explained by examining other relationships. The SSS and the LBS scores were positively correlated with each other, as expected, given they likely measure similar constructs. This relationship was primarily due to the Disinhibition scale. Close examination of this scale

indicates that these questions apply more specifically to alcohol and "partying", while the other scales on the SSS are more general measures and include other aspects of the individuals' life. Further, the SSS was positively correlated with rate of drinking. In general, it appears that measures specific to alcohol are correlated with rate of drinking and the more general measures of impulsivity are not related to rate of drinking. Taken together, it appears that the higher rates of drinking result in more disinhibited behavior only while the individual is drinking. The physiological effects of alcohol tend to result in an individual becoming more disinhibited and these participants appear to primarily engage in these risky behaviors when they are under the influence of alcohol. While the potential exists for the disinhibition from alcohol to generalize to other behaviors, there is no evidence from the present study that problems outside of those presented when under the influence of alcohol exist. This may indicate why choices about alcohol and money do not vary from each other when the participants are not under the influence of alcohol. Higher rates of drinking and their relationship to risky behaviors has been understood for some time. Research (Wechsler, Kuo, Lee, & Dowdall, 2000) has indicated that underage drinking is related to more drinking in private settings (i.e., dormitory and fraternity parties) and situations where one price is paid for unlimited drinking. These authors note that students find it very easy to obtain alcohol. Incorporating the principles of behavior economics becomes very important to lower the availability and increase the price to obtain alcohol for all students who engage in higher rates of drinking, as these individuals indicate higher rates of problems associated with their drinking. Monitoring fraternity parties, closer examination of illegal sale of alcohol and wide-spread dissemination of the problems associated with higher rates of drinking may serve to limit

these negative behaviors. The results from the money now, alcohol later condition may indicate a point of intervention. If individuals regardless of drinking level choose smaller, immediate monetary rewards over larger, delayed rewards for alcohol, perhaps giving an immediate alternative to drinking in large amounts could lower high rates of drinking and limit the potential problem behaviors that result from this drinking.

Overall Results

Taken together, it appears that rate of discounting is only partially predicted by commodity specific choices. Rather, it appears to be a function of both the commodity and time of presentation with discounting being greatest for immediate money, delayed alcohol choices. Other commodity combinations do not vary from each other. It appears that while the value of the delayed reward is influenced by commodity and time of presentation, it is not altered by the participants' consumption rate in conditions exclusively for money or alcohol. Therefore, rate of drinking cannot be considered a sensitive marker for discounting behavior in a sample of college drinkers with a wide range of drinking patterns.

The relationship of high rates of drinking, potential problems associated with high rates of drinking and the ability to forego delayed alcohol for immediate money, suggests that an immediate reinforcer of higher value could be given to limit drinking-related problems for individuals across rates of drinking.

Limitations

While the present study was designed to limit extraneous effects, some caution should be used when interpreting the findings. The participants used in the present study were obtained from a largely homogenous sample. While this enhances the probability to generalize to a college population, generalizability to the population at large must be made with caution. However, the present study produced k-values similar to existing research for the money now, money later conditions, suggesting similar patterns of responding across populations. Further, the present study limited participants to those that consumed at least five alcoholic beverages each week. While this increases the likelihood that participants would find the choices for alcohol to be logical, the discounting behavior of individuals for the present study conditions that drink fewer beverages each week has yet to be determined.

Secondly, it is important to consider that all of the participants in the present study are college students. The present sample showed a mean of 3 years of alcohol use, suggesting these results may have minimal predictive power in individuals that have been drinking for many years or for people who are in treatment. Research indicating that patients with substance abuse diagnoses also show self-report impulsivity and differences in their discounting as compared to those patient without this diagnosis (Crean, et al., 2000), is in contrast the present results and suggests that this college population of substance users is not representative of people who are older and have more stable use / abuse histories. The sample in the present study may be familiar with limiting alcohol intake for periods of time to study, go to class, or because of limited access to money, and are not frustrated by waiting for a larger amount of a valued substance. As indicated

previously, the influence of level of dependence on choices cannot be ignored. However, while the level of dependence may be less than chronic alcohol abusers, these students continue to engage in high levels of drinking with the potential to engage in risky behavior. Therefore, this population warrants investigation to more fully understand their patterns of use and ways to reduce the negative consequences associated with consumption of alcohol.

Third, the present study did not formally assess the secondary factors associated with the large amounts of alcohol. It may be hypothesized that large amounts of alcohol are reinforcing due to secondary factors such as social reinforcement. Offering large amounts of alcohol to this population may indicate "throwing a large party", while small amounts are not valued as they may be consumed by themselves. However, it is valuable to know that the value of large amounts of alcohol is rapidly reduced when immediate money is given, suggesting that the social aspect can be removed.

It is also important to consider that 11 participants were removed from the present study due to the inability to calculate k-values. This study used a within-subjects design and these participants were primarily removed due to the money now, alcohol later and alcohol now, money later choices, despite appropriate responding on other conditions. Therefore, for these subjects, it is feasible to consider that there may have been some confusion regarding making choices between commodities. Additionally, more lenient inclusion data were used for the significant k-values. This was allowed given the lack of previous investigation for money now, alcohol later and alcohol now, money later choices and the high rate of attrition for these choices. It was determined that using a significance value of $p < .05$ was too stringent for the present investigation and inclusion

of all participants produced minimal changes in the effects when compared to the power given when they were included.

Finally, the present study was designed with hypothetical amounts of money and alcohol. When making hypothetical choices about money, it is unclear to what extent these results will generalize to actual choices between alcohol and money for this population. Although this cannot be ruled out, previous research has demonstrated that similar hyperbolic discounting functions have been made for real nonmonetary rewards (Kirby & Herrnstein, 1995) and real monetary rewards (Crean et al., 2000; Kirby, 1997; Richards et al., 1999), suggesting that hypothetical data can be used to examine these types of choices.

Clinical Implications

Despite the limitations indicated previously, the present study is believed to be methodologically sound. The examiners went to great lengths to ensure appropriate condition randomization and to include a wide range of drinking patterns more representative of the college population. The present investigation expanded the existing field of knowledge on discounting and substance use by examining the effects of using different commodities and making choices across commodities. While theoretical models (Vuchinich & Tucker, 1998) have posited that choices within commodities can be extrapolated to choices across commodities, the present study is the only study to our knowledge to attempt to model "real world" choices by choosing across commodities.

The present results indicate that discounting behavior is conditional on both the commodity and the time of the presentation, specifically the money now, alcohol later

choices showed the highest rate of discounting. Discounting was not affected by rate of drinking for any condition. While other research has suggested that discounting is changed by commodity, these previous studies did not include the cross-commodity conditions. These results suggest that the value of a future reward is influenced not only by the commodity presented in the future, but also by which choice is immediately present. This suggests important treatment implications. An individual who is trying to quit or delay using their drug of choice may find that the availability of delayed and immediate rewards and the type of commodity may influence their using behavior. Further, for college drinkers, administration of a monetary reward may reduce or delay alcohol consumption and potentially reduce the negative consequences associated with higher rates of drinking. In treatment for alcoholism, perhaps the presentation of an immediately available reinforcer can function in the same fashion to decrease the value of the drug.

The present study indicates the need to measure discounting behavior with varying commodities and suggests that using same-choice commodities may not give an accurate picture of decision-making. The delayed drug reinforcer (alcohol) was not valued when the immediate reward was money. When money was delayed, no differences were found for the present reinforcer. These results suggest that there may be commodity-specific properties that influence the reinforcing value of immediate versus delayed reinforcers. More specific investigation of this principle is needed to understand how other commodities are viewed when choosing between those with different times of presentation and type.

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APPENDIXES

APPENDIX A: 41 PARTICIPANT GROUP ANALYSES

A within-subjects repeated measures ANOVA was conducted on the type of reinforcer presented immediately or delayed. Specifically, groups were divided by the reinforcer given immediately and the reinforcer given at a delay. By separating groups by which commodity was given as the immediate reward and which was given as the delayed reward, effects across conditions and any interactions between commodities could by determined. A significant main effect for the present reinforcer was found, $F(1, 40) = 4.15$, $p < .05$, indicating that conditions where money was the immediate reinforcer (MM, MA) were significantly different from conditions where alcohol was the immediate reinforcer (AA, AM). Therefore, immediate money showed a significantly higher mean k-value than those with immediate alcohol, regardless of the delayed reinforcer.

A significant main effect was also found for the delayed reinforcer, $\underline{F}(1,40) = 14.12$, $\underline{p} < .001$, indicating that conditions with money as the delayed reinforcer (MM, AM) were significantly different from conditions with alcohol as the delayed reinforcer (MA, AA). Figure 1, p. ??, presents a graph of the means for each condition.

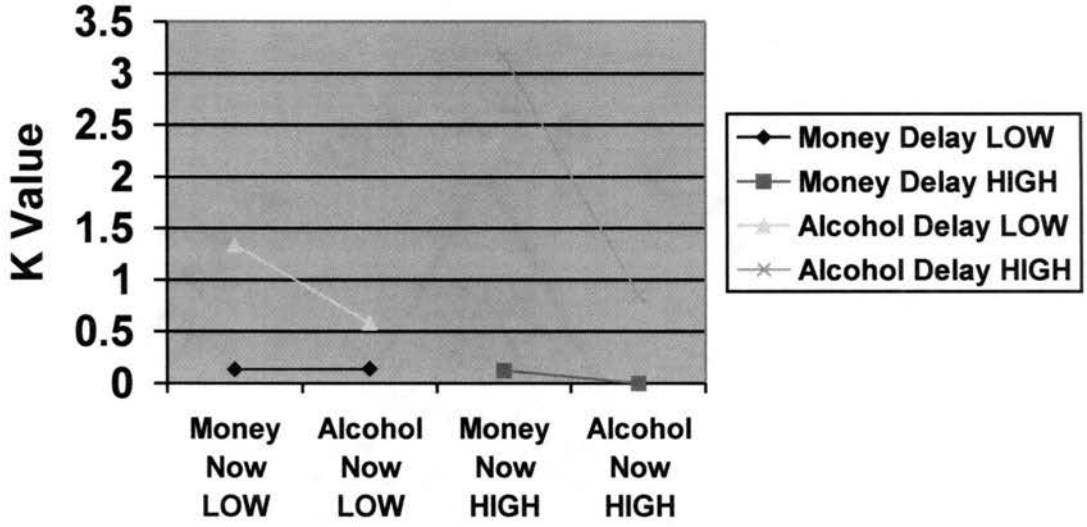
No significant interaction effect was noted for immediate reinforcer X delayed reinforcer, $\underline{F}(1,40) = 3.589$, $\underline{p} = .065$.

An additional 2 X 2 X 2 within-subject, repeated measures ANOVA was conducted to determine the effect on k value of high and low levels for each condition. This analysis included both high and low levels for conditions with similar immediate reinforcers and those with similar delayed reinforcers. Results indicated a significant Level X Delayed Reinforcer interaction, $\underline{F}(1, 40) = 5.25$, $\underline{p} < .05$, indicating that

discounting rates were dependent on both level and the delayed reinforcer. Simple effects tests indicated k value level differed for delayed alcohol and not for delayed money ($p < .00$). Specifically, delayed alcohol showed the highest rate of discounting for the high values, although not for the low values. Figure 3 presents these results. None of the low values for delay were significant. No significant interactions were found for Level X Present, F (1, 40) = 3.05, p = .08, or for the Level X Present X Delayed, F (1, 40) = 2.186, p = .14. No significant main effect was noted for Level X Present, F (1, 40) = 3.05, p = .08 or for Level, F (1, 40) = 3.92, p = .055. Significant main effects were found for Present, F (1, 40) = 4.15, p <.05, and Delay, F (1, 40) = 14.12, p < .001. Therefore, it appears that k differences were not significantly influenced by level for the immediate reinforcer, while k did appear to be affected by the level of the delayed reinforcer. Specifically, delayed money was not influenced by level, while delayed alcohol showed the highest discounting for the high level.

Results of the hierarchical regression indicated that rate of drinking was not significantly correlated with any of the four conditions at either high or low levels. No significant predictors were indicated in the conducted analyses for the low level of AA (F cha = .83, p = .37), the high level of AA (F cha = .22, p = .64), the low level of AM (F cha = 1.59, p = .22), the high level of AM (F cha = 2.60, p = .12), the low level of MA (F cha = .06, p = .81), the high level of MA (F cha = .71, p = .41), the low level of MM (F cha = 1.23, p = .28), and the high level of MM (F cha = .63, p = .43).

FIGURE 5:
41 Subject Group ANOVA
with level



OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD

Date: December 20, 1999 IRB #: AS-00-103

Proposal Title: "TEMPORAL DISCOUNTING IN SOCIAL DRINKERS: IS THERE A SUBSTANCE-SPECIFIC RELATIONSHIP?"

Principal Investigator(s): Frank Collins
Heather Stott

Reviewed and Processed as: Expedited

Approval Status Recommended by Reviewer(s): Approved

Signature:

Carol Olson

Carol Olson, Director of University Research Compliance

December 20, 1999
Date

Approvals are valid for one calendar year, after which time a request for continuation must be submitted. Any modification to the research project approved by the IRB must be submitted for approval with the advisor's signature. The IRB office MUST be notified in writing when a project is complete. Approved projects are subject to monitoring by the IRB. Expedited and exempt projects may be reviewed by the full Institutional Review Board.

VITA

Heather D. Stott

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Doctor of Philosophy

Dissertation: TEMPORAL DISCOUNTING IN SOCIAL DRINKERS: IS THERE A SUBSTANCE-SPECIFIC RELATIONSHIP?

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