TEMPORAL DISCOUNTING AND DEPRESSION

By

RAEGAN L. BURLINGAME

Bachelor of Arts

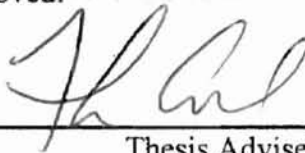University of Oklahoma

Norman, Oklahoma

1998

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirement for
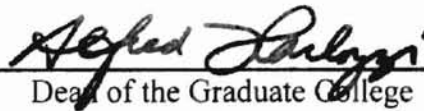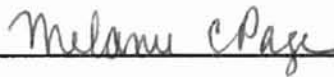the Degree of
MASTER OF SCIENCE
December, 2000

TEMPORAL DISCOUNTING AND DEPRESSION

Thesis Approved:

_____
Thesis Adviser

_____

_____

_____
Dean of the Graduate College

ii

ACKNOWLEDGMENTS

I would like to thank my academic adviser, Frank L. Collins, Ph.D., for his continued guidance and support. His input and feedback were critical to the completion of this study. I would also like to thank my thesis committee members, John M. Chaney, Ph.D., for his active guidance toward the completion of this study, and Melanie C. Page, Ph.D. for her commitment to my academic progress. I greatly appreciate all of the educational support of the faculty members in the Department of Psychology. Lastly, I would like to recognize and thank my family. My parents, brother, future husband, and future parents-in-law are my greatest sources of support in my progress toward my goals.

TABLE OF CONTENTS

LIST OF FIGURES

Figure   Page

CHAPTER I

INTRODUCTION

Many choices in life are between alternatives that will be either immediately rewarding or rewarding at some delayed point in time. When the values of two commodities are equal the immediately rewarding one is obviously more valuable than the one that is delayed. The immediately available reward may be enjoyed right now, and one has nothing to gain by waiting. However, when the delayed reward is larger than the immediate reward, one must choose between the two alternatives. For example, common choices include whether to spend or invest one's money, to smoke or avoid health problems, and to watch television or study in order to earn good grades. We make such choices according to our perception of how rewarding the outcomes may be. Choices for delayed, larger rewards are often referred to as self-control, while choices for immediate, smaller rewards are seen as a sign of impulsivity.

It has been shown that as the delay to a reward increases, its subjective value decreases (Killeen, 1972); therefore, the preference for a delayed reward is an interesting one. Given the evidence that subjective value of delayed rewards decreases over time, one might wonder what would ever motivate individuals to choose them. Some individuals may choose delayed reinforcement, because it is worth more to them than the more immediate alternative. In addition, delayed rewards may be chosen by behaviorally

1

committing to them, which is possible by responding in a way that cancels the availability of the smaller, immediate reward (Rachlin & Green, 1972). For example, a person who has decided to quit drinking alcohol in favor of a healthier lifestyle may decide to take a different route home from work in order to avoid passing his or her favorite bar. Surely, the choice to commit to a larger payoff at some point in the future can prove difficult. The fact that individuals with substance-related disorders attempt to quit numerous times without success is a testament to the challenge inherent in such choices.

Indeed, some individuals, such as problem drinkers, have exceptional difficulty choosing delayed rewards (Vuchinich & Simpson, 1998). Discounting occurs when a larger, delayed reward decreases in value over time. The behavioral manifestation of temporal discounting is that one chooses the smaller, more immediate reward rather than larger, later one. This preference indicates that, subjectively, the value of the larger, delayed reward is really only as much as the smaller, immediate reward. Many reasons probably contribute to the fact that for some people future rewards are not valued enough to be chosen. Possible explanations such as delayed rewards requiring too much effort and the uncertainty of obtaining delayed rewards will be discussed later in this paper.

Interestingly, a pattern of choosing immediate reinforcement often results in the forfeiture of other valuable commodities that involve delay. Often, when individuals choose more immediate alternatives, they are not necessarily forfeiting rewards for which the only requirement is to wait. Rather, many delayed rewards require effort, faith, and self-control. For example, larger, later rewards such as meaningful interpersonal relationships do not suddenly appear after a certain period of time. They require an active

pursuit, and the choice to obtain more immediately reinforcing alternatives, such as those obtained from a drug habit, may be in direct conflict with other, delayed rewards.

A chronic pattern of choosing immediate rewards that results in losing greater reinforcement in the long run can become problematic. Of particular interest in the current study is how individuals with depression often lose interest in their normal activities, risking forfeiture of future rewards. This loss of interest, or anhedonia, may be partially due to the decreased reinforcement value of many behaviors during depression. For example, a depressed individual may have a choice between spending time with friends, a large, delayed reinforcement, and sitting alone on the couch, a smaller, more immediately rewarding alternative. The distinction made between which rewards are large or small is likely to be subject to individual differences and learning history. However, most behaviors may be conceptualized in terms of their costs versus benefits in a temporally extended context. The examples used above may be analyzed accordingly. Spending time with friends involves costs related primarily to emotional and temporal investments. Individuals must spend enough time with each other to become familiar with their histories, goals and hopes. Also, the process of getting to know someone requires an emotional investment that requires the willingness to be vulnerable in circumstances where acceptance from the other person may be uncertain. For some, these costs may not outweigh the benefits of friendship, such as the comfort, fun, and intimacy that it frequently offers. In other words, the reinforcement value of social behavior decreases, while the choice resulting in social isolation provides escape from vulnerability and emotional investment. However, the costs of this behavior may be numerous. The social nature of human activity is pervasive. The costs associated with

decreases social support may be detrimental to one's functioning in work, school, and family relationships, as well as to one's personal health (Vahtera et al., 2000; Orth-Gomer, 2000). During depression, there may develop a pattern in which spending time with friends is never chosen, because its perceived reinforcement value prevents it from being chosen.

However, it is important to note that depressed individuals do not lose interest in all activities; in fact, some activities, such as substance abuse, are actually associated with depression (Johnson, 1995). Substance abuse is a behavior that exemplifies the impulsive choices that often exclude the receipt of larger, later rewards. So, it seems possible that people who are depressed may prefer more immediate means of reinforcement and have more difficulty making choices that result in delayed rewards.

The idea that depressed individuals might prefer more immediate reinforcement was originally proposed by Rehm (1975). In his self-control theory of depression, he suggested that depressed individuals attend more to immediate versus delayed outcomes (Rehm, 1977). However, the results of studies examining this relationship have been mixed.

Interestingly, the selective attention for immediate outcomes that Rehm (1977) described in depressed individuals is comparable to descriptions of impulsive behaviors, such as substance abuse. As it was mentioned earlier, a significant relationship between problematic substance use and rates of temporal discounting has been established in the literature. It is evident that depression and substance abuse have been commonly characterized by a lack of self-control and a preference for immediate rewards, and there is evidence of a significant correlational relationship between depression and substance

abuse that does not even consider the role of temporal discounting. Accordingly, the goal of the current study is to examine the interrelationship between depressed mood, substance use, and temporal discounting. It is hypothesized that self-reported depression scores will predict individuals' discounting rates after statistically controlling for substance use.

The remainder of the current paper will include a discussion of the phenomenon in which the value of delayed reinforcement decreases over time, called temporal discounting. In order to understand how temporal discounting fits into a broader conceptual model of behavior, behavioral theories of choice will be discussed. The remaining literature review will include evidence for the relationships of substance abuse with both temporal discounting and depression. Also, theories of depression and studies that examine directly its relationship to discounting delayed rewards will be presented.

CHAPTER II

LITERATURE REVIEW

Temporal Discounting

As described briefly in the previous section, individuals make many choices in life between immediately reinforcing alternatives and alternatives that will be reinforcing at some delayed point in time. Temporal discounting is representative of how the subjective value of future rewards decreases over time (Myerson & Green, 1995). It has been scientifically investigated and conceptualized as a common process by which people evaluate future goals. In fact, philosophers and economists have long observed the tendency for people to prefer more immediate gratification to delayed gratification, even when the delayed reward is substantially larger (Ainslie & Haslam, 1992).

Basic learning theory supports the notion that more immediate consequences foster learning more effectively. It follows logically that immediate rewards are more meaningful and effective than delayed rewards. In addition, Herrnstein's matching law (1970) shows that preference for rewards is proportional to their rate and amount of delivery and inversely proportional to their delay. Therefore, organisms will prefer rewards that are large, fast, and immediate. Subsequent studies have shown that at one point in time both rewards are valued equally, but before that point the delayed reward is preferred, and after that point the smaller, more immediate one is preferred. Before

preference reverses it is equal between the two rewards and is characterized by this point ambivalence. When preference reverses to the smaller reward, it is characterized by impulsiveness (Rachlin & Raineri, 1992).

This preference reversal can be quantified by an equation called the hyperbolic discount function. It estimates or predicts the extent to which the value of delayed reinforcement decreases with time for any given individual. The following equation represents the hyperbolic discount function (Ainslie, 1992; Mazur, 1987; Rachlin, Raineri, & Cross, 1991):

$$v = V/(1+kD),$$

where v is the present, subjective or discounted value of the delayed reward, V is the nominal value of the delayed reward, k is a constant indicative of the degree of discounting, and D is the delay to the receipt of the reward. In the psychological literature the hyperbolic discount function has been contrasted to the exponential discount function. The exponential discount function, preferred by economists, also represents temporal discounting (Green et al., 1994). The exponential function produces constant, proportional decrements in reward value with equal increments in delay; therefore, preference between the smaller and larger rewards remains constant over time. Rather than producing proportional decrements with the addition of each equal delay the hyperbolic function produces greater decrements in reward value at short delays than at long delays. Therefore, when both rewards are very delayed the larger reward will be preferred. However, as time passes the smaller reward becomes temporally closer, delays to both rewards are smaller, and the larger reward is discounted so that preference reverses to the smaller reward. The point at which individuals reverse their preference is

indicative of their rate of temporal discounting. The slope of the line determines this point with steeper slopes representing higher rates of discounting, which result in earlier words preference reversals.

It has been suggested that the steeply bowed hyperbolic discount function and its resulting temporary preferences for more immediate rewards are fundamental properties of motivation. It is common and often beneficial to get reinforced now rather than wait for a delayed reward that may seem less likely to be delivered. However, frequent preferences for smaller, more immediate rewards can result in self-defeating behavior, such as substance abuse. Moreover, addictive behaviors have been noted as primary examples of discounting the future (Ainslie & Haslam, 1992). Examples of such behavior include drug consumption, gambling, and sexual offenses. The course of addictive behaviors presents many choices for which the alternatives are the immediate "fix" that the source of addiction offers or things such as going to work or spending an evening at home with family. The latter alternatives will lead to later reinforcement such as a paycheck and being trusted by one's family; however, these rewards decrease in value as the individual becomes closer in time to the immediately reinforcing alternative. For example, an individual addicted to heroin may decide he/she will quit after getting high one last time. Then when he/she is in a situation where heroin is available again, he/she gives in and professes that it will be after the next high that he/she will quit.

Of course, it has been shown that all people discount to a certain extent on laboratory measures, and presumably temporal discounting remains an individual difference variable in the real world as well (Kirby & Marakovic, 1996). In the laboratory temporal discounting has been measured with humans and lower Order

animals by presenting a series of choice situations involving either real or hypothetical rewards. The delay, at which their preference switches from smaller, immediate rewards to larger, delayed rewards and vice versa, is determined. The point at which preference reverses is used to determine individuals' k-values or discounting rates.

Individuals vary in their discounting rates, but their choices are subject to the same contingencies of time, reinforcement availability, and reward value. In order to illustrate how temporal discounting occurs in the real world, the next section will discuss the broader concepts of behavioral choice theory. The primary factors influencing behavioral choice, the theoretical implications for countering temporal discounting, and the evidence that substance abusers discount at higher rates will be included in the following discussion.

Behavioral Theories of Choice

Behavioral theories of choice offer explanations for temporal discounting under the assumption that behaviors are instances of a molar behavior-environment relation that extends through time. It has been suggested that the causes of behavior are linked not only to the immediate environmental context but also to general patterns of behavior within a temporal context. This is important, because in effecting behavioral change, one must take into account that different behaviors may be exhibited as a result of one's temporal relationship to the behavioral consequences. In addition, behavioral choice theories developed from the evidence that behavior is controlled by the availability and reinforcement of alternative activities (Vuchinich & Tucker, 1998).

The temporally extended context of behavior and the availability of alternative behaviors are critical to the conceptualization of all behaviors; however, the following discussion will focus on addictive behaviors to illustrate important theoretical concepts. In behavioral theories of choice, two general variables that influence addictive behavior have been identified (Vuchinich & Tucker, 1998). First, environmental constraints on access to the substance are critical to the development of abuse. Commodities, including substances, may be constrained by price, rate of consumption, availability, and delay to their receipt. Second, the availability of alternative activities and the constraints on them are also important to the development of abuse. For example, it has been demonstrated that preference for alcohol consumption increases as the delay to alternative rewards increased (Vuchinich et al., 1987).

Drugs and alcohol are, in general, available at nominal prices, and those that are legal are easily accessed. Some people can easily learn to consume them quickly and in large amounts, which increases their value and fuels the cycle of addiction (Raineri & Rachlin, 1993). Because of the appealing nature of immediate rewards, alternative reinforcement is emerging as an important factor in breaking the cycle of addiction. In fact, treatments designed for heroin and cocaine dependent individuals have implemented contingency management programs that reinforce abstinence based upon the importance of alternative reinforcement (Budney & Higgins, 1998). These treatments combine two ways to counter temporal discounting in their approach. The program simultaneously increases the reward value of delayed rewards by reinforcing abstinence with vouchers and makes immediate rewards less attractive by implementing undesirable consequences for choosing them. Another way discounting behavior may be countered is through self-

control (Rachlin & Green, 1972). It has been shown that animals may avoid having to choose between a smaller, immediate reward and a larger, delayed reward by behaviorally committing to a path that leads to the larger, delayed reward. In a general sense, rule-governed behavior is a variant of self-control in that when one follows a rule he/she has effectively avoided a situation that may have presented a difficult choice between smaller, sooner and larger, later rewards.

Indeed, self-control is an effective strategy to benefit in the long run from choosing larger, delayed rewards; however, some people seem to exhibit very little self-control. For these people, immediate rewards are chosen so often that problems develop over time. Problems such as overeating, gambling, cheating, and substance abuse can be conceptualized as developing out of patterns of discounting behavior. Research in the field provides clear evidence that substance abusers discount at higher rates than normal controls (e.g., Kirby et al, 1999). However, it is unclear whether or not discounting behavior is a cause or an effect of these behavior problems. The cognitive view would suggest that discounting is a cause of such behavior patterns; however, advocates for behavioral choice theory have suggested that it is possible that the relationship is the result of both biological and environmental factors (Vuchinich & Simpson, 1998).

Studies have mainly included alcohol and heroin users. Specifically, heavy drinkers were found to discount more than light drinkers (Vuchinich & Simpson, 1998). In addition, heroin addicts have been found to discount hypothetical monetary rewards at higher rates than controls (Kirby et al., 1999; Madden et al., 1997; Petry et al., 1998), and at even higher rates for hypothetical heroin rewards (Kirby et al., 1999). Heroin addicts have also been shown to discount real monetary rewards at twice the rate of controls

(Kirby et al., 1999). Moreover, drug users appear to have a decreased ability to and a

conceptualize the future than controls, which may be related to their increased likelihood

to engage in behaviors that are more immediately rewarding. A particularly salient

example is that in a card-playing game, heroin addicts were more likely to make choices

resulting in greater immediate gains with delayed net losses rather than choices resulting

in overall net gains but frequent, small punishers and small rewards (Petry et al., 1998).

Substance Use and Major Depression

In addition to the empirical evidence suggesting a relationship between substance

use and temporal discounting, there are numerous studies that have revealed an

association between substance use and depression. The current hypothesis investigates the

relationship between depression and temporal discounting based upon their common

connection to substance use. The following review summarizes some of the evidence for

the relationship between depression and substance abuse.

According to the results of the Epidemiologic Catchment Area study, it is

estimated that there is a 27% rate of co-occurring substance dependence disorder with the

lifetime diagnosis of major depression (Regier et al., 1990). In addition, it has been

suggested that the rate of co-morbidity for depressed mood and substance abuse is one of

the highest of any combination of diagnoses for adolescents and adults (Rohde et al.,

1991). For example, Havassy and Arns (1998) reported in their study that substance

dependent subjects were over-represented among subjects with several other psychiatric

diagnoses, including major depression. Similarly, Lin et al. (1998) reported from a study

in Taiwan that 43% of the patients in their sample with major depression also had a

diagnosis of a substance use disorder. The relationship between smoking and depression has been particularly well

documented. It appears to be reciprocal in that there are significant associations between

nicotine dependence and lifetime prevalence of major depression (Breslau et al., 1991;

Kendler et al., 1993). For example, people with a history of major depression are

significantly more likely to smoke (Breslau et al., 1993; Glassman & Covey, 1996), and

dependent smokers have been found to have more comorbid psychiatric disorders,

including other substance dependence and major depression (Breslau, 1995). In addition,

depressed symptoms are associated with being less likely to quit smoking (West et al,

1989), and a history of depression increases the likelihood of experiencing depression

during withdrawal as well as worse withdrawal symptoms in general (Glassman & Covey,

1996). Interestingly, it has been suggested that depression and nicotine dependence may

share genetic or environmental predispositions (Breslau et al., 1993).

Other findings suggest that tobacco is only one of several legal substances

commonly used by depressed individuals. Lifetime use of caffeine, alcohol, and tobacco

was reported in over 80% of patients in a study in which the course and severity of

substance use in patients with a co-morbid substance-related disorder and major

depression was investigated (Westermeyer et al., 1997). Illicit substances such as opioids

have been associated with depression as well. A longitudinal study of opioid/alcohol

users found that depression varied according to substance use status. Again, the

relationship seemed reciprocal in that increased use was associated with increased

depression and vice versa (Maddux et al., 1987). Indeed, the course of substance use

does not necessarily remain static over time. The co-morbid occurrence of major mental disorders and substance dependence appears to be related to negative life circumstances and dissatisfaction (Havassy & Arns, 1998). This is consistent with behavioral choice theory in that it has been argued that severe drinking episodes, or relapses, are most appropriately distinguished from less severe episodes by the changes in availability of valuable non-drinking activities (Vuchinich & Tucker, 1996).

While the current study depends upon the relationship between substance abuse and depression and upon the elegant conceptualization of substance-related problems according to behavioral choice theory, the hypothesis is concerned with depression alone. In order to shift the focus to depression, the following section highlights several theories of depression. Also, a more detailed discussion of how temporal discounting may relate to depression will be presented.

Theories of Depression

According to the DSM-IV, major depression is characterized primarily by either depressed mood or the loss of interest or pleasure in nearly all activities (American Psychological Association, 1994). There are several psychological theories on the etiology of depression. The following review will include brief summaries of several different models and is mostly based upon the overview provided by Sutker & Adams (1993).

First, cognitive theory of depression, developed by Aaron T. Beck (1972), suggests that individuals become depressed as a result of their negative views of themselves, the world, and the future. It is suggested that depressed persons have

distorted perceptions of their experiences that are manifest in their automatic thoughts. Cognitive theory has not traditionally served as the basis for investigating discounting · behavior; however, it has been suggested that one possible reason people discount future rewards is that they do not expect them to actually come to fruition (Petry et al., 1998). This type of thinking would seem to be consistent with the component of cognitive theory that suggests a negative view of the future.

Second, self-control theory of depression focuses on individuals' inability to manage their behavior toward long-term goals. This model incorporates behavioral and cognitive components in its explanation of how individuals alter the probability of a response in the absence of immediate external supports. Rehm (1977) proposed that deficits in self-monitoring behavior, self-evaluation, and self-reinforcement are all potential sources of maladaptive self-control strategies. One tenet of this model that is especially relevant to the current study is that depressed people attend more to immediate rather than delayed consequences of their behavior. The research regarding this aspect of the theory will be discussed later.

Finally, behavioral theories of depression emphasize insufficient reinforcement as the root of depression. Peter Lewinsohn's (1974) suggests that susceptibility to depression is related to social skills, the range of reinforcing events to a person and the availability of the potential sources of reinforcement. He suggests that insufficient reinforcement may result from the loss of external reinforcement that leads to the extinction of certain behaviors. Depression, then, is proposed to result from the generalization of behavioral extinction to other domains of a person's life. Klinger (1993) discusses this phenomenon as it pertains to the depressive symptom in which there

is a loss of interest in most activities. While it is not mentioned in Klinger (1993), the behavioral theory of depression offers no explanation for behaviors, such as substance abuse, that for some people tend to be associated with depression. However, a criticism of Lewinsohn's theory that Klinger does make is that there is no explanation for why behavioral extinction due to loss of reinforcement would generalize to other sources of reinforcement. Consistent with behavioral choice theory, one possible explanation for both the generalization of behavioral extinction and the seemingly inconsistent increase in some behaviors is related to the extent to which various activities are constrained. Specifically, certain factors unique to depression could effectively constrain the receipt of many delayed rewards, resulting in a decrease in the behaviors they reinforce but an increase in alternative, immediately reinforcing behaviors. The rationale for the current study lies in the possibility that the extinction of some behaviors and increases in other behaviors are related to a pattern of discounting behavior.

There are several possible factors that could influence the manifestation of discounting behavior in depression. Investigation of the possible factors influencing temporal discounting during depression is beyond the scope of this study. However, their presentation is critical to the development of the aforementioned rationale for the current hypothesis. Further, it is important to illustrate a logical motivation for the study that is beyond the shared associations of temporal discounting and depression with substance abuse. A discussion of the possible factors that could influence discounting behavior in the context of depression follows.

First, many sources of reinforcement may require too much effort for a depressed individual to obtain (O'Hara & Rehm, 1982). As mentioned earlier, delayed rewards

often require effort; however, depression results in many different behaviors becoming more effortful, thereby making a larger number of alternatives constrained. In this case, activities such as sitting alone on the couch watching television or drinking or smoking are simply easier than going out with friends and therefore chosen most of the time. Another possible factor that could influence temporal discounting during depression is that individuals could be uncertain about actually getting the reward. It has been suggested that substance abusers may underestimate the probability of attaining delayed rewards, because they are less able to envision the future (Petry et al., 1998). Indeed, the effects of substance use are, or at least may seem, more predictable than many delayed alternatives. One last possible factor that could prevent depressed individuals from choosing delayed rewards could be related to some kind of change in one's methods of self-control. Earlier, it was discussed that individuals may exhibit self-control by behaviorally committing to a delayed reward. There is evidence that the saliency of memories is influenced by mood, with changes in mood being related to reduced memory for information (Balch et al., 1999). In the midst of depression, the memory required to follow through on choices that bind one to delayed rewards may, therefore, be less salient.

However, the first step is to examine the relationship between temporal discounting and depressed mood. It is hypothesized that a positive relationship between rate of temporal discounting and level of depressed mood exists, such that rates of temporal discounting may be predicted from one's self-reported depression. Previous studies addressing this issue have emerged in response to Rehm's (1977) self-control theory of depression. Early studies by Rehm and colleagues have produced equivocal evidence to support the contention that depressed persons are more influenced by

immediate versus delayed reinforcement (Rehm & Plakosh, 1975; O'Hara & Rehm, 1982). In an initial study, Rehm and Plakosh (1975) gave 92 undergraduates a measure of depression, the Multiple Affect Adjective Check List, and a set of six choices to determine their preference for immediate versus delayed rewards. The six-item scale required participants to rate their level of agreement with statements, such as " 'I would rather get $10 right now than have to wait a whole month and get $30 then.'" The participants were divided into three groups according to their depression scores, and a significant negative correlation was found between depression scores and preference for delay. Also, the correlation coefficients for each of the depressed groups differed significantly, with the highest depression scorers having the lowest positive correlation with preference for delay. Later, O'Hara and Rehm (1982) investigated the same concept with real rewards rather than hypothetical ones. As part of the debriefing for a separate study, they offered the participants the choice between receiving payment of the $20 they were promised for participation immediately or the opportunity to earn an additional $2.50 for every two weeks that they delayed receipt up to 8 weeks. The researchers failed to find a significant relationship between participants' Beck Depression Inventory scores and length of delay.

The two studies described above are problematic in their attempts to measure discounting behavior. Specifically, the normative choice pattern that emerges when rewards are delayed is not acknowledged or accounted for quantitatively. The definition and quantitative representation of temporal discounting is that subjective value of delayed rewards decreases over time. Therefore, the data collected in these studies may have been more appropriately regarded as qualitative and analyzed accordingly.

More recently, Gaynor et al. (1999) used a group of participants that was more depressed than the ones in Rehm's studies and employed what they intended to be a more quantitatively rigorous methodology. Specifically, their methodology was based upon the research demonstrating the utility of the hyperbolic discount function (e.g., Mazur, 1987). Gaynor et al. (1999) used a computerized task that required participants to choose points that would be exchanged for money ($.02/point) either the same day or in one week. Participants' preferences were based upon 20 choice trials, however no k-values were determined nor were any other parameters of discounting. Rather, participants were dichotomized into two groups based on their number of impulsive choices (less than 10 versus more than 10). In their analyses, they found no relationship between depressed mood and preference for immediate reinforcement. However, this study is also problematic. The researchers acknowledge the methodology used to determine subjective values of delayed rewards; however, they do not use it. Their methodology was convoluted in that a mathematical conversion was required to determine how much each choice was actually worth, and it failed to assess the subjective values participants were assigning to the delayed rewards.

Two primary characteristics of the current study distinguish it from the previous studies. First, in the current study a traditionally accepted, reliable quantitative measure of temporal discounting is used. In addition, more sophisticated statistical analyses will be employed to account for the relationship between depression and substance use when testing the relationship between depression and temporal discounting.

The conclusions made from this study are relevant to current conceptualizations of psychological problems, such as depression. If a relationship exists, it may provide

evidence that would support clinical approaches, such as social skills training and

environmental changes, that are based upon the self-control and other behavior models of

depression. In addition, motivational approaches that provide a collaborative analysis of

the costs and benefits of behavioral alternatives (Miller & Rollnick, 1991) may be further

supported by evidence that reveals increased discounting of delayed rewards with

increased depression. Also, the results of this study may provide a logical basis for future

experimental studies addressing how behavioral patterns involving choices for substance

use evolve and co-occur with other problematic behaviors.

CHAPTER III

METHODOLOGY

Participants

A total of 104 undergraduates at Oklahoma State University enrolled in either Introductory Psychology or an upper division psychology course participated in the study. Fifty-nine males and 45 females participated. The mean age was 20.07 years (SD= 3.27). The majority of participants reported their marital and living statuses as single and living with roommates. Students either received extra credit or fulfilled a required assignment for the psychology class in which they were enrolled by participating in the present study.

Procedure

Participants were recruited in small groups of 10-20 each. They were asked to report to a classroom on campus at the designated date and time in order to complete self-report questionnaires pertaining to depression and substance use and to complete the computerized Hypothetical Money Choice Task, which measures temporal discounting. Participants' identities were kept anonymous.

<u>Materials</u>

Participants completed four paper-and-pencil measures and one computerized task. First, participants completed the Inventory to Diagnose Depression (IDD), a self-report scale designed to be able to diagnose major depressive disorder (MDD) according to the third and fourth editions of the Diagnostic and Statistical Manual (DSM III; DSM IV, American Psychological Association, 1980 & 1994). The IDD is unique in three ways. It covers all possible symptoms for the diagnosis of MDD in its assessment; it utilizes thresholds to determine the presence or absence of symptoms, which allows for the severity of symptoms to be indicated in scoring; and it assesses for duration of symptoms (Zimmerman & Coryell, 1986). The IDD has been researched for its quality as a self-report measurement. The findings are summarized briefly in this report. It has been found to have high test-retest reliability, with Cronbach's Alpha equal to .92, and good internal consistency, with the median item-total Spearman rank-order correlation equal to .47. The IDD has also been found to be a valid measure of depression, with a Kappa coefficient of .66 (Zimmerman et al., 1986; Zimmerman & Coryell, 1987). In addition, it has been shown to be comparable to several other measures, such as clinician diagnosis, median Kappa coefficient of .62 (Zimmerman et al., 1986), the Diagnostic Interview Scale, K = .49 (Zimmerman & Coryell, 1987; 1988), and the Beck Depression Inventory, r =.90, p< .000 (Pace & Trapp, 1995). Finally, it is important to point out that the IDD has been suggested as being particularly useful for research endeavors in that it can serve as an inexpensive method to gather data on large samples quickly (Zimmerman & Coryell, 1988).

In addition to completing the measure on mood, participants completed a brief questionnaire on their substance use. Use of caffeine, alcohol and tobacco were assessed so that they may be factored out as a source of variability contributing to rate of temporal discounting. The measure was be an excerpt from a longer, comprehensive assessment of substance use developed by Dana Britt (1996). No data on the validity or reliability of this particular measure are available; however, it is only intended to measure the frequency of individuals' substance use, not to diagnose any substance use disorder.

Participants also completed a measurement called the Hypothetical Money Choice Task (HMCT), which was administered on a computer. The program, developed by Rudy Vuchinich, is based on the task developed by Rachlin et al. (1991). The task requires participants to complete a series of hypothetical choices between various amounts of money to be received at various delays. Each pair of hypothetical alternatives appears on the screen by itself until the participant indicates a choice by pressing the designated keys on the computer's keyboard.

The HMCT measures temporal discounting in that the choices participants make determine how they subjectively value larger, later rewards. The hypothetical money amounts are presented in both ascending and descending orders at each delay, and the subjective values of the delayed rewards are determined by finding the average of the crossover points from the ascending and descending presentations. The crossover points are the points at which an individual switches to choosing the immediate reward from choosing the delayed reward when the amounts are in ascending order and vice versa when they are in descending order. The subjective values of the delayed rewards determine the k-values in accordance with the hyperbolic discount function.

The only difference this study presents from previous studies using the HMCT is that administration will be in a group setting rather than individually. Traditionally, administering the computerized HMCT has required participants to complete the protocol alone in the laboratory; however, the current study administered the task in a computer lab where participants were able to complete the HMCT simultaneously. One consideration regarding group administration is whether or not participants influenced each other in their choices on the HMCT. However, this concern was minimal in that participants have a limited amount of time to indicate their choices on the computer, therefore their full attention is required to discriminate the choices presented on each screen.

Another paper-and-pencil measure intended to measure temporal discounting was also administered. The Money Choice Questionnaire (MCQ) was developed by Kirby et al. (1999), but its usefulness as a research tool has not yet been established. We compared the k-values derived from each discounting measure and obtained ratings from participants to compare the two measures on several dimensions. The final paper-and-pencil measure consisted of four questions to be rated on a scale of 1 to 6 for each of the tasks. The questions were: "In general, how easy/difficult was the task?"; "In general, when you had to choose your preferred money amount, how easy/difficult was it?"; "In general, how accurately did your choices reflect your true preferences?"; and "In general, how easy/difficult was it to concentrate during the task?" These ratings were intended to assess subjective differences between the two measures in a simple way so that the assets and drawbacks of each could be compared for the purposes of future research.

CHAPTER IV

RESULTS

Descriptive Statistics

A total of 104 undergraduates at Oklahoma State University enrolled in either

Introductory Psychology or an upper division psychology course participated in the study.

Seven participants did not complete the computerized version of the Hypothetical Money

Choice Task (HMCT) due to technical problems and were omitted from the main

analyses. For the remaining participants, only statistically adequate HMCT k-values were

used. As described by Vuchinich & Simpson (1998), the adequacy of the k parameter is

evaluated by the ratio of the estimate to its standard error. This ratio is distributed as a t

ratio with $(n-r)$ degrees of freedom, where n is the number of data points and r is the

number of parameters in the equation. In this case, n equals 8 (the number of delays

presented) and r is one. Ten participants were eliminated due to non-significant k-values.

A total of 87 participants with significant k-values were used in the remaining analyses.

IDD scores were obtained for all participants (N=104). The mean IDD score was

8.93, with a minimum score of 0 and a maximum score of 27. A subset of the sample

included only those participants who reported alcohol consumption and had significant k-

values. This sub-sample (N=53) was used in the regression analyses, and their mean IDD

score was 9.64, with a minimum score of 0 and a maximum score of 27.

Systematic Evaluation of k-Values

It is important to note that prior to excluding participants with non-significant k-values, preliminary examination of the data revealed irregular patterns in some participants' choices. These irregularities were addressed systematically. Many participants switched their preference from the immediate to the delayed reward value more than once in a set, which influences the value of the computer-generated equivalence point. For those participants ($n=48$) whose choices resulted in more than one potential equivalence point, practical judgment was used to select the one crossover point that most logically fit the rest of their choices. Crossover points that appeared to be the result of inattention were identified by comparing the participants' questionable set of choices to the remainder of their sets of choices. Also, empirical evidence for the nature of the hyperbolic discount function dictates a prototype of choices that results in a distinct slope when graphed. The resulting slope is visibly detectable when examining the choices participants have made. Therefore, examination of the individuals' data and the empirical evidence for prototypical choices guided the selection of one crossover point.

Determining k-Values

K-values were determined using a non-linear regression equation for both computer-generated equivalence points (HMCT1) and the equivalence points derived from clinical judgment (HMCT2). They were significantly correlated, $r(46)= .94$, $p=.00$ and were not significantly different, $t(47)=.909$, $p= .37$. However, using the HMCT2

equivalence points produced a greater number (n=87) of statistically significant k-values than the HMCT1 equivalence points (n=72).

<u>Computerized HMCT Versus Paper-and-Pencil MCQ</u>

Several correlation analyses were conducted with HMCT2 k-values. One such component of the study was to use a new paper-and-pencil measure of temporal discounting and compare it to the traditional HMCT task. The k-values that resulted from the two measures were not significantly correlated, r (85), p<.05, nor were they significantly different, t (86)=-.919, p=.36. Although the two measures of discounting did not seem to measure the same construct, k-values derived from the paper-and-pencil version were subjected to the same correlation and regression analyses as the HMCT2 k-values. It is important to note, though, that the MCQ's validity and reliability have not been sufficiently established. The results from the correlation and regression analyses are presented in support of the conclusion that the MCQ does not appear to measure the same construct as the HMCT. However, several aspects of both discounting measures were compared in order to assess differences in participants' subjective appraisal of each. Participants rated each measure for how easy/difficult it was, the ease/difficulty of making choices, how accurately their choices reflected their true preferences, and how easy/difficult it was to concentrate during the task. The two measures were rated significantly different on the ease/difficulty of making choices, t (86)= 2.27, p<.01, on how accurately the choices reflected their true preferences, t (86)= 2.83, p<.01, and on how easy/difficult it was to concentrate during the task, t (86)= 5.96, p<.01. The paper-and-pencil version was rated as easier on ratings of ease/difficulty of making

choices, and ease/difficulty to concentrate, and as more accurate than the computerized HMCT.

Correlational Analyses

Whether or not rates of temporal discounting were related to other variables, such as IDD scores and substance use, was central to the study's hypothesis. Therefore, several other correlational analyses were conducted as a precursor to the regression analysis. The following analyses automatically omit participants who did not positively endorse substance use. Rate of temporal discounting (HMCT2 k-values) was significantly correlated with the number of beers, other drinks, and total drinks participants reported having on an average day, r (46)=.51, p<.01; r (45)=.42, p<.01; and r (42)=.62, p<.01, respectively. K-values from the MCQ were not significantly correlated with any of the above drinking variables: number of beers, other drinks, and total drinks participants reported having on an average day, r (58)=.13, p=.33; r (57)= -.07, p=.59; and r (54)=.05, p=.74, respectively. Rate of temporal discounting (HMCT2 k-values) was not significantly correlated with IDD scores, r (85)=.12, p=.26, nor was it correlated with any of the items in which participants reported their amount of alcohol consumption in a typical week. K-values from the MCQ were also not significantly correlated with IDD scores, r (102)=.01, p=.89, nor were they correlated with any of the items in which participants reported their amount of alcohol consumption in a typical *week*. The IDD was significantly correlated with number of beers on an average day, r (58) = .27, p<.05; number of other drinks on an average day, r (57)= .34, p<.05; total number of drinks on

an average day, r (54)=.44, p<.01; number of other drinks in an average week, r (63)=.46, p<.01; and total number of drinks in an average week, r (59)=.40, p<.01.

Because rate of temporal discounting (HMCT2) was not significantly correlated with tobacco or caffeine use, a regression analysis was performed only with those participants who reported alcohol use. It should be noted, though, that a few data points left blank by participants reporting alcohol use were filled in for the remaining analyses. If a participant left a question regarding daily or weekly use of alcohol blank, a zero was entered for them. If they had left a question regarding total alcohol use blank, their previous answers were added accordingly. For example, if a participant left the questions regarding their "daily beer consumption" and "daily other alcohol consumption" blank but entered "0" for their total daily alcohol consumption, zeroes were entered for the first two items. A total of twenty-four items out of 318 were filled in by the researcher. Therefore, all participants who reported drinking alcohol and who had significant k-values could be included in the final regression analysis.

Interaction Effect

In order to explore a potential interaction between drinking behavior and depression scores, the HMCT2 data were graphed for visual inspection. Participants were assigned to one of four groups. Median splits were conducted on IDD scores, total number of daily drinks, and total number of weekly drinks. The median IDD score was 9, median total daily drinks was 0, and median total weekly drinks was 6. For the graph depicting total number of daily drinks (Figure 1), group 1 (n=11) participants' IDD scores were greater than or equal to 9 and total number of drinks was greater than 0. Group 2

(n=19) participants' IDD scores were less than 9 and total number of drinks was equal to 0. Group 3 (n=18) participants' IDD scores were greater than or equal to 9 and total number of drinks was equal to 0. Group 4 (n=5) participants' IDD scores were less than 9 and total number of drinks was greater than 0. For the graph depicting total number of weekly drinks (Figure 2), group 1 (n=17) participants' IDD scores were greater than or equal to 9 and total number of drinks was greater than or equal to 6. Group 2 (n=12) participants' IDD scores were less than 9 and total number of drinks was less than 6. Group (n=12) participants' IDD scores were greater than or equal to 9 and total number of drinks was less than 6. Group 4 (n=12) participants' IDD scores were less than 9 and total number of drinks was greater than or equal to 6.
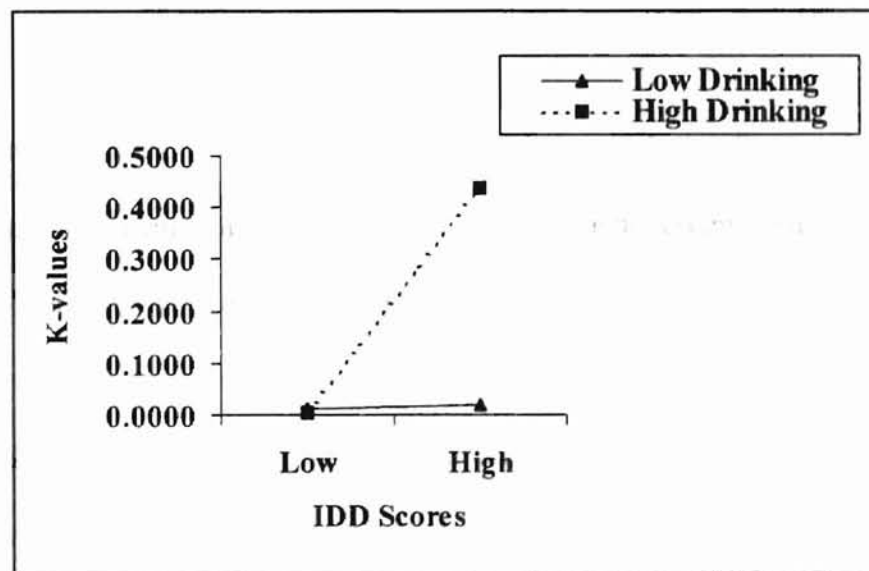
Figure 1. Groups 1,2,3, and 4 for Total Number of Drinks per Day, Where the Dependent Variable Is the Temporal Discounting Parameter, k.
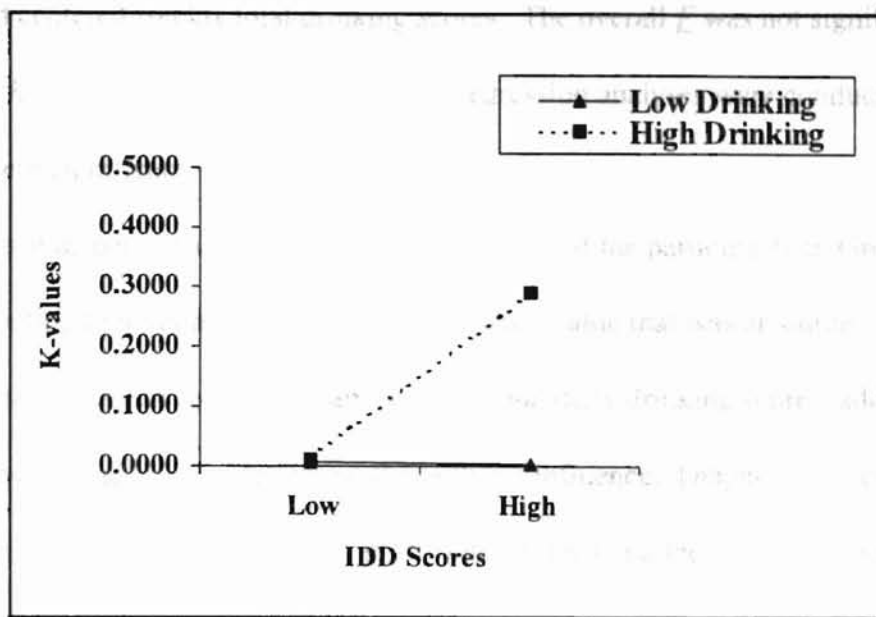
Figure 2. Groups 1,2,3, and 4 for Total Number of Drinks per
Week, Where the Dependent Variable Is the Temporal
Discounting Parameter, *k*.

Multiple Regression Analysis

Interaction effects were testing using a regression analysis. The k-value

representing rate of temporal discounting was the dependent variable. Drinking variables

(daily total drinking and weekly total drinking) and IDD scores were centered first. Two

interaction variables were created using the centered data. The first interaction variable

multiplied daily total drinking by IDD score, and the second interaction variable

multiplied weekly total drinking by IDD score.

For the first regression analysis, the centered IDD scores and centered daily total

drinking scores were entered with the first interaction variable. The overall F was

significant, F (3,40), p<.01. The second regression analysis included the centered IDD

scores and centered weekly total drinking scores. The overall F was not significant in this case. For K-values from the MCQ, the same regression analyses were conducted. Neither were significant.

Close inspection of the data revealed that one of the participants in Group 1 of the graph depicting total number of daily drinks had a k-value that was an outlier. Due to the fact that the regression was significant with the total daily drinking scores, additional analyses were conducted to determine the outlier's influence. Diagnostics were run and determined that one participant was significantly influencing the data set. Therefore, that participant was removed from the data set, and the regression analysis using the total daily drinking and IDD scores was repeated. The overall F-value was no longer significant when the outlier was removed.

CHAPTER V

DISCUSSION

In the current study, depression scores were not found to be significantly

correlated with temporal discounting. However, given that alcohol consumption was

significantly correlated with both depression scores and temporal discounting, an

interaction effect was tested using regression analyses. Although the initial regression

analysis using total daily drinking scores and IDD scores was significant, it was found

that an outlier was exerting enough influence that the regression was no longer significant

after its removal.

It appears that the hypothesis that depressed mood would predict rates of temporal

discounting was not supported. While it initially appeared that daily alcohol consumption

might moderate the relationship between depressed mood and discounting, any effect

initially found in this study was due to the scores of an outlier who had much higher

drinking scores than the rest of the sample. Therefore, it might be worthwhile to examine

the role of depression on discounting behavior specifically in individuals who drink

heavily on a daily basis. However, the results of this study imply that no relationship

exists between depressed mood and temporal discounting for the vast majority of

individuals in this population.

The implications of the current study may be compared and contrasted to previous studies examining the relationship between depression and choice behavior. Previous findings have been mixed. In comparison, the results of this study are consistent with the results of the most recent study that examined this issue. In contract, whereas previous studies have been flawed methodologically, a widely accepted methodology to measure temporal discounting was employed in the current study. Therefore, it can be reasonably concluded that there is no significant relationship between depressed mood and temporal discounting.

As previously mentioned, one component of the current study was the comparison of a shorter, paper-and pencil measure, the Money Choice Questionnaire (MCQ) with the traditional, computerized Hypothetical Money Choice Task (HMCT). Because they were neither significantly different nor significantly correlated, they did not appear to measure the same construct. However, participants' subjective comparisons of the two measures revealed that they found it easier to make choices and easier to concentrate while completing the MCQ, and that they believed it more accurately reflected their true preferences. The implication of this finding is that it may be important to develop shorter measures of discounting that produce valid k-values and make it easier for participants to make choices and concentrate.

Several problems with the design of the current study have implications for the interpretations of findings. First, examination of individual data sets suggests there were problems with attention during the administration of the HMCT. Individuals' choices were not always consistent within sets, yet post-task questions that addressed task difficulty did not reveal beliefs that the task was too challenging. One possible

explanation for inattention during the task is that it was actually not stimulating enough. Task completion takes approximately 20-30 minutes and is repetitive in nature. Therefore, participants' inconsistent responses could have been due to occasional distraction due to boredom. Another possible explanation is related to the potential distractions inherent in a group setting administration. The task itself is programmed to beep when values on the screen are about to change or when a participant takes too long to respond. The occasional beeps from others' computers may have caused participants to look away from their own screens momentarily and lose concentration. It is concluded that participants' data from the HMCT should be inspected carefully rather than relying solely upon the computer-generated values, especially when the task was administered in a group setting.

Another potential problem arises when the format of the substance use questionnaire is considered. Because some participants gave answers that seemed inconsistent, the clarity of the measure's wording must be questioned. Use of the words "average" and "typical" may have led to participants' differential interpretation of the questions posed to them. For example, some participants who gave answers for the average number of beers/wine they drank per typical day may not actually drink on a typical day, but rather, they may have "averaged" the number of drinks they consume in a day by dividing the number they drink per week by 7 and reporting that. It will be extremely important to use clearer, more specific measures of alcohol consumption in the future in order to have more confidence in the validity of findings that emerge from those data.

Concerns also arise when the level of depression in this study's sample are considered. Overall, the sample of students was not very depressed, with a median IDD score of 9. Endorsing the highest items on every question of the IDD would result in a score of 72. One must consider the sampling method when examining this concern. The Undergraduates from mostly Introduction Psychology courses participated on a voluntary basis and were required to make a special trip to a building on campus in which no undergraduate courses are taught. They also would have had to attend their psychology course regularly in order to know about the research opportunity. It is possible that the most depressed undergraduates do not attend class regularly nor have the desire or motivation to make a special trip to an unfamiliar building on campus in order to participate in a study. In the future, it may be more advantageous to sample populations of individuals who have already been identified as experiencing depression.

Finally, although there was no significant interaction found in this study, it should be noted that there were small, unequal numbers of participants in each of the four drinking/IDD categories. Other studies (Vuchinich & Simpson, 1998) have identified students with the highest and lowest drinking rates out of a large sample and used them for their data collection. A similar approach could be taken by identifying individuals with the highest and lowest levels of depression, as well as the highest and lowest levels of drinking behavior. The goal would be to have equal or nearly equal numbers of participants that exhibit high depression and drinking, low depression and drinking, high depression and low drinking, and low depression and high drinking. Any significant interactions found could, therefore, be interpreted confidently.

To conclude, the results of this study revealed significant correlations between drinking and depression scores, as well as with temporal discounting. However, there was no significant interaction effect with total daily drinks and IDD scores once the outlier was removed. It appears that individuals' levels of depression cannot predict their rate of temporal discounting. The correlational findings in this study supported previously established relationships between substance use and depression, as well as alcohol use and temporal discounting. These previously established relationships were integral components to the formation of this study's hypothesis. Therefore, the data supporting those relationships in the current study is believed to be valuable in and of itself. In spite of the problems described above, the goals of the study were met and some interesting findings were made.

REFERENCES

Ainslie, G. (1992). Picoeconomics: The strategic interaction of successive motivational states within the person. New York, NY: Cambridge University Press.

Ainslie, G., & Haslam, N. (1992). Hyperbolic discounting. In G. Loewenstein, & J. Elster, (Eds.), Choice over time (pp.57-92). New York, NY: Russell Sage Foundation.

Balch, W. R., Myers, D. M., & Papotto, C. (1999). Dimensions of mood in mood-dependent memory. Journal of Experimental Psychology: Learning, Memory, and Cognition, 25, 70-83.

Breslau, N., Kilbey, M. M., & Andreski, P. (1991). Nicotine dependence, major depression, and anxiety in young adults. Archives of General Psychiatry, 48, 1069-1074.

Breslau, N., Kilbey, M. M., & Andreski, P. (1993). Nicotine dependence and major depression. Archives of General Psychiatry, 50, 31-35.

Breslau, N. (1995). Psychiatric comorbidity of smoking and nicotine dependence. Behavior Genetics, 25, 95-101.

Budney, A. J., & Higgins, S. T. (1998). A community reinforcement plus vouchers approach: Treating cocaine addiction. Baltimore, MD: National Institute on Drug Abuse.

Gaynor, S. T., Thomas, A. P., & Lawrence, P. S. (1999). Dysphoric mood and preference for immediate versus delayed monetary reinforcement. Psychological Reports, 84,(3), 1281-1293.

Glassman, A. H., & Covey, L. S. (1996). Smoking and affective disorder. American Journal of Health Behavior, 20,(5), 279-285.

Green, L., Fristoe, N., & Myerson, J. (1994). Temporal discounting and preference reversals in choice between delayed outcomes. Psychonomic Bulletin & Review, 1,(3), 383-389.

Havassy, B. E., & Arns, P. G. (1998). Relationship of cocaine and other substance dependence to well-being of high-risk psychiatric patients. Psychiatric Services, 49,(7), 935-940.

Herrnstein, R. J. (1970). On the law of effect. Journal of Exprimental Analysis of Behavior, 13,(2), 243-366.

Johnson, J. G., Spitzer, R. L., Williams, J. B. W., Kroenke, K., Linzer, M., Brody, D., DeGruy, F., & Hahn. S. (1995). Psychiatric comorbidity, health status, and functional impairment associated with alcohol abuse and dependence in primary care patients: Findings of the prime md-1000 study. Journal of Consulting and Clinical Psychology. 63, 133-140.

Kendler, K. S., Neale, M. C., MacLean, C. J., Heath, A. C., Eaves, L. J., & Kessler, R. C. (1993). Smoking and major depression. Archives of General Psychiatry, 50, 36-43.

Killeen, P. (1972). The matching law. Journal of the Experimental Analysis of Behavior, 17, 489-495.

Kirby, K. N., Marakovic, N. N. (1996). Delay-discounting probabilistic rewards: Rates decrease as amounts increase. Psychonomic Bulletin & Review, 3,(1). 100-104.

Kirby, K. N., Petry, N. M., & Bickel, W. K. (1999). Heroin addicts have higher discount rates for delayed rewards than non-drug-using controls. Journal of Experimental Psychology: General, 128,(1), 78-87.

Klinger, E. (1993). Loss of interest. In C. G. Costello (Ed.), Symptoms of Depression (pp. 43- 62). New York, NY: Wiley & Sons.

Lin, C. C., Bai, Y. M., Hu, P. G., & Yeh, H. S. (1998). Substance use disorders among inpatients with bipolar disorder and major depressive disorder in a general hospital. General Hospital Psychiatry, 20, 98-101.

Madden, G. J., Petry, N. M., Badger, G. J., & Bickel, W. K. (1997). Impulsive and self-control choices in opioid-dependent patients and non-drug-using control participants: Drug and monetary rewards. Experimental & Clinical Psychopharmacology, 5, 256-262.

Maddux, J. F., Desmond, D. P., & Costello, R. (1987). Depression in opioid users varies with substance use status. American Journal of Drug Alcohol Abuse, 13,(4), 375-385.

Mazur, J. E. (1987). The effect of delay and of intervening events on reinforcement value. Mahwah, NJ: Lawrence Erlbaum Associates.

Miller, W. R., & Rollnick, S. (1991). Motivational interviewing: Preparing people to change addictive behavior. New York, NY: Guilford Press.

Myerson, J., & Green, L. (1995). Disounting of delayed rewards: Models of individual choice. Journal of the Experimental Analysis of Behavior, 64,(3), 263-276.

O'Hara, M. W., & Rehm, L. P. (1982). Choice of immediate versus delayed reinforcement and depression. Psychological Reports, 50, 925-926.

Orth-Gomer, K. (2000). Stress and social support in relation to cardiovascular health. In P. M. McCabe & N. Schneiderman (Eds.) Stress, coping, and cardiovascular disease. (pp. 229-240). Mahwah, NJ: Lawrence Erlbaum Associates.

Petry, N. M., Bickel, W. K., & Arnett, M. (1998). Shortened time horizons and insensitivity to future consequences in heroin addicts. Addiction, 93,(5), 729-738.

Rachlin, H., & Green, L. (1972). Commitment, choice and self-control. Journal of the Experimental Analysis of Behavior, 17,(1), 5-22.

Rachlin, H., Raineri, A., & Cross, D. (1991). Subjective probability and delay. Journal of the Experimental Analysis of Behavior, 55,(2), 233-244.

Rachlin, H., & Raineri, A. (1992). Irrationality, impulsiveness, and selfishness as discount reversal effects. In G. Loewenstein & J. Elster (Eds.), Choice over time (pp. 93-118). New York, NY: Russell Sage Foundation.

Raineri, A., & Rachlin, H. (1993). The effect of temporal constraints on the value of money and other commodities. Journal of Behavioral Decision Making, 6, 77-94.

Regier, D. A., Farmer, M. E., Rae, D. S., Locke, B. Z., Keith, S. J., Judd, L. L., & Goodwin, F. K. (1990). Comorbidity of mental disorders with alcohol and other drug abuse: Results from the epidemiologic catchment area (eca) study. Journal of the American Medical Association, 264,(19), 2511-2518.

Rehm, L. P. (1977). A self-control model of depression. Behavior Therapy, 8, 787-804.

Rehm, L. P. & Plakosh, P. (1975). Preference for immediate reinforcement in depression. Journal of Behavior Therapy & Experimental Psychiatry, 6(2), 101-103.

Rohde, P., Lewinsohn, P. M., & Seeley, J. R. (1991). Comorbidity of unipolar depression: II. Comorbidity with other mental disorders in adolescents and adults. Journal of Abnormal Psychology, 100,(2), 214-222

Vahtera, J., Kivimaeki, M., Pentti, J., & Theorell, T. (2000). Effect of change on the psychosocial work environment on sickness absence: A seven year follow up of initially healthy employees. Journal of Epidemiology & Community Health, 54,(7), 484-493.

Vuchinich, R. E., Tucker, J. A., & Rudd, E. J. (1987). Preference for alcohol consumption as a function of amount and delay of alternative reward. Journal of Abnormal Psychology, 96,(3), 259-263.

Vuchinich, R. E., & Tucker, J. A. (1996). Alcoholic relapse, life events, and behavioral theories of choice: A prospective analysis. Experimental and Clinical Psychopharmacology, 4,(1), 19-28.

Vuchinich, R. E., & Simpson, C. A. (1998). Hyperbolic temporal discounting in social drinkers and problem drinkers. Experimental and Clinical Psychopharmacology, 6,(3), 292-305.

Vuchinich, R. E., & Tucker, J. A. (1998). Choice, behavioral economics, and addictive behavior patterns. In Miller & Heather (Eds.), Treating Addictive Behaviors, 2nd ed. (pp. 93-104). New York, NY: Plenum Press.

West, R. J., Hajek, P., & Belcher, M. (1989). Severity of withdrawal symptoms as a predictor of outcome of an attempt to quit smoking. Psychological Medicine, 19, 981-985.

Westermeyer, J., Kopka, S., & Nugent, S. (1997). Course and severity of substance abuse among patients with comorbid major depression. The American Journal on Addictions, 6,(4), 284-292.

Zimmerman, M., Coryell, W., Wilson, S., & Corenthal, C. (1986). Evaluation of symptoms of major depressive disorder: Self report vs. clinical ratings. The Journal of Nervous and Mental Disease, 174,(3), 150-153.

Zimmerman, M. & Coryell, W. (1987). The inventory to diagnose depression (IDD): A self-report scale to diagnose major depressive disorder. Journal of Consulting and Clinical Psychology, 55,(1), 55-59.

Zimmerman, M. & Coryell, W. (1988). The validity of a self-report questionnaire for diagnosing major depressive disorder. Archives of General Psychiatry, 45, 738-740.

APPENDIXES

APPENDIX A

INSTITUTIONAL REVIEW BOARD

APPROVAL FORM

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD

Date: October 8, 1999   IRB #:   AS-00-089

Proposal Title: "TEMPORAL DISCOUNTING AND DEPRESSION"

Principal   Frank Collins
Investigator(s):   Raegan Burlingame

Reviewed and
Processed as: Expedited

Approval Status Recommended by Reviewer(s):   Approved

Signature:

_____   _____October 8, 1999_____
Carol Olson, Director of University Research Compliance   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. Approved projects are subject to monitoring by the IRB. Expedited and exempt projects may be reviewed by the full Institutional Review Board.

APPENDIX B

SUBSTANCE USE QUESTIONNAIRE

<u>Substance Use Questionnaire</u>　　　　　　　　　Subject #_____

Please check the appropriate answer or fill in the requested information.

Today's Date (Month/Day/Year) _____

Your Age: _____

Sex:　(1) _____ Male
　　　(2) _____ Female

Which best describes your current marital status? (Check <u>one</u> answer only)

(1)_____ Single (Never Married)　　(4)_____ Widowed
(2)_____ Married　　　　　　　　　(5)_____ Separated
(3)_____ Divorced　　　　　　　　　(6)_____ Co-habitating
　　　　　　　　　　　　　　　　　　(7)_____ Engaged

Which best describes your current living arrangement? (Check one answer only)

(1)_____ Alone
(2)_____ With parents or siblings
(3)_____ With spouse/partner
(4)_____ With roommate(s)/friend(s)
(5)_____ Other (Please specify, _____)

For the following items, please write a brief description of your parents' occupation.
　　Category descriptions provided below may be used, or exact job titles (e.g., elementary teacher, owns small farm) may be provided.
　　Father's occupation: _____
　　Mother's occupation: _____

(1) Executive, major professional
(2) Manager, minor professional
(3) Administrator, small business owner, semi-professional
(4) Clerical; Sales
(5) Skilled worker
(6) Semi-skilled worker
(7) Unskilled worker
(8) Unemployed
(9) Homemaker
(10) Retired

Using the numbers from the list below, indicate how far each of your <u>parents</u> went to school.

Father _____　　　　　Mother _____

(1) Graduate or professional training (degree obtained)
(2) Partial graduate or professional training
(3) College graduate (Bachelor's degree obtained)
(4) Partial college training (include technical training beyond high school; Associate's **degree** obtained)

(5) High school graduate (GED; graduate of technical or trade school)
(6) Partial high school (10th grade through part of 12th grade)
(7) Partial junior high school (7th grade through 9th grade)
(8) Elementary School (6th grade or less)

Caffeine

If you have __NEVER__ drank caffeinated beverages (currently OR in the past), please skip this section and proceed to question 2a..

1a. Do you currently drink caffeinated beverages?   (1) _____ Yes
    (e.g., coffee, tea, sodas, colas)   (2) _____ No

If you answered "yes" to question 1a, please skip questions 1b-1e and proceed to question 1f.

....

    If you answered "no" to question 1a (e.g. do not __currently__ drink caffeinated beverages) but __have__ in the past, please answer the following questions:

1b. At what age did you __first__ begin to drink caffeinated beverages?   _____ years old

1c. At what age did you begin drinking caffeinated beverages   _____ years old
    __regularly__, (e.g., almost daily)

1d. When you drank caffeinated beverages regularly, how many
    beverages did you drink on an __average__ day?   _____ cups,
    glasses, cans, etc.

1e. How long ago did you QUIT drinking caffeinated beverages?

           (1) less than 6 months   _____
           (2) 6 months to 1 year   _____
           (3) 1-2 years   _____
           (4) more than 2 years   _____

    Please now proceed to question 2a..

....

1f. If you __do__ drink caffeinated beverages daily or almost daily,
    please record the number of cups, glasses, cans, etc.
    you typically drink each day:
                       _____ cups, glasses, cans, etc.

1g. How often do you drink caffeinated beverages? (Check __one__ answer only)

    (1) _____ daily or almost daily   (4) _____ 1-3 times a month
    (2) _____ 1-3 times a week   (5) _____ only on occasions
    (3) _____ 4-5 times a week   (6) _____ never or almost never

1h. At what age did you __first__ begin drinking caffeinated beverages?
    _____ years old

1i. At what age did you begin drinking caffeinated beverages <u>regularly</u>?
_____ years old

1j. How long have you drank caffeinated beverages <u>regularly</u>?

(1) _____ less than 6 months
(2) _____ 6 months to 1 year
(3) _____ 1-2 years
(4) _____ over 2 years

Cigarette Smoking

If you have <u>NEVER smoked at all</u> (currently or in the past), please proceed to question 3a .

2a. Do you currently smoke cigarettes?   (1) _____ Yes
     (2) _____ No

If you answered "yes" to question 2a, please skip questions 2b-2e and proceed to question 2f.

....

If you answered "no" to question 2a (e.g., do not <u>currently</u> smoke cigarettes) but <u>have</u> in the past, please answer the following questions:

2b. At what age did you <u>first</u> begin to smoke?   _____ years old

2c. At what age did you begin smoking
<u>regularly</u>, (e.g., almost daily)   _____ years old

2d. When you were a regular smoker, how many cigarettes
did you smoke on an <u>average</u> day?   _____ cigarettes

2e. How long ago did you QUIT smoking?

(1) less than 6 months   _____
(2) 6 months to 1 year   _____
(3) 1-2 years   _____
(4) more than 2 years   _____

Please now proceed to question 3a.

....

2f. If you <u>do</u> currently smoke cigarettes daily or almost daily, please
record the number of cigarettes you typically smoke each day:
_____ cigarettes

2g. How often do you smoke cigarettes? (Check <u>one</u> answer only)

(1) _____ daily or almost daily   (4) _____ 1-3 times a month
(2) _____ 1-3 times a week   (5) _____ only on occasions
(3) _____ 4-5 times a week   (6) _____ never or almost never

2h. At what age did you <u>first</u> begin smoking?
_____ years old

2i. At what age did you begin smoking regularly?
    ____ years old

2j. How long have you been a regular smoker?

    (1) ____ less than 6 months
    (2) ____ 6 months to 1 year
    (3) ____ 1-2 years
    (4) ____ over 2 years

Smokeless Tobacco

If you have __NEVER been a smokeless tobacco user at all__ (currently OR in the past), please skip this section and proceed to question 4a .

3a. Do you currently use smokeless tobacco?
          (1) ____ Yes
          (2) ____ No

    If you answered "yes" to question 3a, please skip to questions 3b-3e and proceed to question 3f.

....

    If you answered "no" to question 3a (e.g., do not __currently__ use smokeless tobacco) but __have__ in the past, please answer the following questions:

3b. At what age did you first begin to use smokeless
    tobacco (dip)?   _____ years old

3c. At what age did you begin dipping
    regularly, (e.g., almost daily)?   _____ years old

3d. When you were a regular dipper, how many dips
    did you have on an __average__ day?   _____ dips

3e. How long ago did you QUIT dipping?
                (1) less than 6 months   ____
                (2) 6 months to 1 year ____
                (3) 1-2 years   ____
                (4) more than 2 years ____

    Please now proceed to question 4a.

....

3f. If you __do__ use smokeless tobacco daily or almost daily, please record the number of dips you typically have each day: ____ dips

3g. How often do you use smokeless tobacco? (Check __one__ answer only)

    (1) ____ daily or almost daily   (4) ____ 1-3 times a month
    (2) ____ 1-3 times a week   (5) ____ only on occasions
    (3) ____ 4-5 times a week   (6) ____ never or almost never

3h. If you currently use smokeless tobacco, how many cans do you use per day?

    (1) ____ less than ½ a can
    (2) ____ between half a can and 1 can
    (3) ____ more than 1 can per day

3i. If you currently use smokeless tobacco, approximately how long do you leave a dip in your mouth?

    ____ minutes ____ hours

3j. At what age did you first begin to use smokeless tobacco?
    _____ years old

3k. At what age did you begin using smokeless tobacco (dipping) regularly?
    _____ years old

3l. How long have you been a regular smokeless tobacco user?

    (1) ____ less than 6 months
    (2) ____ 6 months to 1 year
    (3) ____ 1-2 years
    (4) ____ over 2 years

Alcohol

If you have NEVER drank alcohol (currently OR in the past), please skip this section.

4a. Do you currently drink alcohol?
    (1) ____ Yes
    (2) ____ No

If you answered "yes" to question 4a, please skip questions 4b-4e and proceed to question 4f.

....

If you answered "no" to question 4a (e.g., do not currently drink alcohol) but have in the past, please answer the following questions:

4b. At what age did you first begin to drink alcohol?   ____ years old

4c. At what age did you begin drinking alcohol regularly, (e.g. almost daily)?   ____ years old

4d. When you did drink alcohol regularly, how many drinks did you have on an average day?   ____ drinks

4e. How long ago did you QUIT using alcohol?

    (1) less than 6 months ____
    (2) 6 months to 1 year ____

(3) 1-2 years   ____
(4) more than 2 years ____

....

4f. How many beers do you have...
     a) on an <u>average</u> day?
     b) in a <u>typical</u> week?   ____
                                           ____

4g. How many other drinks (including wine, mixed drinks, etc.) do you have...
     a) on an <u>average</u> day?   ____
     b) in a <u>typical</u> week?   ____

4h. If you <u>do</u> drink alcohol, please record the <u>total</u> number of drinks you typically drink...
     a)____ drinks on an average day
     b)____ drinks in an average week

4i. How often do you drink alcohol? (Check <u>one</u> answer only)

     (1)____ daily or almost daily   (4)____ 1-3 times a month
     (2)____ 1-3 times a week   (5)____ only on occasions
     (3)____ 4-5 times a week   (6)____ never or almost never

4j. At what age did you <u>first</u> begin drinking alcohol?
     ____ years old

4k. At what age did you begin drinking alcohol <u>regularly</u>?
     ____ years old

4l. How long have you been drinking at this rate?

     (1)____ less than 6 months
     (2)____ 6 months to 1 year
     (3)____ 1-2 years
     (4)____ over 2 years

APPENDIX C

HYPOTHETICAL MONEY CHOICE TASK

HYPOTHETICAL MONEY CHOICE TASK

The example that follows illustrates the sets of choices that will appear on the computerized Hypothetical Money Choice Task. Each row represents a set of alternatives from which to choose; however, the computerized task presents each set separately on the screen.

RIGHT NOW	IN 1 WEEK	RIGHT NOW	IN 1 WEEK	RIGHT NOW	IN 1 MONTH
$1.00	$1,000.00	$1.000.00	$1,000.00	$1.00	$1,000.00
$5.00	$1,000.00	$990.00	$1,000.00	$5.00	$1,000.00
$10.00	$1,000.00	$980.00	$1,000.00	$10.00	$1,000.00
$20.00	$1,000.00	$960.00	$1,000.00	$20.00	$1,000.00
$40.00	$1,000.00	$940.00	$1,000.00	$40.00	$1,000.00
$60.00	$1,000.00	$920.00	$1,000.00	$60.00	$1,000.00
$80.00	$1,000.00	$900.00	$1,000.00	$80.00	$1,000.00
$100.00	$1,000.00	$850.00	$1,000.00	$100.00	$1,000.00
$150.00	$1,000.00	$800.00	$1,000.00	$150.00	$1,000.00
$200.00	$1,000.00	$750.00	$1,000.00	$200.00	$1,000.00
$250.00	$1,000.00	$700.00	$1,000.00	$250.00	$1,000.00
$300.00	$1,000.00	$650.00	$1,000.00	$300.00	$1,000.00
$350.00	$1,000.00	$600.00	$1,000.00	$350.00	$1,000.00
$400.00	$1,000.00	$550.00	$1,000.00	$400.00	$1,000.00
$450.00	$1,000.00	$500.00	$1,000.00	$450.00	$1,000.00
$500.00	$1,000.00	$450.00	$1,000.00	$500.00	$1,000.00
$550.00	$1,000.00	$400.00	$1,000.00	$550.00	$1,000.00
$600.00	$1,000.00	$350.00	$1,000.00	$600.00	$1,000.00
$650.00	$1,000.00	$300.00	$1,000.00	$650.00	$1,000.00
$700.00	$1,000.00	$250.00	$1,000.00	$700.00	$1,000.00
$750.00	$1,000.00	$200.00	$1,000.00	$750.00	$1,000.00
$800.00	$1,000.00	$150.00	$1,000.00	$800.00	$1,000.00
$850.00	$1,000.00	$100.00	$1,000.00	$850.00	$1,000.00
$900.00	$1,000.00	$80.00	$1,000.00	$900.00	$1,000.00
$920.00	$1,000.00	$60.00	$1,000.00	$920.00	$1,000.00
$940.00	$1,000.00	$40.00	$1,000.00	$940.00	$1,000.00
$960.00	$1,000.00	$20.00	$1,000.00	$960.00	$1,000.00
$980.00	$1,000.00	$10.00	$1,000.00	$980.00	$1,000.00
$990.00	$1,000.00	$5.00	$1,000.00	$990.00	$1,000.00
$1,000.00	$1,000.00	$1.00	$1,000.00	$1,000.00	$1,000.00

↓

For example, these two values appear
on the computer screen together under the
labels highlighted at the top. Participants
will indicate their choices by pressing the
designated keys on the keyboard.

APPENDIX D

MONEY CHOICE QUESTIONNAIRE

Money Choice Questionnaire

Subject Number _____

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

1.	Would you prefer	$54 today	or	$55 in 117 days?
2.	Would you prefer	$55 today	or	$75 in 61 days?
3.	Would you prefer	$19 today	or	$25 in 53 days?
4.	Would you prefer	$31 today	or	$85 in 7 days?
5.	Would you prefer	$14 today	or	$25 in 19 days?
6.	Would you prefer	$47 today	or	$50 in 160 days?
7.	Would you prefer	$15 today	or	$35 in 13 days?
8.	Would you prefer	$25 today	or	$60 in 14 days?
9.	Would you prefer	$78 today	or	$80 in 162 days?
10.	Would you prefer	$40 today	or	$55 in 62 days?
11.	Would you prefer	$11 today	or	$30 in 7 days?
12.	Would you prefer	$67 today	or	$75 in 119 days?
13.	Would you prefer	$34 today	or	$35 in 186 days?
14.	Would you prefer	$27 today	or	$50 in 21 days?
15.	Would you prefer	$69 today	or	$85 in 91 days?
16.	Would you prefer	$49 today	or	$60 in 89 days?
17.	Would you prefer	$80 today	or	$85 in 157 days?
18.	Would you prefer	$24 today	or	$35 in 29 days?
19.	Would you prefer	$33 today	or	$80 in 14 days?
20.	Would you prefer	$28 today	or	$30 in 179 days?
21.	Would you prefer	$34 today	or	$50 in 30 days?
22.	Would you prefer	$25 today	or	$30 in 80 days?
23.	Would you prefer	$41 today	or	$75 in 20 days?
24.	Would you prefer	$54 today	or	$60 in 111 days?
25.	Would you prefer	$54 today	or	$80 in 30 days?
26.	Would you prefer	$22 today	or	$25 in 136 days?
27	Would you prefer	$20 today	or	$55 in 7 days?

APPENDIX E

POST-TASK QUESTIONNAIRE

POST-TASK QUESTIONNAIRE

You have just completed two tasks, one computerized and one paper-and-pencil, in which you were asked to choose between two money amounts. Please answer the following questions about those tasks. Note: Please indicate your answer for each question by circling *one* of the *numbers* on the scale from 1 to 6.

For the **COMPUTERIZED** task:

1. In general, how easy/difficult was the task?

1-----------2-----------3-----------4-----------5-----------6
very   very
easy   difficult

2. In general, when you had to choose your preferred money amount, how easy/difficult was it?

1-----------2-----------3-----------4-----------5-----------6
very   very
easy   difficult

3. In general, how accurately did your choices reflect your true preferences?

1-----------2-----------3-----------4-----------5-----------6
very   not accurately
accurately   at all

4. In general, how easy/difficult was it to concentrate during the task?

1-----------2-----------3-----------4-----------5-----------6
very   very
easy   difficult

For the **PAPER-AND-PENCIL** task:

1. In general, how easy/difficult was the task?

```
1-----------2------------3------------4------------5-----------6
very                                                very
easy                                                difficult
```

2. In general, when you had to choose your preferred money amount, how easy/difficult was it?

```
1-----------2------------3------------4------------5-----------6
very                                                very
easy                                                difficult
```

3. In general, how accurately did your choices reflect your true preferences?

```
1-----------2------------3------------4------------5-----------6
very                                        not accurately
accurately                                      at all
```

4. In general, how easy/difficult was it to concentrate during the task?

```
1-----------2------------3------------4------------5-----------6
very                                                very
easy                                                difficult
```

ν

VITA

Raegan L. Burlingame

Candidate for the Degree of

Master of Science

Thesis: TEMPORAL DISCOUNTING AND DEPRESSION

Major Field: Psychology

Biographical:

Education: Graduated from Edmond Memorial High School, Edmond, Oklahoma, in May 1994; received Bachelor of Arts degree in Psychology from University of Oklahoma, Norman, Oklahoma in May 1998. Completed the requirements for the Master of Science degree with a major in Psychology at Oklahoma State University in December 2000.

Experience: Administrative/Research Assistant; Oklahoma City Veterans Affairs Medical Center, Oklahoma City, Oklahoma, January 1997-July 1998; Research Assistant, University of Oklahoma, Norman, Oklahoma, August 1996-May 1997; Open House Coordinator for Graduate Admissions, Oklahoma State University, September 1998-May 1999; Graduate Instructor for Introductory Psychology, Oklahoma State University, August 1999-May 2000; Psychological Associate, Psychological Services Center & Marriage and Family Clinic, Oklahoma State University, September 1998-present.

Professional Memberships: Student Member of American Psychological Association.