ATTENTIONAL BIAS TO ALCOHOL-RELATED CUES

IN SOCIAL DRINKING

COLLEGE STUDENTS

Presented to the Graduate Council of
Texas State University-San Marcos
in Partial Fulfillment
of the Requirements

for the Degree

Master of ARTS

by

Cory R. Overby, B.S.

San Marcos, Texas
August 2011

ATTENTIONAL BIAS TO ALCOHOL-RELATED CUES

IN SOCIAL DRINKING

COLLEGE STUDENTS

Committee Members Approved:

____
Dr. Reiko Graham, Chair

____
Dr. Natalie Ceballos

____
Dr. Paul Raffeld

Approved:

____
J. Michael Willoughby
Dean of the Graduate College

FAIR USE AND AUTHOR'S PERMISSION STATEMENT

Fair Use

Duplication Permission

ACKNOWLEDGEMENTS

The author would like to acknowledge the valuable assistance and guidance of Drs. Reiko Graham, Natalie Ceballos and Paul Raffeld throughout the course of his graduate work. This manuscript was submitted on April 17, 2011.

TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS v

LIST OF TABLES viii

LIST OF FIGURES ix

ABSTRACT x

CHAPTER

I. INTRODUCTION 1

II. REVIEW OF LITERATURE 3

- Attentional bias to alcohol cues 3
- Alcohol, Stress and Attention 7
- Social Drinking 10
- Salivary cortisol 13

III. METHOD 17

- Participants 17
- Self-Report Measures 18
  - State-Trait Anxiety Inventory (State Version) 18
- Paced Auditory Serial Addition Task (PASAT) 19
- Three Stimulus Oddball Paradigm 19
- Salivary Analysis 20
- Procedure 21
- Analytic strategy 23

IV. RESULTS 26

- Stress measures 26
- Reaction Times 29

V. DISCUSSION 3

VI. CONCLUSION 37

REFERENCES 41

LIST OF TABLES

Table **Page**

1. Approximate experimental timeline on the day of testing 22

2. Participant demographic numbers by condition group 26

LIST OF FIGURES

Figure	Page
1. Mean cortisol levels by group	28
2. Average STAI scores	28
3. Reaction times pre and post stressor by condition group	29

ABSTRACT

ATTENTIONAL BIAS TO ALCOHOL-RELATED CUES

IN COLLEGE STUDENT

SOCIAL DRINKERS

THESIS

by

Cory R. Overby, B.S.

Texas State University-San Marcos

August 2011

SUPERVISING PROFESSOR: REIKO GRAHAM

Problem drinking behavior has been suggested to vary along a continuum, progressing from binge drinking to debilitating alcoholism (Delin & Lee, 1992). However, even among light to moderate social drinkers, some cognitive indicators (e.g., attentional bias) of risk for alcohol use disorders may be found. The literature suggests that acute stress contributes to the development of problem drinking, especially among college students who utilize alcohol to cope with stress, and may serve as an environmental trigger for attentional biases toward alcohol and subsequent alcohol consumption (Field & Powell, 2007). The aim of this study was to examine the effect of stress on attentional bias to alcohol-related images in light and moderate social drinking college students. Participants performed a computerized, visual oddball target detection task in which they were asked to react to specific target pictures (either alcohol-related or neutral objects) before and after an acute stressor (timed mental arithmetic). Stress levels were measured via self-report measures and salivary cortisol, and performance on the oddball task was measured via reaction times (RT) to correct target images. It was hypothesized that a difference would be found in salivary cortisol levels and self report measures pre- and post-stressor, with a higher level of stress shown post stressor. It was also hypothesized that, following an acute stressor, participants responding to alcohol targets would exhibit faster RT than those who responded to the object targets. Analyses indicated that the stressor did not have a significant effect on salivary cortisol levels, but did reveal a significant within-subjects difference in State Trait Anxiety Inventory (STAI) scores pre- and post-stressor indicating the stressor had measurable effect on subjective, but not objective levels of stress. A mixed analysis of variance did not detect a significant difference between the RTs of the two condition groups as a function of stress (pre- and post -stressor). The lack of a significant reaction time difference between the two groups suggests that no attentional bias was exhibited in the alcohol target group compared to the object group, counter to predictions. Limitations of this study and considerations for future research are discussed.

CHAPTER I

INTRODUCTION

In 2009, approximately 53.9% of adults in the United States consumed an alcoholic beverage within the past 30 days of the date of their survey (Centers for Disease Control, 2009). Excessive alcohol use is known to be linked to many maladies including various cancers (Bofetta & Hashibe, 2006; Tuyns, 1990), cardiovascular disease (Djousse, Lee, Buring & Gaziano, 2009), liver disease (Lieber, 2000) and is a major contributor to mortality in the United States (Midanik et al., 2004; Mokdad, Marks, Stroup & Gerberding, 2004). Young adults, especially those in the collegiate portion of the populace, are at great risk for alcohol-related injuries or death (Hingson, Heeren, Winter, & Wechsler, 2005). Nonetheless, the proportion of college students who consumed five or more drinks in one sitting increased from 41.7% to 44.7% between 1999 and 2005 (Hingson, Zha & Weitzman, 2009). While drinking in moderation has been shown to be medically beneficial for middle-aged and older adults (Ikehara et al., 2009), no medicinal benefits have been found for younger adults (Department of Health and Human Services, 2008).

Longitudinal cardiovascular research has found that those who engaged in binge type drinking (≥ 5 drinks in one session) in late adolescence and early adulthood displayed coronary calcification (an early marker of atherosclerosis) 15 years later (Pletcher et al., 2005), suggesting that early drinking behavior may contribute to serious ailments later in life. The study was part of the larger Coronary Artery Risk Development in Young Adults (CARDIA) study which took place over a period of years from 1985-2001. This finding was still present even after the researchers controlled for potential confounds including age, gender/ethnicity, income, physical activity, family history, body mass index, and smoking. Nonetheless, binge drinking on college campuses is still widely practiced (National Institute on Alcohol Abuse and Alcoholism, 2007). The ability to detect the antecedents of possible problem drinking would greatly assist prevention and intervention programs in their quest to tame the excess use of alcohol in this population.

The focus of this study was upon light and moderate social drinkers as opposed to non-drinkers or heavy drinkers and alcoholics. Alcohol use disorders have previously been viewed as a continuum from heavy drinking to alcoholism (Delin & Lee, 1992). Those falling upon the more severe end of the continuum, dependent drinkers and alcoholics, exhibit marked attentional bias (i.e., heightened attention toward particular stimuli) toward alcohol-related cues (Fadardi and Cox, 2006; Parsons and Nixon, 1998). If attentional bias is found in light and moderate social drinkers, this may provide an avenue for the early detection of possible problem drinking. This study sought to find evidence for stress-induced attentional bias to alcohol-related cues in socially drinking college students which could possibly serve as a marker for the development of future problem drinking behavior.

CHAPTER II

LITERATURE REVIEW

Alcohol research has provided a wealth of information about alcohol use and its effect on cognitive processes, including attentional bias. This review will discuss the available literature on attentional bias as it relates to alcohol cues and the methodologies utilized to examine this phenomenon. It will provide an overview of the previous findings in relation to attentional bias and the theoretical frameworks which attempt to explain it. This review also discusses the literature on attention, stress and alcohol and how they interact in relation to alcohol use in social drinkers.

Attentional bias to alcohol cues

Attentional bias to alcohol cues (i.e., heightened attention toward alcohol-related stimuli) in alcoholics has been investigated using a variety of methodologies (Field, Munafo & Franken, 2009), as well as in heavy social drinkers who are not considered to have alcohol use disorders. In both of these groups, there have been significant biases reported in attention to alcohol and alcohol-related cues on visual probe tasks in which the participants had to identify a probe presented after two side-by-side pictures either alcohol-related or emotionally neutral pictures (e.g., Field, Mogg & Bradley, 2005; Field & Powell, 2007). These studies found that heavy drinkers displayed heightened attention for the alcohol-related cues (Field et al., 2005; Field & Powell, 2007). A similar study investigating attention bias in abstinent alcoholics and social drinkers found that social drinkers exhibited marked attentional biases for alcohol pictures (i.e., faster detection of a visual probe displayed in the same location as an alcohol-related picture relative to probes displayed in the same location as neutral pictures) compared to the abstinent alcoholics (Noel et al., 2006). However, in Noel et al.'s study, attentional biases were only detected when the images were presented for 500 ms. Also, the drinking frequency of the social drinking group was not quantified and inclusion criteria only stipulated that the social drinkers "drink occasionally" and therefore, the social drinking group's consumption was not quantified.

The introduction of an environmental cue, such as alcohol-related visual stimuli, and its affect upon an individual's attention is explained by the Elaborated Intrusion Theory of Desire (EI; Kavanagh, Andrade & May, 2005). According to EI theory, thoughts about an appetitive target can be triggered by external cues and associative processes (learned associations). These processes, "underlie apparently spontaneous, intrusive thoughts about a target that can arise while attention is primarily directed to another task" (Kavanagh et al., 2005, pp. 447). The associative processes can be elicited by verbal or pictorial stimuli and are thought to be the result of learning. For example, when an alcoholic views a billboard advertisement for an alcoholic beverage, this environmental cue may trigger an acquired affective reaction or a sense of deficit and thereby initiate elaborative cognitions. This reaction may be manifested as attentional bias toward cues such as alcohol-related photos (Kavanagh et al., 2005). In a review of attentional bias and addictive disorders, Field and Cox (2008) hypothesize that through classical conditioning, the presentation of substance abuse-related stimuli elicits the expectation of the availability of the substance which, in turn, elicits attentional bias and subjective craving. Central to these models is the notion that attentional biases are the result of learned or “conditioned” associations involving alcohol-related stimuli.

In much of the literature on alcohol consumption and attentional biases to alcohol-related cues, the Stroop Test was utilized. The Stroop Test is a test of attention utilizing words printed in different color inks, for example, the word “green” printed in blue ink. For many of the studies described in this review, the test was modified to use alcohol-related and control words printed in various colors. These studies utilized a computerized version of the Stroop Test which recorded the reaction times of a participant’s responses to indicate the font color of the words. In other words, the participants pushed keys on a computer keyboard or response pad to indicate the font color of a word and ignore the word’s meaning (William, Mathews & MacLeod, 1996). Attentional biases toward alcohol-related words are indicated by longer reaction times to name the font color of alcohol-related words relative to control words.

Cox, Yeates and Regan (1999) used a Stroop task to examine attentional bias in heavy and light drinkers. The researchers found that each group showed evidence of attentional bias for alcohol and alcohol-related words relative to neutral words (i.e., longer latencies to name the font color of alcohol-related words). However, compared to the light drinkers, the heavy drinkers showed considerably longer latencies in reaction time to alcohol-related words; the longer latencies were thought to be caused by distraction or attentional capture by the alcohol-related cues. A study by Sharma, Albery and Cook (2001) also found significant attentional bias in reaction time on a modified Stroop task for alcohol words in problem and heavy drinkers, but not light drinkers.

The current study focused specifically upon light and moderate social drinkers whose alcohol consumption patterns are most representative of college students.

A study by Fadardi and Cox (2008) found that college student social drinkers displayed attentional bias toward alcohol related words on a Stroop test, and that attentional biases were a predictor of alcohol consumption in these university students. Utilizing regression analyses which controlled for factors such as age, gender and executive cognitive functioning, the authors found that attentional bias was a positive predictor of alcohol consumption level. These results support the notion that attentional bias is linked to an individual's level of alcohol consumption and may explain why attentional bias is more pronounced in alcoholic as opposed to heavy drinkers. The findings also suggest that the presence of attentional bias may be an indicator of progressing alcohol consumption. According to Fadardi and Cox (2008), once attentional biases are manifested, the ability of a person to inhibit or ignore the cognitive and motivational processes associated with the process of drinking becomes difficult. This idea is relevant to the current study because it suggests that understanding and reshaping attentional biases toward alcohol cues may be useful if incorporated with drinking intervention and prevention programs in collegiate settings.

Participants in the current study included only social drinkers. Social drinkers were determined to be those individuals with an alcohol consumption level of less than or equal to 14 drinks per week for men and less than 7 for women as indexed by a score on the Quantity and Frequency Index of alcohol consumption (Cahalan, Cisin & Crossley, 1969). This was done to ensure that the participants were light to moderate social drinkers, since drinking above the threshold of 13 drinks per week would classify an individual as a heavy drinker. The attentional task used in the current study administered to the participants differed from Field et al. (2005) and Field and Powell (2007). Whereas the aforementioned studies employed a dot-probe task, the current study utilized a 3-stimulus oddball image task, in which participants were presented with infrequent target images (either alcohol-related images such as mugs and bottles of beer, glasses or bottles of wine, cocktails, or shots or bottles of liquor or emotionally neutral images of objects, such as office supplies, household items and non-alcoholic beverages), infrequent distracter images (either alcohol-related or neutral object images), as well as frequently presented nonsense shapes. Participants were randomly assigned to two groups, one which responded to alcohol targets (and ignored neutral object images and nonsense shapes), and another which responded to object targets (and ignored alcohol-related images and nonsense shapes).The oddball paradigm makes use of "distracter" images, which leads to a disruption in the uniformity of environment a participant experiences (Johnson & Proctor, 2004). This makes the oddball paradigm a useful tool for examining the ability to maintain attention to targets during a particular task.

Alcohol, Stress and Attention

Acute stress has been shown to instigate cravings for alcohol in dependent individuals (Sinha & O'Malley, 1999) and plays a significant role in the vulnerability and maintenance of substance abuse (Sinha, 2001). It has been hypothesized that a conditioned association between stress coping (i.e., relief from negative affect) and alcohol use may lead to a sense of deprivation (Koob & Le Moal, 1997). This sense of deprivation that is elicited by an induced negative mood (e.g., the result of a stressor) may enhance attentional biases toward alcohol-related cues (Kavanagh et al., 2005). It would be expected that those with high levels of alcohol consumption (heavy drinkers and alcoholics) should have more pronounced attentional biases toward alcohol cues than those with lower levels of consumption (light and moderate drinkers), especially after a stressor.

Stress has an intimate link with many substances of abuse (Sinha, 2001) and has been shown to co-occur with alcohol abuse in college students (O'Hare & Sherrer, 2000). Stress reduction is a reason for drinking reported among many adult moderate drinkers (El-Guebaly, 2007), as well as college students (O'Hare & Sherrer, 2006). In a review of adolescent and young adult drinking motives, drinking to cope with stress was linked most closely to problem drinking behavior, while social reasons were the most cited motive associated with moderate drinking (Kuntsche, Knibbe, Gmel & Engels, 2005). Increased drinking frequency has also been found to be related to coping in college students specifically (Stewart, Morris, Mellings & Komar, 2006). This increased frequency of drinking in response to stress may provide a gateway to future heavier drinking (Dawson, Grant & Ruan, 2005).

In 1986, Steele, Southwick and Pagano (1986) developed the attention-allocation model (AAM) which states that a combination of alcohol intake and a distracting activity (such as rating artistic pictures for pleasantness) will contribute to a quicker recovery of positive affect following a stressor as opposed to alcohol intake and no distracting activity. Specifically, Steel et al. (1986) found that consumption of alcohol paired with a distracting task (in this case picture rating) provided a faster recovery in affect from negative feedback on a previously taken IQ test. These findings that distraction plays a role in affect change after a stressor were later confirmed by Steele and Josephs (1988) and therefore may suggest an underlying framework for the importance of social drinking among college students, especially in the use of anxiety/stress reduction. Steele and Josephs (1988) examined 40 college students to examine how alcohol mediated their reactions to an impending stressor (a speech about what they disliked about their physical appearance). Students who engaged in alcohol consumption and an image rating task showed a drop in anxiety ratings on the STAI (State-Trait Anxiety Inventory), while anxiety worsened for those who did not engaged in any distracting activity. This suggests that alcohol may influence affect (in this case anxiety to an impending stressful situation); a reduction in anxiety due to alcohol consumption may occur when participants are engaged in some other type of activity. However, this may only be one link between alcohol use, stress reduction and attentional bias, as other individual differences such as gender, family history of alcohol consumption and cognitive functioning may play a part (Sayette, 1999).

Field and Quigley (2009) examined attentional bias and the effects of mild stress on initial orienting toward alcohol-related cues in 29 social drinking men. The participants reported an average of 13.11 U.S. standard drinks per week, which would classify them as “heavy” social drinkers. The authors used pictorial stimuli in a visual probe task in which the participants were instructed to identify the orientation of an arrow pointing either up or down along with the presentation of 14 pairs of pictures at 100 and 500 ms, with one picture being alcohol-related and the other being a control image. In order to induce stress, participants in one group were informed that they would have to give a speech about their feelings on the Iraq War and while being videotaped (stress condition). Another group was given simple anagrams to solve (control condition). The study found greater attentional bias to alcohol cues in the stress group (i.e., faster reaction times to detect targets that occurred in the same location for alcohol pictures) but only for those who had higher scores on the Coping Motives subscale of the Drinking Motives Questionnaire. The authors concluded that experiencing mild stress changes the attentional processing of alcohol-related cues in social drinkers. These results replicate previous findings of attentional biases to alcohol-related stimuli in a sample of heavy social drinking young adults (Field & Powell, 2007). The current study differs from that of Field and Powell in that participants were light and moderate social drinkers, and included both male and female participants. The current study also examined self-report measures of anxiety and drinking frequency as well as the analysis of salivary cortisol as a marker of HPA axis activation. The hormone levels of cortisol in saliva provide a non-invasive, physiological measure of stress to compare with the self-report measures of state anxiety and perceived stress. Cortisol has been used as a biomarker in the examination of alcohol and its effects on HPA axis reactivity (e.g., Frias, Torres, Miranda, Ruiz & Ortega, 2002).

Social Drinking

The scientific literature examining alcohol and reasons for and consequences of its use is quite large and encompasses decades of research; however, only a small portion of the literature focuses on light to moderate social drinkers. Social drinking is quite prevalent among young adults and is especially frequent in college students (Bot, Engels, Knibbe & Meeus, 2007; Perkins, 2002; Scholte, Poelen, Willemsen, Boomsma & Engels, 2008). Light to moderate (or even heavy) social drinking is not traditionally viewed as an area of concern among college students (Hayman, 1967; Perkins, 2002) and is viewed as important for social functioning (Murphy, Hoyme, Colby & Borsari, 2006). These perceptions, however, are not the same within the general populace. For example in a study by Segrist and Pettibone (2009), the volume at which college students consider drinking at one sitting “binge” or “problem” drinking is often considerably higher than the > 5 drinks in one sitting definition for binge or episodic (i.e., in one sitting) heavy drinking as defined by the National Institute of Alcohol Abuse and Alcoholism (NIAA, 2004). Making the distinction between the beneficial effects of light to moderate alcohol consumption and the detrimental effects of excessive use can be difficult (Agarwal, 2002; Ashley et al., 1997). Research suggests that those who engage in binge drinking, especially early on, are at the greatest risk for later abuse (Chassin, Pitts & Prost, 2002).

Some research has alluded to possible “seeds” for future problem drinking being present and detectable. In support of this, Paradis, Demers, Picard and Graham (2009) found that the risk of binge drinking increases with the frequency of daily or weekly drinking. Studying over 10,000 drinkers between ages of 18 and 76 as part of the Canadian Gender Alcohol and Culture study, Paradis et al. (2009) found that those who drink more than once a week were more likely to have more than two drinks at one sitting. Logistic regression showed that drinking frequency was the best predictor of future binge drinking. Binge drinking has also been shown to be a predictor (along with family history) of alcohol dependence (Hasin, Paykin & Endicott, 2001). In further support of this notion, Jennison (2004) conducted a 10-year follow up study examining binge drinking in 1447 college students and the short term and long term consequences upon their health. It was concluded that binge drinking is associated with the development of later alcohol dependence and abuse.

A study by Fadardi and Cox (2006) sought to test the idea that alcohol related dysfunctions in executive cognitive functioning contribute to processes such as attentional bias which lead to alcohol "wanting". Participants consisted of alcohol dependent and social drinkers which were administered a Stroop test as well as the Shipley Institute of Living Scale (SILS) to test executive cognitive functioning. The study found that attentional bias to alcohol related words on a Stroop Test in alcohol abusers is not the result of executive cognitive functioning deficiencies which was thought to be brought about by excessive drinking. The social drinkers were not completely free of attentional bias however, only showing less bias toward the alcohol-related content than the alcohol-dependent group. Regression analyses found attentional bias toward alcohol-related words predicted alcohol consumption as indexed by the Alcohol Use Questionnaire; that is, the alcohol-related content captured drinkers' attention even if an attempt was made to ignore the stimuli. This study would seem to indicate that attentional bias is not caused by excessive drinking and appears in non-dependent drinkers as well, although not to the same magnitude as the dependent drinkers.

With a better understanding of how cognitive processes like attentional bias relate to alcohol use, there may be a possibility of revealing cognitive or behavioral markers for possible future problematic drinking or alcohol abuse in those who drink socially, even at a light or moderate level. This could be accomplished by the use of tests such as the tasks described in the literature and in the current study to examine students for attentional biases to alcohol-related cues as a possible marker for future problem drinking or the use of attentional retraining programs to reduce these biases as a part of alcohol treatment programs. Such findings are important for college campuses around the United States where drinking continues to be a problem (Berkowitz & Perkins, 1986; Dawson, Grant, Stinson & Chou, 2004; Wechsler, Lee, Kuo & Lee, 2000).

In summary, college students often deal with a large amount of stress in many situations and have unique associations (e.g., fraternities and other social groups) which create social and emotional pressures to consume alcohol that may contribute to later alcohol abuse (Grekin & Sher, 2006; Ross, Niebling & Heckert, 1999). Stress, in particular, has been found to be a major factor in alcohol use and abuse among college students (Park, Armeli & Tennen, 2004; Spear, 2002). Biases in attention to alcohol-related targets have been shown in alcohol-dependent individuals and may appear in light or moderate social drinkers as well (Stormark, Laberg, Norby & Hugdahl, 2000). The current study examined attentional bias to alcohol-related target images prior to and following the induction of an acute stressor. Given that stress may play an important role in attentional biases to appetitive cues (e.g., pictures of alcohol and alcohol-related items; Field & Powell, 2007), the presentation of an acute stressor may enhance attentional biases to these cues even in non-clinical populations (i.e., individuals that do not have a diagnosed chemical use disorder).

Salivary cortisol

Salivary cortisol was used in the current study as an objective marker of the stress response, in addition to self-reported anxiety as a subjective measure of stress. These measures were included to measure the effect the acute stressor may have had upon the participants and to act as a manipulation check for the stressor (timed arithmetic). Cortisol is a glucocorticoid hormone which occurs naturally in the human body. It is produced by the zona fasciculata portion of the adrenal cortex (Barrett, Barman, Boitano & Brooks, 2010). It is heavily active in the stress response, secreted within minutes following stimulation by a stressor, and peaks approximately 30 minutes afterward (Kirschbaum & Hellhammer, 2000). Cortisol has been implicated in several functions including learning, memory, and emotion (Miller, Chen & Zhou, 2007). As mentioned, cortisol becomes elevated in response to stress (Dickerson & Kemeny, 2004). While it can have local anti-inflammatory consequences, prolonged cortisol secretion can be damaging to tissues and may act as an immunosuppressor (Rice, 1999; Selye, 1978). Chronic stimulation of the HPA axis by stressors and the subsequent release of cortisol impair the normal negative feedback mechanisms that maintain homeostasis. This may result in diseases or disorders such as Cushing's syndrome, hypoglycemia, truncal obesity, insulin resistance and dyslipidemia (Chrousos & Gold, 1998; Whitworth, Williamson, Mangos & Kelly, 2005). Because cortisol levels are intimately tied with the stress response, measurement of its levels in saliva should provide an objective physiological assessment of stress. Many researchers have confirmed the viability of utilizing salivary cortisol as a measure of the functionality of the HPA axis (Chiapelli, Iribarren & Prolo, 2006; Coste, Strauch, Letrait & Bertagna, 1994; Laudat et al., 1988; Lewis, 2006). There also may be variation across individuals that may contribute to differences in attentional bias.

This study examined the possibility of detecting attentional biases to alcohol-related cues in light and moderate social drinking college students; specifically, the effect of stress on attentional biases to alcohol-related or object target pictures in a 3 stimulus oddball task. It was hypothesized that participants assigned to detect alcohol-related targets would show attentional biases for alcohol-related images relative to participants assigned to detect control images, as indexed by an a faster reaction times to detect alcohol targets compared to control targets. It is hypothesized that the acute stressor should trigger cognitive processes as described by the EI theory, which should enhance attentional biases toward alcohol images. In the current study, the enhancement of attentional biases to alcohol targets due to stress would be inferred from statistically significant faster reaction times to alcohol targets as compared to reaction times for neutral image targets on the oddball image task following the presentation of an acute stressor.

In summary, there is evidence to suggest that attentional bias toward alcohol-related objects may be observed in light and moderate social drinkers, which may be even more pronounced following an acute stressor (de Wit, Soderpalm, Nikolayev & Young, 2003). The current study predicts that such attentional bias can be found in light and moderate social drinking college students. This bias may be manifested as faster reaction times to alcohol-related picture cues than object cues on a three stimulus oddball paradigm, as previous research has shown (e.g., Fadardi & Cox, 1999) attentional bias for alcohol-related stimuli is tied to alcohol consumption and the cognitive processes related to that consumption behavior. Also, because attentional biases toward alcohol-related stimuli are should be greatest in problem drinkers such as alcoholics, attentional biases in light and moderate social drinkers may be an indicator of a possible progression toward heavier drinking behavior in the future.

There is also support that stress may play a role in facilitation of attentional bias as outlined in EI theory (Kavanagh et al., 2005). Stress reactions should be demonstrated objectively by an increase in salivary cortisol levels from pre to post stressor, as well as subjectively by increases in self-reported state anxiety. An evident stress reaction along with enhancement of attentional biases following an acute stressor would further support a link to stress as a possible facilitator for attentional bias to alcohol-related stimuli and subsequent alcohol consumption. If this is the case, the assessment of attentional bias may be a beneficial tool to be utilized in the design of alcohol abuse intervention and prevention programs in collegiate settings. A shift in perspective may be all that is needed to better help those who may be in need and prevent those who may be vulnerable to drinking problems from a future of alcohol abuse or dependence. It would also further alcohol and addiction research in the areas of cognitive testing and how stress and visual stimuli facilitate consumption behavior.

CHAPTER III

METHOD

Data for this study were derived from a larger INIA event related potential (ERP) study conducted in the Biology Department of the University of Texas-San Antonio under the supervision of Drs. Reiko Graham and Natalie Ceballos. The study protocol was approved by the University of Texas-San Antonio (UTSA) and Texas State University-San Marcos Institutional Review Boards.

Participants

Participants were recruited via flyers posted around the campuses of Texas State and UTSA, and by word of mouth. Participants consisted of 39 (21 male, 18 female) light and moderate social drinkers. Participant's alcohol consumption was determined utilizing the Quantity-Frequency Index (QFI). Participants whose weekly consumption exceeded the limit for moderate drinkers (>13 for males and >7 for females) were excluded as they would be considered heavy drinkers. It has been previously established that heavy drinkers exhibit attentional biases to alcohol-related cues (words on a Stroop test and digital photos), albeit to a lesser extent than alcoholics and a greater extent than non-drinkers (Drobes et al., 2009).

The students ranged in age from 21-31 years with a mean age of 23.92 (*SD* = 2.84) years. To control for factors which affect salivary cortisol measurement, the students were asked to not smoke, drink caffeinated drinks, eat, or chew gum at least one hour prior to sample collection as well as reporting any medication they may have been taking which may also interfere with cortisol measurement (Kirschbaum et al., 1997; Lovallo, Whitsett, al'Absi, Sung, Vincent, & Wilson, 2005). The sample was predominantly Caucasian (50%) followed by Hispanic (32.5%), African American (7.5%) and "Other" (7.5%).

The variables in this study consisted of the participant's condition group (alcohol or object target groups), their level of stress measured by salivary cortisol, State Trait Anxiety Inventory – State Form (STAI; Spielberger, Gorsuch, & Lushene, 1970), and their mean reaction times on a 3 stimulus visual oddball task.

Self-report measures

State-Trait Anxiety Inventory (State Version). Participants were administered the State-Trait Anxiety Inventory (state version, Form Y; Spielberger, Gorsuch & Lushene, 1970) five times during the study: at the beginning of the study, prior to the first oddball task, prior to the PASAT, after the PASAT (before the second oddball task administration), and at the end of the experiment. The State-Trait Anxiety Inventory (STAI) is designed to measure anxiety in adults. The version utilized in the current study was the state version, which assesses how the person feels at that moment. The STAI uses 20 statements to which the individual rates their feelings at the time with the statements on a four point Likert-type scale ranging from 1 = "Not At All" to 4 = "Very Much So". In an independent evaluation of the STAI, Barnes, Harp and Jung (2002) found the scale to be a generally satisfactory index of anxiety for a broad range of studies which involved various populations. Barnes et al. (2002) reviewed the use of the STAI in 816 published, peer-reviewed articles and found that the Y form (the most current edition replacing the previous X form) of the measurement to have a mean alpha reliability of .92

Paced Auditory Serial Addition Task (PASAT)

The Paced Auditory Serial Addition Task (PASAT; Gronwall, 1977) requires participants to attend to the auditory presentation of a series of single-digit numbers and respond by verbally indicating the sum of the number just heard and the number heard immediately prior. The numbers in the current study were presented in increasingly shorter periods of time (2.4, 2.0, 1.6, and 1.2 seconds between stimuli presentation). The task was originally created to assess cognitive performance in patients with a closed-head brain injury (Diehr, Heaton, Miller, & Grant, 1998; Gronwall, 1977). However, many studies have successfully utilized the PASAT as a stressor for experimental purposes (Benham, 2007; Mathias, Stanford & Houston, 2004; McCann et al., 1993). For the purposes of this study, the PASAT was utilized as a controlled acute stressor performed following the first administration of the visual oddball task.

Three-Stimulus Oddball Paradigm

Participants performed a 3-stimulus variant of the visual oddball task (Rodriguez-Holguin, Porjesz, Chorlian, Polich & Begleiter, 1999) before and following the presentation of an acute stressor. The task consisted of infrequent target images, infrequent non-target images and frequently presented novel non-target images (i.e., alcohol-related pictures, office supplies, or frequently presented nonsense shapes). The images were presented on a computer screen for 500 ms with an inter-stimulus interval that varied between 750 and 1250 ms. (Hermann et al., 2001; Mogg, 2004). The participants were seated in a chair in front of a CRT monitor. They were shown a series of images on the center of the screen. These included 320 non-target images, 40 targets and 40 non-target stimuli which were 8 cm wide by 12 cm high. It was the participant's task to respond, by pressing a button on a response box with the index finger of his/her dominant hand, to target images and to ignore the non-target images. Participants were randomly assigned to detect and respond (i.e., push a button on a button box) to either alcohol-related or neutral images. Stimuli were presented with EPrime experimental software (Psychology Software Tools Inc., Sharpsburg, PA).

Salivary Analysis

Measurement of cortisol by means of saliva collection is a simple, non-invasive method often utilized in research involving assessment of HPA axis activity (Kirschbaum & Hellhammer, 1989), and has been shown to correlate well with measures of perceived stress (Vedhara et al., 2003). Collection requires small amounts of saliva ranging from 0.025 – 2 mL (de Weerth, Graat, Buitelaar & Thijssen, 2003). Examination of free unbound cortisol levels in saliva is often performed by enzyme-linked immunosorbent assay, a non-radioactive assay which has become more widely utilized over the past three decades (Hausmann, Vleck & Farrar, 2007; Lequin, 2005).

Saliva collection was done using salivette tubes (Salimetrics, State College, PA). Participants were provided with a cotton salivette and requested to chew lightly on it and roll it with their tongue. Once saturated, the participant placed the cotton tube into a microfuge tube for later processing (Kalman & Grahn, 2004). Participants' samples were bagged in plastic freezer bags and refrigerated for storage prior to analysis. Analysis of the saliva samples was performed using an enzyme immunoassay (EIA) kit from Diagnostic Systems Laboratory (Webster, TX) for cortisol. The analyses were performed in the Biology Department at Texas State University-San Marcos.

Procedures for sample analysis were performed as per the specified protocols supplied by the manufacturer (Diagnostic Systems Laboratories Inc, Webster, TX). First, the samples were taken from refrigeration and brought to room temperature. The samples were then centrifuged and shaken before 25 microliters (µL) of saliva per sample were pipetted into a pre-treated microtiter plate along with supplied controls. 100 µL of cortisol enzyme conjugate solution was then added to each well and the plate was gently tapped for 5-10 seconds. Then 100 µL of cortisol antiserum were pippetted into each well and the wells were incubated by shaking at 500-700 rpm for 45 minutes. The wells were then aspirated and washed with a wash solution five consecutive times using 0.35 mL of wash solution for each well. 100 µL of TMB chromagen solution was pippetted into each well and these were again incubated at 500-700 rpm for 15 minutes. Following this, 100 µL of stopping solution were pippetted into each well and the plate was hand shakenfor 5-10 seconds. The absorbence of the samples was then analyzed using an MXR microtiter plate reader with Revelation analysis software set to a wavelength of 450 nm (Dynex Technologies, Chantilly, VA). The analysis supplied the concentration percentage of cortisol of each sample in micrograms per deciliter which was then recorded into a Microsoft Excel spreadsheet for further analysis.

Procedure

The participants completed several self-report measures and provided two baseline saliva samples (one at the beginning of the study, another prior to the first oddball task). Participants then completed the oddball task and state anxiety (STAI) questionnaire. Participants then performed the PASAT. Following the PASAT, the participants again completed the STAI, provided a third saliva sample and performed the oddball task again. Following this task, the participants completed the STAI and provided a fourth saliva sample approximately 30 minutes after the PASAT and prior to exiting the lab. The procedures and measures are detailed in Table 1. Event Related Potential (ERP) measurements listed in the table were part of a larger study and were not included in this study's analyses.

Table 1. Approximate experimental timeline on the day of testing (actual times varied across participants).

Time	Procedure
2:00 P.M.	Enter lab; informed consent; STAI; 1st saliva collection (baseline)
2:20 P.M.	EEG Prep
2:50 P.M.	STAI; 2nd saliva collection; ERP; 1st image task
3:10 P.M.	STAI; PASAT
3:30 P.M.	STAI; 3rd saliva collection; ERP; 2nd image task
3:50 P.M.	STAI; Electrode removal
4:00 P.M.	4th saliva collection; Exit lab

The participants were divided into two groups, 20 participants in the alcohol group and 19 participants in the object group. The object group was asked to attend to neutral object targets and push a button on a response box with the index finger of the dominant hand whenever one appeared, while ignoring alcohol-related distracters and frequently occurring nonsense shapes. The other half (the alcohol group) was asked to attend to alcohol–related targets and ignore object distracters and nonsense shapes.

Reaction times to detect correctly recognized targets were recorded and mean reaction times to the different targets were calculated.

Analytic strategy

A key portion of this experiment was the introduction of an acute stressor, the PASAT. In order to determine if the stressor elicited the response intended, a manipulation check was needed. To serve this purpose, the cortisol levels of the participants were examined along with STAI scores as indexes of stress. Both salivary cortisol levels and STAI scores were examined utilizing a mixed ANOVA. In both examinations, the between subjects factors were the group type (alcohol targets or object target groups). For the cortisol analysis, the within subject factors were the salivary cortisol levels pre and post stressor and similarly for the STAI analyses, the between subject factors were the STAI scores pre and post stressor. Salivary cortisol levels were examined from the second and fourth collection times which were pre (T1) and post (T2) stressor respectively. These samples were utilized for both groups – the alcohol target group and the object target group. Therefore, the salivary cortisol variable would have two levels – pre-stressor and post-stressor. STAI scores were similarly examined, utilizing scores immediately before the PASAT and following the PASAT at the same time as saliva collection number three. The STAI scores variable also had two levels being pre and post stressor. The concern of the analysis was the difference between the two condition groups at two time periods, T1 and T2. Mixed design ANOVAs with time as a within subjects factor and group as a between subjects factor was utilized to examine both the salivary measure and the self report measure differences in the two condition groups at T1 and T2.

The current study aimed to answer two questions. First, do light and moderate social drinkers exhibit attentional bias to alcohol-related cues? Second, if attentional bias was exhibited, was it moderated by stress? To examine to first question, the primary focus of analysis was the participants' reaction times on the oddball image task as a function of target image type. If an overall bias for alcohol images exists, then participants in the alcohol target group should be faster to detect targets relative to participants in the object target group (i.e., main effect of target type). This would be manifested as a significant main effect for target type (i.e., group – alcohol targets or object targets). Such a result would indicate that the target type did make a difference in the participant reaction scores.

To examine the second question, reaction times to detect the two different target types were examined at two different time periods: before and after the PASAT. To determine if the prediction that an acute stressor would elicit attentional bias in social drinking college students, we would expect to see faster reaction time scores displayed by the alcohol target group compared to the object target group following the acute stressor. Participants' reaction times were examined in both groups (alcohol targets and neutral targets) at pre (T1) and post (T2) acute stressor timeframes utilizing a mixed design analysis of variance (ANOVA) with time as a within subjects factor and group (alcohol vs. neutral targets) as a between subjects factor to discern any differences between the two groups as a function of stress (i.e., time by target type interaction). If attentional bias varies as a function of stress, we would expect to see a decrease in the faster time scores from pre to post stressor for the alcohol target group then the object target group. In other words, we would expect to see an interaction of group and time suggesting their scores changed significantly from one time to the other. This would support the prediction that the alcohol target group will display faster reaction time scores then the object target group following an acute stressor.

CHAPTER IV

RESULTS

A total of 39 cases were examined during the data analysis with cross tabulations showing both groups being similar for sex, age, race and drinking frequency (see Table 2) All of the data was analyzed utilizing SPSS 15 for Windows.

Table 2. Participant demographic numbers by condition groups		
Variable	Alcohol Targets	Object Targets
	n = 20	n = 19
Male	12	9
Female	8	10
African American	1	2
Hispanic	7	6
Caucasian	10	10
Other	2	1
Age (Mean)	24.1 (± 3.2)	23.7 (± 2.5)
Driking Frequency (QFI)	1.31 (± 1.4)	1.03 (± 0.9)

Stress Measures

Stress measures were examined as a manipulation check to determine if the acute stressor had a measurable effect upon the participants. Average cortisol levels of the participants over time showed a steady decrease throughout the procedure and are displayed in Figure 1. A mixed ANOVA consisting of reaction times pre and post stressor in two groups examined differences in average cortisol between the two groups across time periods T1 and T2 (using the second and fourth saliva sample collections) with a within subjects factor of collection time and between subjects factor of target type showed no significant differences between the alcohol target group and the object target group $F(1,35) = .309$, $p = .582$.

Examining the average STAI scores at each administration period showed that the scores at time period 4, following the PASAT, exhibited an increase (Figure 2) from time period 3 (prior to the PASAT) followed by a decrease at time period 5 (prior to leaving the lab). The subjective measures of stress were examined utilizing a mixed ANOVA looking at STAI scores in each group across T1 and T2. That is, STAI scores immediately prior to the PASAT (STAI3) and scores following the PASAT at the third saliva collection time were utilized. The ANOVA had two factors which were the target condition groups – alcohol target and object target. Both conditions had two levels – the STAI scores prior to and following the stressor. While no significant difference was found between the two groups, STAI scores did show a significant effect of time from T1 and T2, $F(1, 35) = 6.45$, $p = 0.015$. This would suggest that the stressor did have an effect upon the participants, regardless of target type (Figure 2). There was no significant interaction between time and condition group. This increase in average state anxiety scores is at odds with the salivary measures and the progressively descending pattern of cortisol levels over the course of the experiment.

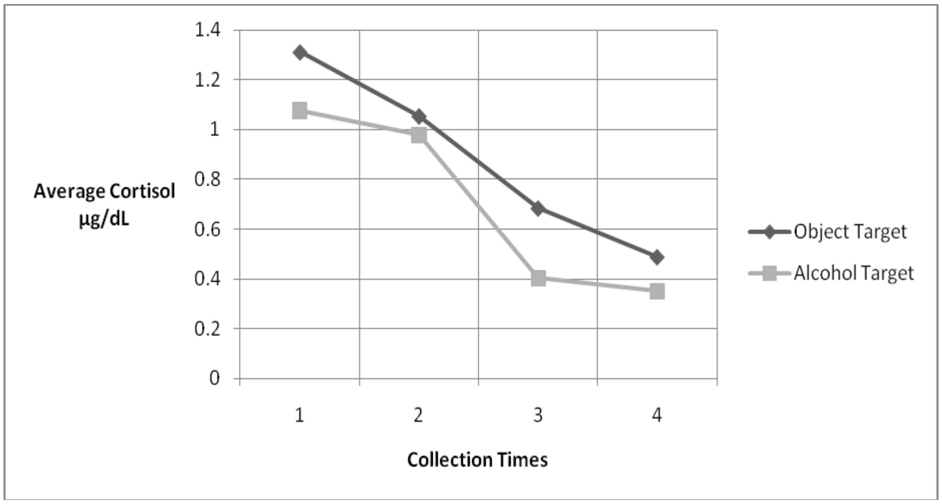

Figure 1. Mean Cortisol Levels By Group. A descending pattern was found from baseline to the final collection time.

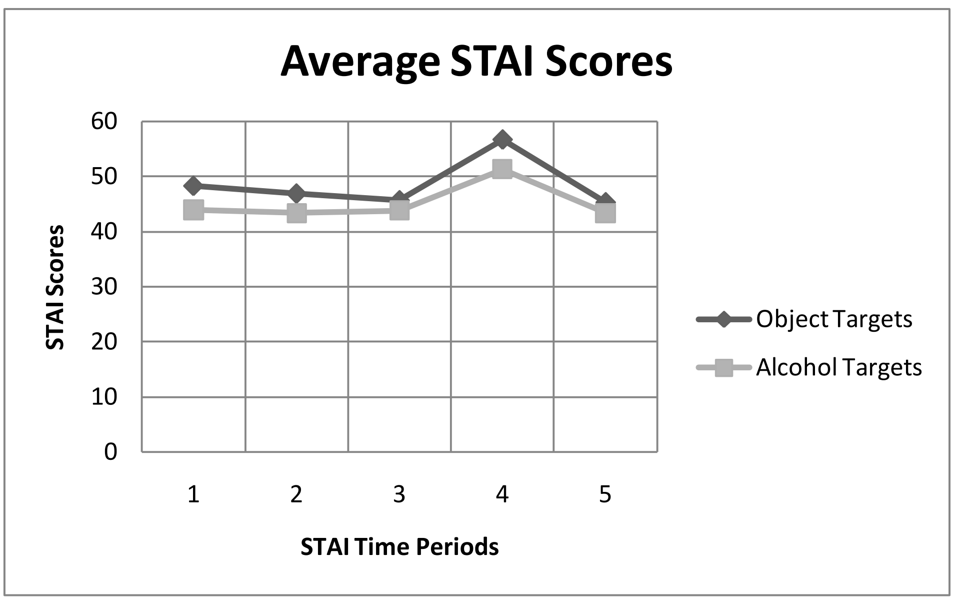

Figure 2. Average STAI Scores. Time period 4 showed an increase, in relation to the other time periods, which coincided with the administration of the PASAT.

Reaction Times

Preliminary examination of the group mean reaction times (*N* = 39) exhibited decreases post stressor (Figure 3). The alcohol target group had a mean of 519.68 ms (*SD* = 64.59 ms) for T1 and a mean of 501.38 ms (*SD* = 44.88 ms) for T2, a difference of 18.29 ms. The object target group had a mean of 542.19 ms (SD = 63.53 ms) for T1 and a mean of 523.35 ms SD = 45.75 ms) for T2, a difference of 18.84 ms. This preliminary

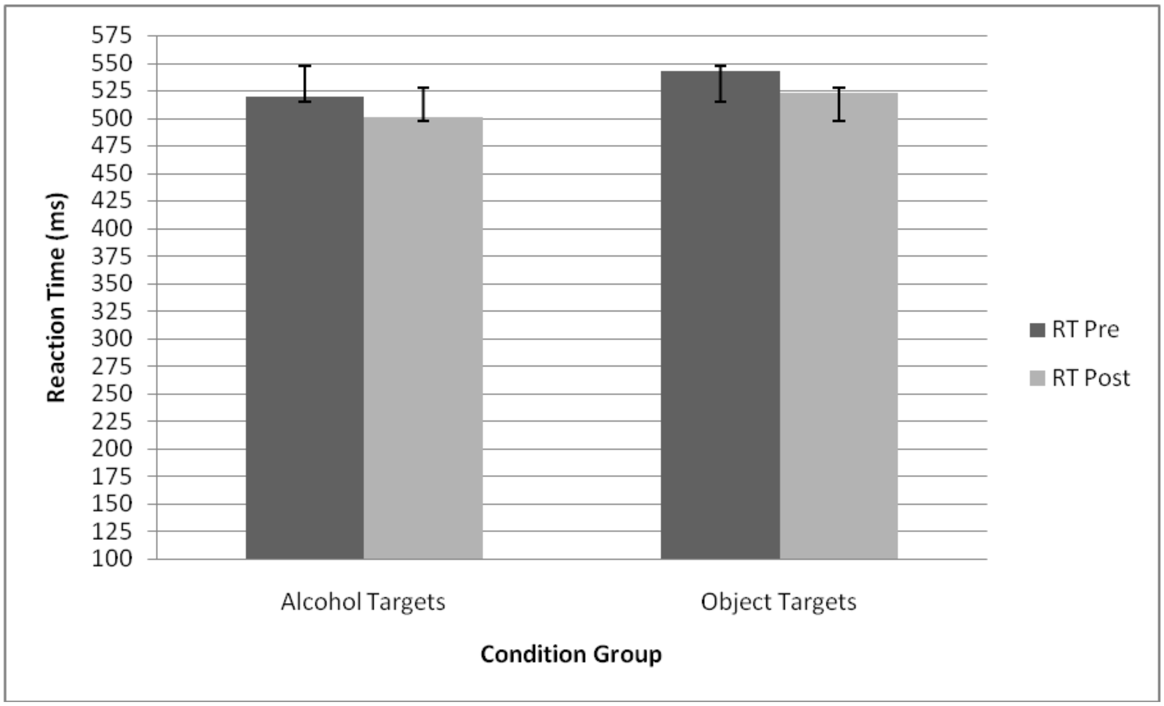

Figure 3. Reaction times pre and post stressor by condition group. Alcohol target group showed slightly faster mean reaction times than the object group pre and post stressor.

examination suggests that the alcohol target group exhibited faster reaction times on the oddball task then the object group at both task times – before and after the introduction of a stressor. While this fits our expectation of faster reaction times for the alcohol group, the differences between the target condition groups were small.

A mixed-model analysis of variance (ANOVA) was utilized to formally examine mean reaction times to detect targets during the oddball task. The ANOVA consisted of two factors each with two levels. The between subjects factor was target condition (alcohol target vs. object target) and the within-subjects factor was time (pre vs. post stressor).

To demonstrate an overall bias for alcohol-related stimuli, it was hypothesized that a mixed ANOVA would show a main effect for target type labeled in the analysis and condition group. No main effect was seen for target type – that is no between groups difference was evident. The ANOVA did reveal a significant within-subjects main effect of reaction time difference across the time periods pre- and post-stressor $F(1, 35) = 10.44$, $p = 0.003$ with both groups exhibiting a reduction in reaction time post-stressor - an 18.29 ms reduction for the alcohol target condition group and 18.84 ms reduction for the object condition group. This indicates that both groups displayed differences in reaction time scores from pre to post stressor. There was no interaction found between condition group and reaction times pre- and post-stressor time periods (T1 and T2) $F(1, 35) = 2.65$, $p = 0.113$. This would indicate that there was no discernable enhancement of attentional bias in the alcohol target group as a function of stress, counter to predictions.

CHAPTER V

DISCUSSION

It is thought that conditioned associations for the alcohol related targets elicited by stress trigger heightened attention for those targets as compared to neutral object targets following an acute stressor (Kavanagh et al., 2005). Such attentional biases are seen in alcoholics and other problem drinkers, and to a lesser extent in heavy social drinkers (Sharma, Albery & Cook, 2001). The current study examined social drinking college students, a portion of the populace who have a high risk for the development of alcohol use disorders (Johnston, O'Malley, Bachman, Schulenberg, 2009; Slutske, 2005). The ability to detect attentional bias for alcohol in moderate drinkers could be a marker for future alcohol problems and could aid in developing more progressive prevention and intervention programs aimed at college students.

Reaction times to detect targets in a 3 stimulus oddball paradigm were examined for differences between two groups of participants: those who were required to respond to alcohol-related target images, and those required to respond to emotionally neutral object target images. It was expected that light and moderate social drinkers would show attentional biases to alcohol-related pictures during an oddball image task – displaying faster reaction times for alcohol-related target pictures, as compared to a group tasked with targeting object pictures. It was also hypothesized that an acute stressor would enhance attentional biases by eliciting a larger disparity in reaction times to the two types of target images post stressor (i.e., the alcohol target group showing faster reaction times to targets relative to the object target group after the PASAT).

A key element in this study was the use of an acute stressor. Therefore, it was imperative to determine the efficacy of the stressor in creating a negative effective state. Two measures of stress were utilized, salivary cortisol levels and scores on the STAI. Changes in these measures before vs. after the stressor were utilized as a manipulation check to determine if the PASAT did, in fact, elicit a stress response from the participants. The data for the cortisol displayed a progressively descending pattern of cortisol levels. Taken alone, this would seem to indicate that the stressor had no measurable effect upon the participants and therefore may not have been stressful enough to modulate attentional biases as predicted. These results are at odds with the STAI measures, which indicated an increase in stress immediately following the introduction of the acute stressor. Thus, the two stress measures are contradictory: cortisol levels (an objective measure of stress) did not show any evidence of stress reaction to the PASAT, while the STAI scores (a subjective measure of stress) increased following the PASAT.

This disparity between objective and subjective measures of stress may be the result of external factors which may have affected the levels of salivary cortisol. The lack of reactivity displayed in cortisol levels may be explained by external (ongoing or anticipated) stressors (Smyth et al., 1998). For example, many of the participants' sessions were during or close to major examination periods and this may have played a role in the trend seen in the cortisol levels, which were elevated at the beginning of the experimental session and declined steadily over the course of the session. As academic stress is known to have an effect upon cortisol (Ng, Koh, Mok, Chia & Lim, 2003), it is possible that elevated cortisol levels due to external variables like exams created a ceiling effect for cortisol levels. Cortisol responses to the stressor may have been blunted or absent, as was observed in this study, if a previous, ongoing or upcoming major stressor was experienced or being anticipated (Kirschbaum et al., 1995). Given that factors which are known to affect salivary cortisol levels such as tobacco and caffeine use (Kirschbaum & Hellhammer, 1989) were controlled in the current study, the decreasing cortisol levels across time may have been due to major external stressors, like exams, that were not under experimental control. Alternatively, the acute stressor itself may not have been significant enough to effect salivary cortisol levels.

While it is difficult to control for stressors which may affect the students outside of the lab (environmental confounds) including personal relationships, academic responsibilities, and social obligations among other factors, all of which may impact salivary cortisol and other stress measures (Kirschbaum, Kudielka, Gaab, Schommer & Hellhammer, 1999), future studies should monitor and attempt to control for levels of stress elicited outside of the lab. Those participants who began the experiment with elevated levels of cortisol may show a blunted or absent physiological response to a presented stressor (Kirschbaum et al., 1995; Malarkey, Pearl, Demers, Kiecolt-Glaser & Glaser, 1995).This may have implications not only for physiological measures of stress, but for the process of enhancing or modulating attentional biases to addition-related stimuli, especially those like cigarettes or alcohol that are often used as ways of coping with stress. Future research could utilize pretests or screening procedures to determine if external factors may be at work and affecting salivary cortisol levels prior to the laboratory stressor. Another option would be to utilize different physiological measures of the stress response such as salivary amylase (Nater et al., 2005) and/or monitor heart rate and blood pressure. In addition, different kinds of acute stressors could be explored that may be more efficacious stressors, such as the Trier Social Stress Test (TSST, Kirschbaum, Pirke & Hellhammer, 1993), a more physical stressor such as a cold pressor test, or a combination of stressors.

This study hypothesized that an overall bias for alcohol targets would be found indicating attentional biases toward alcohol in moderate college-aged drinkers. This would be seen as a significant main effect for target condition. A mixed ANOVA did not find a statistically significant main effect for condition groups. This is at odds with previous studies examining the effects of acute stress among social drinkers who have reported attentional biases toward alcohol in this group (Field & Powell, 2007). This might have occurred because the participant population was comprised of light and moderate social drinkers and therefore a noticeable effect may not be seen as would be found in heavy social drinkers or alcoholics.

Another possibility may be that task demands may have a role in whether attentional biases toward alcohol-related stimuli are manifested in a given task. For example, previous research reporting attentional biases toward alcohol-related stimuli in social drinkers has utilized different measures of attentional bias from the current study. Whereas the current study utilized reaction time scores on an three stimulus oddball task, others studies reporting attentional biases to alcohol-related stimuli utilized modified Stroop tests with alcohol-related or control words (Cox et al., 1999; Sharma et al., 2001). Previous studies using pictorial stimuli have reported attentional biases to alcohol pictures only in samples of heavy social drinkers and, consistent with the results of the current study, did not find evidence of attentional biases to alcohol stimuli in light social drinkers (Field & Powell, 2007; Field & Quigley, 2009; Townshend & Duka, 2001). Future research should utilize larger sample sizes in order to detect the possibility of more subtle attentional biases in light and moderate social drinkers. The sample size for this study was a small, convenience sample recruited from the University of Texas-San Antonio and Texas State University-San Marcos. This small size (N = 39; n = 20 alcohol target group and n = 19 object target group) may not have had enough power to detect differences between the two target condition groups and therefore, there is a risk of a Beta or Type II error.

The second prediction made in this study was that attentional biases toward alcohol would be moderated by stress, that is the introduction of an acute stressor would enhance alcohol-related attentional biases on the the oddball task. This effect would have been evident as an interaction between time and target condition group. A mixed ANOVA did not show an interaction for time and condition group and only a main effect of time, which indicated that participants were faster to detect targets at T2, regardless of whether they were alcohol-related pictures or pictures of neutral objects. Previous research has found stress to have a considerable effect on the magnitude of attentional biases to alcohol images (Field & Powell, 2007), even after mild stress (Field & Quigley, 2009). One possibility for the discrepancy between the results of the current study and previous studies is that light and moderate social drinkers may not have attentional biases for alcohol-related cues. The current study's results, taken at face value, would indicate that this may be the case. However, as noted earlier, the kind(s) of acute stressors employed may be an important factor to consider in future studies. The use of a different type of stressor or a combination of stressors, along with a larger sample size may increase the power of the study to determine if the current results were due to a legitimate null result or Type II error.

The similar decrease in mean reaction times in each condition group may possibly be explained by practice effects from one task session to another. Practice effects are expected when utilizing repeated measures on performance assessments (Hausknecht, Halpert, Di Paolo & Moriarty-Gerrard, 2007). Future research may control for practice effects by providing participants with practice sessions prior to data collection which may curtail the practice effects. Alternatively, the addition of another group who does not receive an acute stressor but performs a non-stressful control task instead of the PASAT may also serve to tease apart the effects due to practice from those due to stress.

Future research, taking into account the previously mentioned considerations, should also aim to develop procedures such as attentional retraining which could then be integrated into problem drinking intervention and prevention programs on college campuses. Future research designs may seek to be more geared toward producing a deployable procedure or task which would be effectively in detecting and altering the attentional and other cognitive processes associated with problem drinking. These considerations would keep in line with the goal of making a positive impact upon the incidence of problem drinking upon college campuses in the U.S. and abroad.

CHAPTER VI

CONCLUSION

Social drinking is a behavior which is extremely common in adults, particularly college students (Johnston et al., 2009). Those who engage in light or moderate social drinking are often perceived as not being at risk for the development of drinking problems or alcohol abuse (Hayman, 1967; Perkins, 2002) as much of the research attention (aside from alcoholics) is focused upon binge or heavy drinkers (Ham & Hope, 2003; Johnston et al., 2009). Nevertheless, research has suggested that attentional bias for alcohol-related stimuli may exist in the light/moderate social drinking groups (Drobes, Carter & Goldman, 2009). This study examined this hypothesis in a sample of social drinking college students. As part of a larger study of collegiate social drinkers, the current study explored attentional bias to alcohol-related cues in college student social drinkers. This was done by utilizing images of alcohol or neutral objects as to-be-detected targets and mental arithmetic as a controlled acute stressor. It was hypothesized that the presentation of alcohol images should trigger intrusive thoughts, thereby facilitating attention toward alcohol-related targets, and that this would be reflected in shorter reaction times for the alcohol target images group than the object target images group. Further, it was thought that attentional biases toward alcohol images would be enhanced following the stressor.

Examination of reaction times of the two groups was that there were no significant differences between reaction times to detect object and alcohol images, providing no evidence for attentional biases specifically toward alcohol images. Furthermore, stress did not enhance attentional biases to alcohol images relative to objects. Instead, reaction times to both target types decreased from Time 1 to Time 2, an effect that may have due, at least in part, to practice effects. While salivary measures showed no increase in relation to administration of the acute stressor, STAI scores did show an increase coinciding with the administration of the PASAT. This may mean that the stressor was strong enough to elicit a measurable reaction at least in perceived anxiety but not enough to elicit a physiological response of cortisol. However, it could also mean that some other factor(s) contributed to a blunted physiological response while the PASAT elicited a stress reaction only shown through STAI scores. The STAI scores indicate that the stressor had a measurable effect which was not reflected in the cortisol data. This disparity between the two measures could be due to external factors, such as exams or relationship stress which were beyond the control of investigators, which may have affected the cortisol reactivity in participants prior to entering the study session.

The results of this study did not support the hypothesis of attentional biases to alcohol-related targets in light and moderate social drinking college students. The current study's results would suggest that light and moderate social drinkers do not display attentional bias for alcohol-related cues as opposed to neutral target objects. However, further research would be needed to investigate this concept with a larger sample of participants which may provide the power to detect more subtle differences in attentional biases to alcohol images in light and moderate social drinkers. In addition, controlling for practice effects with either familarization sessions on the oddball task or the addition of another group who does not receive the stressor between administrations of the oddball task may help to tease apart the effects of stress from practice effects. Finally, utilizing an acute stressor or combination of stressors which may elicit a greater physiological stress response may also increase the likelihood of finding group differences due to target types (alcohol vs. objects).

The possibility of recognizing cognitive processes (e.g., attentional biases) associated with problem drinking in college students would greatly contribute to alcohol abuse prevention efforts and awareness. By better understanding the role of attention and stress in social drinkers, more effective programs can be constructed to aid alcohol abuse prevention (e.g., the identification of individuals at risk for subsequent alcohol problems) and may have an impact upon programs targeting other types of addiction. College students experience a great amount of stress (Ross et al., 1999) which has been shown to greatly contribute to increased drinking behavior in college (Broman, 2005) and persists at high levels across the college years (Bewick et al., 2008). Current programs in many colleges have a focus upon binge and heavy drinkers which have shown little effect (Wechsler et al., 2002). More detailed knowledge on light and moderate drinkers may provide programs within universities and colleges with data that will not only aid in targeting at risk groups for prevention but also lay the foundation for easily implemented, computer-based screening to identify those individuals which may be most at risk for the development of an alcohol use disorder. Successful prevention through more precisely targeted programs and more sensitive screening tools would not only save students, parents and universities large financial sums from annual injuries and damages but also may provide the means to save the lives of at risk students.

REFERENCES

Agarwal, D. (2002). Cardioprotective effects of light-moderate consumption of alcohol: A review of putative mechanisms. *Alcohol and Alcoholism, 37(5),* 409-415.

Ashley, M., Ferrence, R., Room, R., Bondy, S., Rehm, J. & Single, E. (1997). Moderate drinking and health: Implications of recent evidence. *Canadian Family Physician, 43*, 687-694.

Balko, R. (2003, December 5). Back door prohibition: The new war on social drinking. *Policy Analysis, 501,* 1-28.

Barrett, K., Barman, S., Boitano, S. & Brooks, H. (2010). *Ganong's review of medical physiology* (23rd ed.). New York: McGraw-Hill.

Beck, K., Arria, A., Caldeira, K., Vincent, K., O'Grady, K. & Wish, E. (2008). Social context of drinking and alcohol problems among college students. *American Journal of Health Behavior, 32,* 420-430.

Benham, G. (2007). The shape of stress : the use of frequent sampling to measure temporal variation in S-IgA levels during acute stress. *Stress and Health, 23,* 295-301.

Berkowitz, A. & Perkins, H. (1986). Problem drinking among college students: A review of recent research. *Journal of American College Health, 35*, 21-28.

Bewick, B., Mulhern, B., Barkham, M., Trusler, K., Hill, A. & Stiles, W. (2008). Changes in undergraduate student alcohol consumption as they progress through university. *BMC Public Health, 8:163*.

Borsari, B. & Kate, C. (2001). Peer influences on college drinking: A review of the research. *Journal of Substance Abuse, 13(4)*, 391-424.

Bot, S., Engels, R., Knibbe, R. & Meeus, W. (2007). Sociometric status and social drinking: Observations of modeling and persuasion in young adult peer groups. *Journal of Abnormal Child Psychology, 35*, 929-941.

Broman, C. (2005). Stress, race and substance use in college. *College Student Journal, 39*, 340-352.

Brown, T. & Dobs, A. (2002). Endocrine effects of marijuana. *Journal of Clinical Pharmacology, 42*, 90S-96S.

Cahalan, V., Cisin, I., & Crossley, H. (1969). *American drinking practices*. New Brunswick, NJ: Rutgers Center for Alcohol Studies.

Centers for Disease Control and Prevention (2009). Behavioral Risk Factor Surveillance System: Adults who have had at least one drink of alcohol in the past 30 days. Retrieved December 13, 2010 from http://apps.nccd.cdc.gov/brfss/list.asp?cat=AC&yr=2008&qkey=4411&state=All.

Chassin, L., Pitts, S. & Prost, J. (2002). Binge drinking trajectories from adolescence to emerging adulthood in a high-risk sample: Predictors and substance abuse outcomes. *Journal of Consulting and Clinical Psychology, 70(1)*, 67-78.

Cox, W., Yeates, G. & Regan, C. (1999). Effects of alcohol cues on cognitive processing in heavy and light drinkers. *Drugs and Alcohol Dependence, 55*, 85-89.

Curran, G., Stoltenberg, S., Hill, E., Mudd, S., Blow, F. & Zucker, R. (1999). Gender differences in the relationship among SES, family history of alcohol disorders and alcohol dependence. *Journal of Studies on Alcohol, 60*, 825-832.

Dawson, D. & Grant, B. (1998). Family history of alcoholism and gender: Their combined effects on DSM-IV alcohol dependence and major depression. *Journal of Studies on Alcohol, 59(1)*, 97-106.

Delin, C. & Lee, T. (1992). Drinking and the brain: Current evidence. *Alcohol & Alcoholism, 27*, 117-126.

Department of Health and Human Services and U.S. Department of Agriculture. (2005). *Dietary Guidelines for Americans, 2005*. (6th Ed.). Washington, DC: U.S. Government Printing Office.

de Wit, H., Soderpalm, A., Nikolayev, L. & Young, E. (2003). Effects of acute social stress on alcohol consumption in healthy subjects. *Alocholism: Clinical and Experimental Research, 27*, 1270-1277.

Dickerson, S. & Kemeny, M. (2004). Acute stressors and cortisol responses: A theoretical integration and synthesis of laboratory research. *Psychological Bulletin, 130*, 355-391.

Diehr, M., Heaton, R., Miller, W. & Grant, I. (1998). The Paced Auditory Serial Addition Task (PASAT): Norms for age, education and ethnicity. *Assessment, 5*, 375-387.

Djousse, L., Lee, I., Buring, J. & Gaziano, M. (2009). Alcohol consumption and risk of cardiovascular disease and death in women. *Circulation, 120*, 237-244.

Drobes, D., Carter, A. & Goldman, M. (2009). Alcohol expectancies and reactivity to alcohol-related and affective cues. *Experimental and Clinical Psychopharmacology, 17(1)*, 1-9.

El-Guebaly, N. (2007). Investigating the association between moderate drinking and mental health. *Annals of Epidemiology Supplement, 17(5)*, S55-S62.

Fadardi, J. & Cox, W. (2006). Alcohol attentional bias: drinking salience or cognitive impairment? *Psychopharmacology, 185*, 169-178.

Fadardi, J. & Cox, W. (2008). Alcohol-attentional bias and motivational structure as independent predictors of social drinkers' alcohol consumption. *Drug and Alcohol Dependence, 97*, 247-256.

Field, M., Mogg, K. & Bradley, B. (2005). Craving and cognitive biases for alcohol cues in social drinkers. *Alcohol & Alcoholism, 40(6)*, 504-510.

Field, M. & Powell, H. (2007). Stress increases attentional bias for alcohol cues in social drinkers who drink to cope. *Alcohol & Alcoholism, 42(6)*, 560-566.

Field, M. & Cox, W. (2008). Attentional bias in addictive behaviors: A review of its development, causes, and consequences. *Drug and Alcohol Dependence, 97(1-2)*, 1-20.

Field, M., Munafo, M. & Franken, I. (2009). A meta-analytic investigation of the relationship between attentional bias and subjective craving in substance abuse. *Psychological Bulletin, 135*, 589-607.

Field, M. & Quigley, M. (2009). Mild stress increases attentional bias in social drinkers who drink to cope: A replication and extension. *Experimental and Clinical Psychopharmacology, 17(5)*, 312-319.

Frias, J., Torres, J., Miranda, M., Ruiz, E. & Ortega, E. (2002). Effects of acute alcohol intoxication on pituitary-gonadal axis hormones, pituitary-adrenal axis hormones, β-endorphin and prolactin in human adults of both sexes. *Alcohol & Alcoholism, 37(2)*, 169-173.

Grekin, E. & Sher, K. (2006). Alcohol dependence symptoms among college freshmen: Prevalence, stability and person-environment interactions. *Experimental and Clinical Psychopharmacology, 14(3)*, 329-338.

Gronwall, D. M. A. (1977). Paced auditory serial-addition task: A measure of recovery from concussion. *Perceptual Motor Skills*, *44*, 367-373.

Ham, L. & Hope, D. (2003). College students and problematic drinking: A review of the literature. *Clinical Psychology Review*, *23*, 719-759.

Harris, D., Reus, V., Wolkowitz, O., Mendelson, J. & Jones, R. (2003). Altering cortisol level does not change the pleasurable effects of methamphetamine in humans. *Neuropsychopharmacology*, *28*, 1677-1684.

Hasin, D., Paykin, A. & Endicott, J. (2001). Course of DSM-IV alcohol dependence in a community sample: Effects of parental history and binge drinking. *Alcoholism: Clinical and Experimental Research*, *25*, 411-414.

Hausknecht, J., Halpert, J., Di Paolo, N. & Moriarty-Gerrard, M. (2007). Retesting in selection: A meta-analysis of coaching and practice effects for tests of cognitive ability. *Journal of Applied Psychology, 92(2)*, 373-385.

Hayman, M. (1967). The myth of social drinking. *American Journal of Psychiatry, 124*, 585-594.

Heesch, C., Negus, B., Keffer, J., Snyder, R., Risser, R. & Eichhorn, E. (1995). Effects of cocaine on cortisol secretion in humans. *The American Journal of the Medical Sciences, 310*, 61-64.

Herrmann, M., Weijers, H., Wiesbeck, G., Boning, J. & Fallgatter, A. (2001). Alcohol cue-reactivity in heavy and light social drinkers as revealed by event-related potentials. *Alcohol & Alcoholism, 36*, 588-593.

Hingson, R., Heeren, T., Winter, M. & Wechsler, H. (2005). Magnitude of alcohol-related mortality and morbidity among U.S. college students ages 18-24: Changes from 1998-2001. *Annual Review of Public Health, 26*, 259-279.

Hingson, R., Zha, W. & Weitzman, E. (2009). Magnitude of and trends in alcohol-related mortality and morbidity among U.S. college students ages 18-24, 1998-2005. *Journal of Studies on Alcohol and Drugs Supplement, 16*, 12-20.

Hoge, E., Austin, E. & Pollack, M. (2007). Resilience: Research evidence and conceptual considerations for posttraumatic stress disorder. *Depression and Anxiety, 24*, 139-152.

Ikehara, S., Iso, H., Yamagishi, K., Yamamoto, S., Inoue, M., Tsugane, S. et al. (2009). Alcohol consumption, social support, and risk of stroke and coronary heart disease among Japanese men: the JPHC study. *Alcoholism: Clinical and Experimental Research, 33(6)*, 1025-1032.

Jennison, K. (2004). The short-term effects and unintended long-term consequences of binge drinking in college: A 10-year follow-up study. *The American Journal of Drug and Alcohol Abuse, 30*, 659-684.

Johnson, A. & Proctor, R. (2004). *Attention: Theory and Practice*. Thousand Oaks, CA: Sage Publications Inc.

Johnston, L., O'Malley, P., Bachman, J. & Schulenberg, J. (2009). *Monitoring the Future: National survey results on drug use, 1975-2008; Vol. II, College students and adults ages 19-50* (NIH Publication No. 09-7403). Bethesda, MD: National Institutes on Drug Abuse.

Jones, B., Jones, B. C., Smith, H. & Copley, N. (2003). A flicker paradigm for inducing change blindness reveals alcohol and cannabis information processing biases in social users. *Addiction, 98*, 235-244.

Kavanagh, D., Andrade, J. & May, J. (2005). Imaginary relish and exquisite torture: The elaborated intrusion theory of desire. *Psychological Review, 112*, 446-467.

Kavanagh, D., May, J. & Andrade, J. (2009). Tests of the elaborated intrusion theory of craving and desire: Features of alcohol craving during treatment for an alcohol disorder. *British Journal of Clinical Psychology, 48(3)*, 241-254.

Kirschbaum, C. & Hellhammer, D. (1989). Salivary cortisol in psychobiological research: An overview. *Neuropsychobiology, 22*, 150-169.

Kirschbaum, C., Pirke, K. & Hellhammer, D. (1993). The Trier Social Stress Test--a tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology*, *28*, 76-81.

Kirschbaum, C., Prussner, J., Stone, A., Federenko, I., Gaab, J., Lintz, D. et al. (1995). Persistent high cortisol responses to repeated psychological stress in a subpopulation of healthy men. *Psychosomatic Medicine*, *57*, 468-474.

Kirschbaum, C. & Hellhammer, D. (2000). Salivary cortisol. In G. Fink (Ed.). *Encyclopedia of Stress (Vol. 3)*. San Diego: Academic Press.

Kirschbaum, C., Kudielka, B., Gaab, J., Schommer, N. & Hellhammer, D. (1999). Impact of gender, menstrual cycle phase, and oral contraceptives on the activity of the hypothalamus-pituitary-adrenal axis. *Psychosomatic Medicine, 61*, 154-162.

Koob, G. & Le Moal, M. (1997). Drug abuse: Hedonic homeostatic dysregulation. *Science, 278*, 52-58.

Kuntsche, E., Knibbe, R., Gmel, G. & Engels, R. (2005). Why do young people drink? A review of drinking motives. *Clinical Psychology Review, 25*, 841-861.

Lewis, M. (1996). Alcohol reinforcement and neuropharmacological therapeutics. *Alcohol and Alcoholism Supplement, 31(1)*, 17-25.

Lieber, C. (2000). Hepatic, metabolic and nutritional disorders of alcoholism: From pathogenesis to therapy. *Critical Reviews in Clinical Laboratory Sciences, 37(6)*, 551-584.

Malarkey, W., Pearl, D., Demers, L., Keicolt-Glaser, J. & Glaser, R. (1995). Influence of academic stress and season on 24-hour mean concentrations of ACTH, cortisol, and β-endorphin. *Psychoneuroendocrinology, 20(5)*, 499-508.

Mathias, C., Stanford, M. & Houston, R. (2004). The physiological experience of the Paced Auditory Serial Addition Task (PASAT): does the PASAT induce autonomic arousal? *Archives of Clinical Neuropsychology, 19*, 543-554.

McCann, B., Carter, J., Vaughan, M., Raskind, M., Wilkinson, C. & Veith, R. (1993). Cardiovascular and neuroendocrine responses to extended laboratory challenge. *Psychosomatic Medicine, 55*, 497-504.

McKirnan, D. (1977). A community approach to the recognition of alcohol abuse: The drinking norms of three Montreal communities. *Canadian Journal of Behavioral Science, 9(2)*, 108-122.

Midanik, L., Chaloupka, F., Toomey, T., Fellows, J., DuFour, M., Landen, M. et al. (2004). Alcohol-attributable deaths and years of potential life lost – United States, 2001. *Morbidity and Mortality Weekly Report, 53(37)*, 866-870.

Mitchell, D., Richell, R., Leonard, A. & Blair, R. (2006). Emotion at the expense of cognition: Psychopathic individuals outperform controls on an operant response task. *Journal of Abnormal Psychology, 115*, 559-566.

Mogg, K., Bradley, B., Miles, F. & Dixon, R. (2004). Time course of attentional bias for threat scenes: Testing the vigilance-avoidance hypothesis. *Cognition and Emotion, 18*, 689-700.

Murphy, J., Hoyme, C., Colby, S. & Borsari, B. (2006). Alcohol consumption, alcohol-related problems, and quality of life among college students. *Journal of College Student Development, 47(1)*, 110-121.

Muraven, M., Collins, R. & Morsheimer, E. (2005). One too many: Predicting future alcohol consumption following heavy drinking. *Experimental and Clinical Psychopharmacology, 13(2)*, 127-136.

Nater, U., Rohleder, N., Gaab, J., Berger, S., Jud, A., Kirschbaum, C. et al. (2005). Human salivary alpha-amylase reactivity in a psychosocial stress paradigm. *International Journal of Psychophysiology, 55*, 333-342.

National Institute of Alcohol Abuse and Alcoholism. (2004). NIAAA council approves definition of binge drinking. *NIAAA Newsletter*, 3:3.

National Institute on Alcohol Abuse and Alcoholism (2007). *What colleges need to know now: An update on college drinking research.* NIH Publication No. 07-5010.

Ng, V., Koh, D., Mok, B., Chia, S. & Lim, L. (2003). Salivary biomarkers associated with academic assessment stress among dental undergraduates. *Journal of Dental Education, 67(10)*, 1091-1094.

Noel, X., Colmant, M., van der Linden, M., Bechara, A. Bullens, Q., Hanak, C. et al. (2006). Time course of attention for alcohol cues in abstinent alcoholic patients: The role of initial orienting. *Alcoholism: Clinical and Experimental Research, 30(11)*, 1871-1877.

O'Hare, T. & Sherrer, M. (2000). Co-occurring stress and substance abuse in college first offenders. *Journal of Human Behavior in the Social Environment, 3(1)*, 29-44.

O'Hare, T. & Sherrer, M. (2006). Stress, recent changes in alcohol consumption level, and problem drinking in freshman first offenders. *Journal of Human Behavior in the Social Environment, 13(3)*, 33-50.

Paradis, C., Demers, A., Picard, E. & Graham, K. (2009). The importance of drinking frequency in evaluating individuals' drinking patterns: implications for the development of national drinking guidelines. *Addiction, 104(7)*, 1179-1184.

Park, C., Armeli, S. & Tennen, H. (2004). The daily stress and coping process and alcohol use among college students. *Journal of Studies on Alcohol, 65*, 126-135.

Parsons, O. (1986). Cognitive functioning in sober social drinkers: A review and critique. *Journal of Studies on Alcohol, 47(2)*, 101-114.

Parsons, O. & Nixon, S. (1998). Cognitive functioning in sober social drinkers: A review of the research since 1986. *Journal of Studies on Alcohol, 59*, 180-190.

Perkins, H. (2002). Social norms and the prevention of alcohol misuse in collegiate contexts. *Journal of the Studies on Alcohol Supplement, 14*, 164-172.

Pletcher, M., Varosy, P., Kiefe, C., Lewis, C., Sidney, S. & Hulley, S. (2005). Alcohol consumption, binge drinking, and early coronary calcification: Findings from the Coronary Artery Risk Development in Young Adults (CARDIA) study. *American Journal of Epidemiology, 161(5),* 423-433.

Robson, P. (1989). Psychological profile of social drinkers. *British Journal of Addiction, 84*, 1329-1336.

Rodriguez-Holguin, S., Porjesz, B., Chorlian, D., Polich, J. & Begleiter, H. (1999). Visual P3a in male subjects at high risk for alcoholism. *Biological Psychiatry, 46,* 281-291.

Ross, S., Niebling, B. & Heckert, T. (1999). Sources of stress among college students. *College Student Journal, 33(2),* 312-317.

Sayette, M. (1999). Does drinking reduce stress? *Alcohol Research & Health, 23(4),* 250-255.

Scholte, R., Poelen, E., Willemsen, G., Boomsma, D. & Engels, R. (2008). Relative risks of adolescent and young adult alcohol use: The role of drinking fathers, mothers, siblings and friends. *Addictive Behaviors, 33*, 1-14.

Segrist, D. & Pettibone, J. (2009). Where's the bar? Perceptions of heavy and problem drinking among college students. *Journal of Alcohol & Drug Education*, *53(1),* 35-53.

Sharma, D., Albery, I. & Cook, C. (2001). Selective attentional bias to alcohol related stimuli in problem drinkers and non-problem drinkers. *Addiction, 96*, 285-295.

Sinha, R. & O'Malley, S. (1999). Craving for alcohol: Findings from the clinic and the laboratory. *Alcohol & Alcoholism*, *34*, 223-230.

Sinha, R. (2001). How does stress increase risk of drug abuse and relapse? *Psychopharmacology*, *158*, 343-359.

Slutske, W. (2005). Alcohol use disorders among U.S. college students and their non-college-attending peers. *Archives of General Psychiatry*, *62*, 321-327.

Smyth, J., Ockenfels, M., Porter, L., Kirschbaum, C., Hellhammer, D. & Stone, A. (1998). Stressors and mood measured on a momentary basis are associated with salivary cortisol secretion. *Psychoneuroendocrinology, 23(4)*, 353-370.

Spear, L. (2002). The adolescent brain and the college drinker: Biological basis of propensity to use and misuse alcohol. *Journal of Studies on Alcohol Supplement, 14*, 71-81.

Steele, C., Southwick, L. & Pagano, R. (1986). Drinking your troubles away: The role of activity in mediating alcohol's reduction of psychological stress. *Journal of Abnormal Psychology, 95(2)*, 173-180.

Steele, C. & Josephs, R. (1988). Drinking your troubles away II: An attention-allocation model of alcohol's effect on psychological stress. *Journal of Abnormal Psychology, 97(2)*, 196-205.

Stewart, S., Peterson, J. & Pihl, R. (1995). Anxiety sensitivity and self-reported alcohol consumption rates in university women. *Journal of Anxiety Disorders, 9(4)*, 283-292.

Stewart, S., Morris, E., Mellings, T. & Komar, J. (2006). Relations of social anxiety variables to drinking motives, drinking quantity and frequency, and alcohol-related problems in undergraduates. *Journal of Mental Health, 15(6)*, 671-682.

Stormark, K., Laberg, J., Nordby, H., & Hugdahl, K. (2000). Acoholics' selective attention to alcohol stimuli: Automated processing? *Journal of Studies on Alcohol and Drugs, 61(1)*, 18-23.

Townshend, J. & Duka, T. (2001). Attentional bias associated with alcohol cues: differences between heavy and occasional social drinkers. *Psychopharmacology, 157*, 67-74.

Tuyns, A. (1990). Alcohol and cancer. *Proceedings of the Nutrition Society, 49*, 145-151.

Van Oers, J., Bongers, I., Van de Goor, L. & Garretsen, H. (1999). Alcohol consumption, alcohol-related problems, problem drinking, and socioeconomic status. *Alcohol and Alcoholism, 34(1)*, 78-88.

Vedhara, K., Miles, J., Bennett, P., Plummer, S., Tallon, D., Brooks, E. et al. (2003). An investigation into the relationship between salivary cortisol, stress, anxiety and depression. *Biological Psychology, 62*, 89-96.

Wechsler, H., Davenport, A., Dowdall, G., Moeykens, B. & Castillo, S. (1994). Health and behavioral consequences of binge drinking in college. *Journal of the American Medical Association, 272*, 1672-1677.

Wechsler, H., Lee, J. Kuo, M. & Lee, H. (2000). College binge drinking in the 1990s: A continuing problem. *Journal of American College Health, 48*, 199-210.

Wechsler, H., Lee, J., Kuo, M., Seibring, M., Nelson, T. & Lee, H. (2002). Trends in college binge drinkin during a period of increased prevention efforts. Findings from 4 Harvard school of public health college alcohol study surveys: 1993-2001. *Journal of American College Health*, *50*, 203-217.

Williams, J., Mathews, A. & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin*, *120*, 3-24.

VITA

Cory R. Overby was born at Camp LeJeune, North Carolina on September 24, 1975, the son of Robert Edward Overby and Stephanie Lynn Overby. Cory's family settled in Cuero, Texas where he eventually graduated from Cuero High School. After graduation he attended Victoria College to study art and design. After a year of studies Cory enlisted in the U.S. Navy and served as a photolithographer. He received an honorable medical discharge for a service connected disability in March of 2000. After his time in the Navy, he returned to college and graduated from the University of Houston-Victoria in 2006 with a Bachelor of Science in Psychology. In August 2007, Cory enrolled in graduate studies at Texas State University-San Marcos to pursue his degree in Health Psychology.

Permanent Address: 1402 N. Clinton St.

Cuero, Texas 77954

This thesis was typed by Cory R. Overby.