

A COMPREHENSIVE REVIEW AND MULTI-METHOD EXAMINATION OF THE
RELATIONSHIP BETWEEN SOCIAL ANXIETY AND ALCOHOL USE

by

Susan Reed Battista

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ABSTRACT

Epidemiological studies show that those with high social anxiety are at increased risk of having alcohol use problems. This risk appears especially high in socially anxious women. Researchers have long sought to understand this relationship, but findings are often inconsistent and point towards the need for novel methodologies to more comprehensively study how alcohol affects social anxiety. The current dissertation begins with a comprehensive review paper outlining the prominent theories in this area and reviews experimental studies examining links between alcohol intake and social anxiety. Next, for Studies 1 and 2, socially anxious participants were randomly assigned to consume alcohol or control beverages and then completed a standardized social interaction with a confederate. In Study 1, videos of the social interactions were coded for participant safety behaviors (i.e., eye contact, time speaking, latency to respond to questions, and nervous laughter). Those who consumed alcohol spent more time speaking during the interaction, and experienced a lesser increase in state social anxiety, than those who did not consume alcohol. In Study 2, participants completed measures of post-event processing (i.e., dwelling on events after they happen) a few days after completing the social interaction. Women who consumed alcohol had decreased levels of post-event processing compared to women who had not consumed alcohol, whereas men who consumed alcohol had higher levels of post-event processing than men who consumed control beverages. Finally, in Study 3, participants used palm pilots for 22 days to track their state social anxiety through the afternoon and evening, while also recording their alcohol use. Multi-level modeling showed that for every alcoholic beverage consumed, subsequent state social anxiety decreased by approximately 4%. Taken together, these findings support the idea that socially anxious individuals experience negative reinforcement from drinking as it alleviates symptoms of social anxiety and reduces the use of safety behaviors, which may maintain social anxiety. However, socially anxious women may experience additional negative reinforcement from drinking due to its effect on the social anxiety-maintaining cognitive process of post-event processing. Results have implications for improving treatment programs for those who use alcohol as a means of coping with social anxiety.

LIST OF ABBREVIATIONS USED

AAS	Audience Anxiousness Scale
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
AS	Anxiety Sensitivity
BAC	Blood Alcohol Concentration
DQ	Demographic Questionnaire
DDQ	Daily Drinking Questionnaire
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition
EMA	Ecological Momentary Assessment
ICC	Intraclass Correlation
MANOVA	Multivariate Analysis of Variance
NIAAA	National Institute of Alcohol Abuse and Alcoholism
PEP	Post-event Processing
RAPI	Rutger's Alcohol Problem Index
SA	Social Anxiety
SIAS	Social Interaction Anxiety Scale
SPS	Social Phobia Scale
SPSBS	Social Phobia Safety Behavior Scale
SRD	Stress Response Dampening
STAI	State-Trait Anxiety Inventory
SUDS	Subjective Units of Distress Scale
VAS	Visual Analogue Scale

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CHAPTER 1: INTRODUCTION

Social anxiety describes a specific type of anxiety that is experienced in situations that involve interacting with, being observed by or performing in front of other people. It entails a fear of acting in a way that would lead to feelings of embarrassment and/or humiliation. Clinically, social anxiety disorder (previously known as social phobia) is diagnosed when the fear/anxiety is out of proportion to actual threat posed by the situation, and the person often attempts to avoid situations that provoke such feelings or endures them with great distress. Further, the anxiety causes a marked impairment in everyday functioning (e.g., difficulties in relationships, at work, etc.) and lasts more than six months (Diagnostic and Statistical Manual of Mental Disorders-5th Edition; American Psychiatric Association, 2013)

The lifetime prevalence of social anxiety disorder in North America is estimated to be approximately 12.1 % (Kessler et al., 2005), while the 12-month prevalence has been found to range from 2.8% (Grant et al., 2005) to as high as 7.2% (Stein, Torgurd, & Walker, 2000). When considering non-clinical samples, as many as 61% of individuals report experiencing significant social anxiety even if the full criteria for social anxiety disorder is not met (e.g., Stein, Walker & Forde, 1994). More specifically, when examining university students, a study by Izgic, Akyuz, Dogan, and Kugu, (2004) found that 7.9% of students met full criteria for social anxiety disorder in the past year.

Social anxiety symptoms typically begin during childhood or adolescence (e.g., Kessler et al., 2005; Wittchen & Fehm, 2003) and although some experience improvements without treatment, most continue to have symptoms into adulthood (e.g., Beesdo-Baum et al., 2012). The impairments caused by social anxiety include decreased

work productivity, social and romantic relationship problems, and overall poorer quality of life (see Kessler, 2003 for a review). Moreover, social anxiety disorder frequently co-occurs with other anxiety, mood and substance use disorders and in most cases, it precedes the onset of the secondary disorder. For example, it has been prospectively linked to the development of depression (Stein et al., 2001), heavy smoking (Sonntag, Wittchen, Höfler, Kessler, & Stein, 2000), and both alcohol abuse and dependence (Crum & Pratt, 2001).

Drinking in student populations has been an ongoing concern with approximately 87% of Canadian students reporting using alcohol in the past year and 92% indicating they had used it in their life (Kuo et al., 2002). Drinking has been linked to a number of adverse consequences in students, including impaired driving, physical and verbal fights, risky sexual behavior, physical illness and interpersonal problems (e.g. Cooper 2002; Perkins, 2004; Wechsler, Moeykens, Davenport, Castillo, & Hansen, 1995). Although a number of researchers have focused on linking the *amount* that students drink to adverse consequences, there is evidence that alcohol amount may not be prospectively linked to future difficulties (e.g. overall wellbeing), but rather, it may be specifically those who experience *problems* from their alcohol use that go on to experience further difficulties (Molnar, Buressi, Perrier, & Sadava, 2009). Findings of this nature suggest that alcohol use and alcohol-related problems are not perfectly related and that there may be different etiological pathways that lead to alcohol use and/or to alcohol-related problems/consequences (e.g., Neal & Carey, 2007). One such pathway includes looking at social anxiety as a risk factor for the development of alcohol-related problems.

Research indicates that individuals with social anxiety disorder are about 2.3 times more likely to develop alcohol abuse or dependence than those without social anxiety disorder (Crum & Pratt, 2001). Moreover, it is estimated that up to 30% of cases of substance dependence could be prevented if symptoms of social anxiety were treated early on (Kessler et al., 1997). However, when considering non-clinical populations, the connection between social anxiety and alcohol use is less clear. In student samples, there are inconsistencies regarding the direction of the relationship between social anxiety and alcohol use. Some studies indicate a positive relationship (e.g., Neighbors et al., 2007), while others have found a negative relationship (e.g., Lewis et al., 2008; Stewart, Morris, Mellings, & Komar, 2006) or no relationship (e.g., Gilles, Turk, & Fresco, 2006). On the other hand, when examining drinking *problems* rather than alcohol amount, research consistently shows a positive association between social anxiety and alcohol-related problems in student samples (e.g., Buckner, Schmidt & Eggleston, 2006; Lewis & O'Neill, 2000; Stewart et al., 2006). In sum, there is converging evidence that social anxiety may lead to problematic drinking in both clinical and student samples (see Morris, Stewart, & Ham, 2005, for a review).

Given findings of this nature, a number of theories have been proposed to help explain this connection. Detailed descriptions of the Tension Reduction Theory (Conger, 1951), Self-Medication Hypothesis (Khantzian, 1985), and Stress-Response Dampening Model (Sher & Levenson, 1982) are provided in Chapter 2. At the crux of each of these theories is the idea that alcohol reduces state social anxiety, thereby providing negative reinforcement that encourages drinking in future situations that elicit state social anxiety. This particular type of drinking (i.e., as a means of coping with negative emotions -- in

this case, state social anxiety) may be especially persistent and difficult to treat (Marlatt & Gordon, 1985). Hence, empirical research in this area has been abundant using a variety of cross-sectional, longitudinal, and experimental designs. However, the majority of these studies looked at how alcohol affected self-reports or physiological (e.g., heart rate) measures of social anxiety, which may not capture other important factors that contribute to or maintain the experience of social anxiety.

Social anxiety is commonly conceptualized using cognitive-behavioral models, which outline a number of core components that are theorized to maintain social anxiety (Clark & Wells, 1995; Hofmann, 2007; Rapee & Heimberg, 1997). Those with social anxiety tend to hold a number of maladaptive beliefs about themselves, including that they have poor social skills and will be unable to meet their own social expectations; that they have little control over their emotions and how they will behave in social situations; and that they will be judged negatively or rejected by others. When confronted with a social situation, those with social anxiety tend to become very self-focused, carefully monitoring their own thoughts and behaviours. Further, they may avoid social situations all together or engage in safety behaviours, which are defined as strategies intended to hide or reduce anxiety. Finally, individuals with social anxiety are likely to engage in anticipatory and/or post-event processing. Anticipatory processing involves thinking about and/or worrying about an upcoming event and what may happen in that situation. Post-event processing occurs after an event and involves dwelling on thoughts and feelings related to what happened during the event. Below, the main components are described in more detail, including a brief summary of any theoretical models and/or past

research that has shed light on how alcohol may affect each component and contribute to our understanding of the social anxiety and alcohol link.

Those with high levels of social anxiety tend to hold more negative beliefs about their social abilities than those with lower levels of social anxiety (e.g., Alden & Wallace, 1995). Further, when in social situations, individuals with high social anxiety tend to bias their attention inward and focus on monitoring their own thoughts and actions (see Heinrichs & Hofmann, 2001, for a review). This self-focused attention is problematic because it interferes with attending to other aspects of the situation (e.g., information and social cues from other people). Indeed, it was found that those with higher levels of social anxiety recalled less information about their interaction partners after a standard social interaction than individuals with lower levels of social anxiety (Hope, Heimberg, & Klein, 1990).

A number of studies have examined how alcohol affects one's attention in a social situation. According to Steele and Josephs' (1988) Attention Allocation Model, alcohol limits the ability to process information, which results in attending to the most salient cues in the environment (a phenomenon also known as alcohol myopia). Similarly, Hull's (1981) Self-Awareness Model postulates that alcohol interferes specifically with the processing of self-relevant information. When applied to social anxiety, these theories predict that alcohol may reduce self-focused attention (the Attention Allocation Model) and negative biases about the self (the Self-awareness Model), both of which have been found to maintain social anxiety.

As will be described more fully in Chapter 2, there have been a few experimental studies demonstrating that when participants were given a distraction task after

consuming alcohol, they reported less state social anxiety in response to a social stressor compared to participants who were not given a distraction task (Josephs & Steele, 1990; Steele & Josephs, 1988). There is also evidence that relative to objective ratings, participants rated their performance during a social interaction as more positive when they consumed alcohol, indicating that alcohol may impair self-awareness (e.g., Keane & Lisman, 1980). Finally, there is some, albeit limited, evidence that changes in attention may partially mediate decreases in state social anxiety due to alcohol (Sher, Bartholow, Peuser, Erickson, & Wood, 2007). Taken together, when considering two components of cognitive-behavioral models of social anxiety-- negative beliefs about the self and self-focused attention-- there is some support that alcohol may reduce state social anxiety by shifting one's attention away from the self and reducing negative evaluations of the self.

Another component outlined in cognitive-behavioral models of social anxiety is anticipatory processing, which is described as a cognitive process experienced before an event takes place. It involves thinking about what will happen during the event, and is often biased towards recollections of past social failure, which leads to predictions of upcoming social failure and increased social anxiety (Mellings & Alden, 2000). For example, it has been found that when participants were anticipating an upcoming speech task, they reported more anxiety and predicted they would perform worse when instructed to engage in anticipatory processing, compared to a group of participants who were given a distraction task (Vassilopoulos, 2005).

When considering how alcohol may affect anticipatory processing, Sayette's (1993a) Appraisal Disruption Model may be particularly relevant. This model states that alcohol interferes with the initial appraisal of a situation as threatening and predicts that

state social anxiety will only be reduced if one has consumed alcohol *prior* to encountering and assessing a social situation. Hence, alcohol may interfere with anticipatory processing and lead to less state social anxiety before and during an event. In studies that have manipulated the timing of alcohol consumption relative to learning about an upcoming social stressor, greater social anxiety reduction has been found when participants learn about the social stressor *after* having consumed alcohol compared to *before* (e.g., Sayette, Martin, Peffott, Wertz, & Huffor, 2001; Sayette & Wilson, 1989). Although the consumption of alcohol may interfere with the initial appraisal of situation, it is unknown whether this interference is specific to anticipatory processing and social anxiety relevant information.

Similar to anticipatory processing, another component theorized to maintain social anxiety is post-event processing. This is described as a “postmortem” of an event after it happened that involves dwelling on perceived inadequacies (Clark & Wells, 1995). A detailed review of studies that have examined the relationship between social anxiety and post-event processing can be found in Chapter 6. In short, there are numerous studies showing that individuals with higher trait social anxiety engage in greater levels of post-event processing than those lower in trait social anxiety (e.g., Kocovski, Endler, Rector, & Flett, 2005). Previous research to date, however, has not specifically examined how alcohol may affect this process. Hence, the study described in Chapter 6 presents a novel research area, specifically exploring how alcohol affects post-event processing and providing further understanding of the link between social anxiety and alcohol problems.

Another component outlined in cognitive-behavioral models of social anxiety is safety behaviors, which are defined as strategies that are intended to control or hide social

anxiety (e.g., avoiding eye contact; Wells et al., 1995). Research shows that individuals with social anxiety are more likely to engage in these types of behaviours and believe that these behaviours reduce their social anxiety (McManus, Sacadura, & Clark, 2008) compared to individuals low in social anxiety. However, findings show that reducing the use of safety behaviours (an exercise often done in treatment) actually reduces social anxiety (Salkovskis, 1991). There have been some investigations examining how alcohol affects some specific safety behaviors. For example, one study found that men who consumed a moderate dose of alcohol were more open (i.e., disclosed more information to their partner) during a social interaction than those who consumed a high dose of alcohol or no alcohol (Caudill, Wilson, & Abrams, 1987; Experiment One). However, Study 2 presented in Chapter 4 was the first to specifically examine the effect of alcohol on safety behaviours in a sample of socially anxious individuals.

As demonstrated above, the relationship between social anxiety and alcohol use is neither simplistic nor straightforward. Although research in this area is prolific, clear and consistent conclusions are sparse. Hence, Chapter 2 provides a detailed review of experimental research that has specifically looked at the link between social anxiety and alcohol. One limitation in this field is the tendency to focus solely on symptoms of social anxiety, rather than the various factors that have been found to maintain it. There is a great deal of research to support cognitive-behavioral models of social anxiety, which outline a number of components (e.g., negative self-evaluations, self-focused attention, anticipatory and post-event processing and safety behaviours) that contribute to social anxiety (Clark & Wells, 1995; Hofmann, 1997; Rapee & Heimberg, 1997). Studies examining how alcohol influences each of these components are limited, especially when

considering post-event processing and safety behaviours. Therefore, I chose to focus on these specific variables of interest and conducted an experimental study that looked at the effect of alcohol on both safety behaviours (Study 1; Chapter 4) and post-event processing (Study 2; Chapter 6).

Another limitation in this area of research is the types of methodologies that are used to investigate the link between social anxiety and alcohol. Although cross-sectional methods have consistently identified a positive relationship between social anxiety and alcohol problems (e.g., Schneier et al., 2010), these studies do not provide information on causality. In order to look at how or why social anxiety and alcohol problems are linked, experimental methods are necessary. However, these studies are limited as well in that they sacrifice a degree of external validity in order to achieve maximum experimental control. This involves the administration of a standard type and dose of alcohol, strict instructions on how quickly drinks must be consumed, and a staged task designed to elicit anxiety (e.g., giving a speech or engaging in a social interaction with a confederate). Although these experimental studies are extremely informative in isolating causal factors and controlling for possible confounding variables, it is necessary to determine if findings extend to real-world settings.

The use of experience sampling methods is becoming increasingly common and is a useful way to examine behaviours as they occur in real life (Affleck, Zautra, Tennen, & Armeli, 1999). These methods use an idiographic approach, which looks for relations among variables within a given individual across a variety of situations or over a certain time period. They can also be used to determine if patterns found within individuals generalize across individuals or relate to between-subject variables. Although some

studies have used daily process methods to examine the relationship between various mood states and drinking (e.g., Grant, Stewart, & Mohr, 2009), none have looked specifically at how drinking affects social anxiety. Hence, Study 3 described in Chapter 8 had participants track their daily drinking and state social anxiety for 22 days using a palm pilot to determine if relationships found in the lab extended to a real world setting.

In sum, the overriding goal of this dissertation was to provide a comprehensive review of previous research that has examined the effect of alcohol on social anxiety and to advance our knowledge by conducting a series of empirical studies exploring this relationship using various methodologies. The dissertation is composed of nine chapters. Chapter 2 provides a review of experimental studies that have examined social anxiety and alcohol use in a lab-based setting. It provides an overview of theoretical models connecting social anxiety and alcohol, a summary of current findings in this area and suggests limitations and directions for further study. Then, Chapter 4 presents an experimental study (Study 1) that was conducted to look at the effects of alcohol on safety behaviours in a sample of socially anxious students. In Chapter 6, (Study 2), I examined how alcohol affected post-event processing of a social interaction (i.e., dwelling on an event after it happened) in the same sample of socially anxious university students used in Study 1. Chapter 8 describes another study (Study 3) that extended the lab-based findings into a real world setting where participants used palm pilots to indicate their levels of social anxiety and drinking in real time, over a 22-day period. Finally, Chapter 9 provides an overall summary of the findings for each study, conclusions and future directions.

CHAPTER 2: A CRITICAL REVIEW OF LABORATORY-BASED STUDIES EXAMINING THE RELATIONSHIPS OF SOCIAL ANXIETY AND ALCOHOL INTAKE¹

Abstract

Research has revealed inconsistencies regarding the relationship between social anxiety and alcohol use. The goal of the current review is to examine lab-based studies that have been conducted in an attempt to help disentangle the social anxiety – alcohol link. Specifically, this review focuses on the most prominent theories present in this area of research, namely, the Tension Reduction Theory, the Stress-Response Dampening Model, the Self-Awareness Model, the Attention Allocation Model, and the Appraisal-Disruption Model. The review then describes the empirical studies that have been conducted to test predictions derived from each of these theories. This is followed by a discussion of some methodological considerations in this area of research, including an examination of participant characteristics, study selection criteria, alcohol administration procedures, the nature of the anxiety-inducing tasks that have been used in this area of research, and the different types of outcome measures that are typically used to measure social anxiety. The review ends with some tentative conclusions and directions for future research, including recommendations to recruit individuals with high levels of trait social anxiety, to closely monitor blood alcohol levels achieved at different time points during the study, to examine more interaction-based social anxiety provoking tasks, and to employ a wider range of outcome measures (e.g., cognitive and behavioural outcomes relevant to social anxiety).

2.1 INTRODUCTION

¹ Adapted from Battista, S.R., Stewart, S.H., & Ham, L.S. (2010). A critical review of laboratory-based studies examining the relations of social anxiety and alcohol intake. *Current Drug Abuse Reviews*, 3, 3-22. Copyright (2010) with permission from Betham Science Publishers. As first author of this review paper, I conducted the literature search and wrote the manuscript with suggestions and input from my coauthors, peer reviewers, and the journal editor.

Disentangling the relationship between social anxiety and alcohol use and misuse is no small feat. Indeed, this issue has daunted many researchers since the late 1970s. According to epidemiological studies, it is well established that individuals with a diagnosis of social anxiety disorder (previously known as social phobia) have a much greater likelihood of having an alcohol use disorder than individuals without a diagnosis of social anxiety disorder (e.g., Grant et al., 2004; Himle & Hill, 1991; Kessler, et al., 1997; Ross, 1995). Moreover, individuals with co-occurring social anxiety disorder and alcohol use disorders experience more severe problems and have a poorer prognosis than individuals who have social anxiety disorder in the absence of an alcohol use disorder or vice versa (Brady & Lydiard, 1993). There is also evidence to show that the onset of social anxiety disorder typically precedes the onset of alcohol use disorders (e.g., Falk, Yi, & Hilton, 2008), suggesting that those with social anxiety disorder may use alcohol as a coping strategy for dealing with their anxiety symptoms, ultimately leading to a pattern of problematic alcohol use behaviors.

This association, however, is less clear when examining non-clinical samples that often consist of university students. Research to date on this issue in university students has revealed inconsistent findings regarding the direction of the relationship between social anxiety and alcohol use. Similar to epidemiological findings on the co-occurrence of diagnoses, some studies indicate a positive relationship between social anxiety and alcohol use or alcohol-related problems (e.g., Buckner, et al., 2006; Kushner & Sher, 1993; Lewis & O'Neill, 2000; Neighbors et al., 2007). On the other hand, many researchers have found an inverse relationship between social anxiety and alcohol use, pointing towards social anxiety as a protective factor against alcohol use (Eggleston,

Woolaway-Bickel, & Schmidt, 2004; Ham, Bonin, & Hope, 2007; Ham & Hope, 2005; Holle, Heimberg, Sweet, & Holt, 1995; Lewis et al., 2008; Myers, Aarons, Tomlinson, & Stein, 2003; Stewart et al., 2006), while others have found no association between these two variables (e.g., Bruch, Heimberg, Harvey, McCann, & Slavkin, 1992; Bruch, Rivet, Heimberg, & Levin, 1997; Buckner et al., 2006; Gilles et al., 2006; Ham, Hope, White, & Rivers, 2002; Lewis et al., 2008; Thomas, Thevos, & Randall, 1999).

The majority of studies in this area have used epidemiological surveys and self-report questionnaires to investigate the association between social anxiety and alcohol use. Although important and informative, such designs are limited in that they fail to identify potential causal mechanisms that may underlie the relationship between social anxiety and alcohol. Hence, the use of laboratory-based, experimental methods is fundamental to enhancing our understanding of how alcohol affects social anxiety and how social anxiety affects alcohol use behaviors.

Although a number of researchers have examined the relations between other anxiety disorders (e.g., panic disorder, generalized anxiety disorders) and alcohol use disorders (see Stewart & Conrod, 2008), the goal of this review is to examine specifically at the social anxiety – alcohol relationship. The link between social anxiety and alcohol use is of particular interest for a number of reasons. First, alcohol use disorders are the most common substance use disorder and social anxiety disorder is the second most common anxiety disorder next to specific phobia, making this form of co-morbidity a problem for a substantial proportion of the population (Kessler et al., 2005). Second, as stated earlier, among those with social anxiety disorder, alcohol use disorders may be particularly prevalent [e.g., Grant et al. (2005) found that 48% of those with lifetime

social anxiety disorder also had a lifetime alcohol use disorder diagnosis]. Finally, the onset of social anxiety disorder consistently precedes an alcohol use disorder diagnosis in the majority of cases at much higher proportions than other anxiety-alcohol use disorder combinations (e.g., Falk, Yi, & Hilton, 2008). Though temporal ordering alone does not establish causation, the finding that social anxiety disorder tends to precede an alcohol use disorder diagnosis is consistent with the theoretical explanations discussed in this dissertation, which propose that alcohol is used as a maladaptive means of coping with social anxiety. It should be noted that a number of researchers (e.g., Carrigan & Randall, 2003; Morris et al., 2005) have provided comprehensive reviews of the literature on social anxiety and alcohol use. However, none to date have focused specifically on experimental studies that have investigated this relationship. Further, the reviews to date have not systematically explored the numerous theories that have been proposed to explain social anxiety and alcohol use and how findings from experimental studies relate to the predictions made by such theories.

Therefore, the goal of the current paper is to review studies that have tested the effects of alcohol on state social anxiety, or vice versa (i.e., the effects of state social anxiety on alcohol intake), using a variety of laboratory-based paradigms. Although there are a number of lab-based studies that have examined the effects of alcohol on stress or general anxiety, I have only reviewed studies in which participants engaged in tasks that were explicitly designed to induce *social* anxiety or that could reasonably be considered social anxiety relevant (as opposed to those designed to induce other specific types of stress or more general anxiety). This resulted in exclusion of studies that used a cold pressor task (e.g., Brown & Cutter, 1977), exposure to a specific feared stimuli (e.g.,

snakes) unrelated to social anxiety (e.g., Rimm, Briddell, Zimmerman & Caddy, 1981; Thyer & Curtis, 1984), exposure to white noise (e.g., Stewart & Pihl, 1994), and threat of or exposure to shock (e.g., Dengerink & Fagan, 1978; Ewing & McCarty, 1983; Higgins & Marlatt, 1973; Polivy, Schueneman & Carlson, 1976; Sutker, Allain, Brantley, & Randall, 1982).

Furthermore, the studies covered in the present review include those designed to test the effects of alcohol on state social anxiety, whether those alcohol effects be pharmacologically- and/or cognitively-mediated. In addition to having a variety of pharmacological effects on the human body, alcohol can also produce effects that are largely due to the drinker's expectations of what alcohol should do (e.g., Marlatt & Rohsenow, 1980). These effects are often referred to as "expectancy effects" or "placebo effects". Expectancies are the cognitive pathway that can explain why exposure to alcohol cues leads to the learned tension reduction effects of alcohol in socially anxious individuals. Based on findings supporting the importance of expectancy effects (e.g., Wilson & Abrams, 1977), alcohol researchers have often employed study designs that allow for the comparison of the pharmacological versus the expectancy effects of alcohol; this study design compares those randomly assigned to an alcohol condition to those randomized to a placebo control condition. An even more comprehensive design used is called the balanced placebo study (Marlatt & Rohsenow, 1980) which consists of four cells of participants: (a) those who are led to believe they have received alcohol and in fact, they have (i.e., alcohol), (b) those who are led to believe they have received alcohol when in fact, they have not (i.e., placebo), (c) those who are led to believe they have not received alcohol when in fact, they have (i.e., anti-placebo or inverse placebo) and (d)

those who are led to believe that they have not received alcohol and in fact, they have not (i.e., control). Some researchers have eliminated the use of the anti-placebo group due to findings indicating that, at least at higher blood alcohol levels, it is extremely difficult to effectively convince participants who have received alcohol that they have not received alcohol (Levenson, Oyama, & Meek, 1987; Sayette, Breslin, Wilson, & Rosenblum, 1994a). It should be noted, however, that in most studies, participants who are told that they received alcohol, when in fact, they did not (i.e., the placebo group) usually believe that they have consumed alcohol, although they typically report lower levels of subjective intoxication than the alcohol group (e.g., Abrams, Kushner, Medina & Voight, 2001). In the current review, I have included studies examining the pharmacological effects of alcohol (i.e., studies that involved alcohol administration), examining the expectancy effects of alcohol (i.e., studies that involved placebo administration), and/or using research designs to distinguish between pharmacological and expectancy effects.

The review begins by outlining the theoretical foundations on which the connection between social anxiety and alcohol use is thought to rest. Specifically, Tension Reduction Theory (Conger, 1951), the Stress-Response Dampening Model (Sher & Levenson, 1982), the Self-Awareness Model (Hull, 1981), the Attention Allocation Model (Steele & Josephs, 1988), and the Appraisal-Disruption Model (Sayette, 1993a) will each be discussed. Second, a summary of the empirical research findings of lab-based studies in this area is presented, organized into sections according to which underlying theory is being tested. Then, methodological considerations and limitations that are present in this area of research are outlined. This includes a discussion of participant characteristics, study selection criteria, alcohol administration procedures, the

nature of the anxiety-inducing task, and the outcome measures that are typically used in this area of research. Finally, with these methodological considerations in mind, tentative conclusions and future research directions are discussed.

2.2 RELEVANT THEORETICAL FRAMEWORKS

Lab-based research examining the effects of alcohol on anxiety originated with animal studies that largely used rats as subjects (e.g., Baum, 1969; Freed, 1968; Scarborough, 1957). A review of the animal literature exploring the connections between anxiety and alcohol is beyond the scope of this review (see Cappell & Herman, 1972). It is nonetheless important to consider that the theoretical rationale connecting anxiety and alcohol was rooted in animal research, and that this topic continues to be explored using animal models. Conger (1951) proposed the Tension Reduction Theory after finding that rats exhibited less avoidance behaviour when they were intoxicated, implying that they were less fearful or anxious after consuming alcohol. This theory has since been widely used to help explain how alcohol use is maintained in humans; specifically, that alcohol acts as a negative reinforcer by reducing the drinker's anxiety or tension. According to the tenets of Tension Reduction Theory, two related hypotheses should be supported when the Tension Reduction Theory is applied to explaining the relationship between alcohol and *social* anxiety: (a) individuals should experience state social anxiety reduction when they drink, and (b) individuals should learn to drink for these state social anxiety reduction effects. Both of these hypotheses have been empirically tested using lab-based studies with humans.

Methods to investigate the first hypothesis typically involve consumption of a specified alcohol dose or control beverage followed by a state social anxiety induction

procedure (e.g., giving a self-disclosing speech or going through a social interaction with a confederate), to examine alcohol's effects on state social anxiety levels using physiological, behavioral, and/or subjective measures (e.g., Abrams, et al., 2001; Abrams & Wilson, 1979; Himle et al., 1999; Sayette, Smith, Breiner, & Wilson, 1992; Wilson & Abrams, 1977). In order to test the second hypothesis, participants are informed that they will be required to engage in a task designed to elicit state social anxiety (e.g., giving a self-disclosing speech or talking with a confederate) and then are offered the opportunity to consume alcohol, to determine whether they are motivated to consume alcohol for its state social anxiety reduction effects (e.g., Abrams, Kushner, Medina, & Voight, 2002; deWit, Söderpalm, Nikolayev, & Young, 2003; McNair, 1996). The testing of these two hypotheses is complicated, however, by a number of relevant situational and individual difference variables that may moderate these expected effects. This has led to the development of other theories explaining the connection between social anxiety and alcohol use, while taking into account these additional moderating factors.

The Stress Response Dampening model (Sher & Levenson, 1982) was developed to explain more specifically when alcohol would lead to state anxiety reduction. Rather than viewing alcohol as reducing general tension (as in the Tension Reduction Theory), the Stress Response Dampening model centers on alcohol's amelioration of the 'stress response' (i.e., change from baseline in reaction to specific anxiety-provoking or stressful events). Moreover, rather than viewing alcohol as being an effective anxiolytic drug for all persons (as in the Tension Reduction Theory), the Stress Response Dampening model also emphasizes the importance of certain personality traits or other individual differences that may predispose some individuals to experience greater Stress Response

Dampening effects when consuming alcohol. Linking the Stress Response Dampening model to explaining the connection of social anxiety and alcohol intake, it would be expected that those with higher levels of trait social anxiety would experience greater dampening effects from alcohol, and would be motivated to drink to reduce state social anxiety more so than others. In relevant empirical tests of this model, researchers have included measures of various personality and individual difference factors in order to test two modifications of the hypotheses outlined above for the Tension Reduction Theory: (c) individuals with higher levels of certain trait social anxiety-related individual difference factors should experience greater state social anxiety reduction from consuming alcohol compared to individuals who have lower trait levels of these individual difference factors, and (d) individuals with higher levels of these trait social anxiety-related individual difference factors should also be more motivated to consume alcohol when anticipating a state social anxiety provocation task, compared to individuals who have lower trait levels of these individual difference factors.

To specifically explore these two hypotheses emerging from the Stress Response Dampening model in the context of alcohol challenge or stress-induced drinking studies, researchers have either recruited their ‘experimental group’ of participants because they were diagnosed with social anxiety disorder (e.g., Naftolowitz, Vaughn, Ranc, & Tancer, 1994) or because they possessed specific trait social anxiety-related personality characteristics (e.g., Lewis & Vogeltanz-Holm, 2002; Samluluk & Stewart, 1996). Most often, but not always, such studies included a ‘control group’ of participants who did not have a diagnosis of social anxiety disorder or who possessed low levels of the specific trait social anxiety-related personality characteristic in question (e.g., Naftolowitz et al.,

1994). Some relevant studies examining the Stress Response Dampening model do not compare extreme groups but instead include continuous measures of such individual differences within the study protocol so that their relationship with state social anxiety-reduction can be examined via correlational or moderator regression analyses (e.g., Kidorf & Lang, 1999; Knight & Godfrey, 1993).

It should be noted that the Self-Medication Hypothesis (Khantzian, 1985) has often been cited as a theory that may help explain the social anxiety-alcohol link (see Carrigan & Randall, 1995 for a review). The Self-Medication Hypothesis states that alcohol and other illicit substances are particularly appealing to individuals who have certain psychiatric conditions (e.g., depression, anxiety) because they view the substance as a means of alleviating symptoms associated with the disorder. Related to social anxiety, I view this hypothesis as very similar to Stress Response Dampening in that individuals with social anxiety disorder or high levels of social anxiety may feel compelled to use alcohol as a means of alleviating their socially anxious symptoms. This theory would then lead to the same predications made by Stress Response Dampening (see hypotheses C and D described above).

In addition to personality and individual difference variables, a number of other theories have also considered how cognitive factors may play a role in the relationship between alcohol and anxiety reduction namely, the Self-Awareness Model of alcohol (Hull, 1981), the Attention Allocation Model (Steele & Josephs, 1988), and the Appraisal-Disruption Model (Sayette, 1993a). Each of these models appear potentially useful in understanding the link between social anxiety and alcohol use/misuse in that they propose specific cognitive mechanisms through which alcohol may interfere with

the processing of social anxiety-related information, which in turn, may reduce state social anxiety, thus making drinking a rewarding option in the short term for socially anxious individuals.

The Self-Awareness Model (Hull, 1981) of alcohol use proposes that alcohol interferes with the encoding of self-relevant information, thereby decreasing self-awareness and also decreasing negative self-evaluation following failure. This theory seems particularly relevant to those with social anxiety who are normally very self-focused and prone to negative self-evaluations following social situations (Clark & Wells, 1995). For such individuals, alcohol should be particularly rewarding in that it serves to provide relief from state social anxiety through reduced social self-awareness. To add to our list of hypotheses, emerging from the Self-awareness Model, it would also be expected that: (e) decreases in state social anxiety after consuming alcohol should be mediated by decreases in self-awareness. Testing this theory has involved examining levels of self-awareness after participants have consumed alcohol and determining if alcohol-induced changes in self-awareness are associated with alcohol-induced reductions in state social anxiety (e.g., Keane & Lisman, 1980; Yankofsky, Wilson, Adler, Hay & Vrana, 1986).

The Attention Allocation Model (Steele & Josephs, 1988) has also been used as an explanation for why and when alcohol reduces state social anxiety. This theory states that alcohol limits one's perceptual capacity by limiting the ability to engage in effortful processing. This, in turn, results in attention being devoted to the most salient cues in the environment – an effect referred to as “alcohol myopia”. This model seems readily applicable to explaining the link between social anxiety and alcohol intake because trait socially anxious individuals normally attend selectively to cues related to their social

anxiety at the expense of attending to cues unrelated to social threat (e.g., Woody, 1996; Woody & Rodriguez, 2000). Thus, alcohol's effects in narrowing their focus of attention to other salient cues in the environment would presumably be quite rewarding for trait socially anxious individuals. When applied to explaining the link between social anxiety and alcohol intake, the Attention Allocation model would hypothesize that: (f) alcohol should reduce state social anxiety only if the individual has the opportunity to attend to salient cues unrelated to his/her social anxiety (i.e., attending to a salient distractor). To test this hypothesis, researchers have manipulated the type of activity that participants engage in while intoxicated (e.g., either completing a distraction task or doing nothing) in order to investigate whether the presence of other salient cues (as in a distraction task) leads to state social anxiety reduction compared to when such distracting cues are absent (e.g., Josephs & Steele, 1990; Sher, et al., 2007; Steele & Josephs, 1988).

Finally, another cognitive model used to explain how alcohol may reduce anxiety is the Appraisal-Disruption Model (Sayette, 1993a). Sayette reasoned that alcohol interferes with the initial appraisal of information by weakening the connections made between new information and old information stored in long-term memory. Hence, when a socially anxious individual encounters a socially stressful situation when sober, such as being informed of an upcoming social threat situation, recollections of past failures and social inadequacies may lead to the impending situation being appraised as threatening and perceived as anxiety-provoking. In this case, even if the individual does go on to consume alcohol, the drinking will not produce state social anxiety-reduction because the initial threat appraisal was intact. However, if the socially stressful situation was encountered while the socially anxious person was alcohol intoxicated, then the appraisal

of the situation would be disrupted and it would be less likely to be perceived as a social threat. This would then result in the person experiencing less state social anxiety. Specific to social anxiety, this theory may be relevant because when sober, individuals with social anxiety tend to remember and dwell on prior social failures when confronted with new social situations. However, if the new social situation is encountered when the individual is intoxicated, then these past memories and associations may be disrupted, leading the individual to perceive the new social situation as less threatening. Thus, the final hypothesis that emerges from the Appraisal Disruption Model is that: (g) state social anxiety reduction should occur when a socially stressful or state social anxiety-provoking situation is encountered and appraised while the individual is alcohol intoxicated relative to when that social situation is encountered and appraised when the individual is sober. In order to test this hypothesis, researchers have manipulated when participants learn about an upcoming socially stressful situation (i.e., while alcohol intoxicated versus while sober) and then measured their levels of state social anxiety while completing the task (e.g., Sayette, et al., 2001; Sayette & Wilson, 1991). This hypothesis has also been examined using an emotional Stroop task (Amir, Freshman, & Foa, 2002) to directly test whether alcohol interferes with the processing of social threat related information (Gerlach, Schiller, Wild, & Rist, 2006).

In summary, there are a number of proposed theories to explain the links between social anxiety and alcohol intake. This chapter will review lab-based experimental studies that have addressed each of the seven main hypotheses derived from the aforementioned models.

2.3 HYPOTHESIS A: INDIVIDUALS SHOULD EXPERIENCE STATE SOCIAL ANXIETY REDUCTION WHEN THEY DRINK

In order to examine Hypothesis A, researchers have recruited undergraduate student samples, unselected for social anxiety, or they have recruited samples of individuals diagnosed with social anxiety disorder. It should be noted that although trait social anxiety can be viewed as an individual difference factor (see Hypotheses C and D), the studies that have been included in this section did not have a comparison group of individuals low in trait social anxiety or did not examine the effect of trait social anxiety on their results. Therefore, studies that looked only at high social anxiety individuals were included in Hypotheses A and B. The studies' protocols have then typically involved assigning participants to an alcohol, placebo, or control condition, followed by having participants complete an anxiety-inducing task (e.g., giving a speech or interacting with a confederate). The dependent variables in these types of studies have consisted of self-reported state social anxiety, physiological measures of anxiety (e.g., heart rate), and/or behavioural measures of anxiety (e.g., having outside observers rate the participant on behaviors such as amount of time speaking). These measures were often administered at different time points throughout the study, with some studies looking at measures of anxiety taken while participants were *anticipating* the anxiety-provoking task, others looking at measures taken *during* the anxiety-provoking task, and others looking at measures taken *after* the anxiety-provoking task.

2.3.1 Undergraduate Samples

In an early investigation, Wilson and Abrams (1977) recruited a sample of male undergraduate students and had them take part in a videotaped social interaction with a

female confederate after consuming a randomly assigned beverage using a balanced placebo design (see above under *Introduction* for a description of this design). Results revealed that participants who believed that they were drinking alcohol had less of an increase in heart rate during the social interaction (with trends in the same direction for self-reported anxiety; $p < .10$), compared to participants who believed that they were drinking tonic water only. Contrary to Hypothesis A, there were no differences between the group that actually did receive alcohol and the group that received tonic water only (i.e., the placebo group), suggesting that the expectancy of alcohol, rather than pharmacological effects of alcohol, led to ameliorated heart rate increases during the social interaction. Moreover, to investigate a behavioural measure of social anxiety, the researchers measured the amount of time that participants spent speaking during the interaction. Results revealed no differences between groups regarding the amount of time that they spent speaking, indicating no pharmacological or expectancy effects of alcohol on anxiety using a behavioural measure.

In a later study (Woolfolk, Abrams, Abrams, & Wilson, 1979), observers who were blind to participant condition and to the purpose of the study were asked to rate male participants in videotaped participant-confederate interactions from Wilson and Abrams' (1977) study. Observers rated participants using visual analogue scales of ten adjective pairs (e.g., extremely anxious/not at all anxious; likable/unlikable; etc.). Interestingly, female observers rated participants who were in the alcohol expectancy conditions as less anxious during the interaction than participants in the no alcohol expectancy conditions. No differences in ratings were found between groups that actually received alcohol and those that did not, indicating an expectancy effect of alcohol rather

than a pharmacological one on this observer-rated measure of anxiety. On the other hand, when male observers rated the same videos, no differences were found among the groups. The authors offer a few explanations for this gender difference, including the possibility that male raters may have been more reluctant to rate the male participants negatively than female raters.

In an early investigation that included only female undergraduate students, a different pattern of findings emerged. Using a balanced placebo design, Abrams and Wilson (1979) found that women who believed that they had received alcohol had *greater* increases in heart rate and skin conductance, but no changes in self-reported anxiety both when anticipating and taking part in a social interaction with a male confederate, as compared to women who believed that they had received a non-alcoholic drink. In addition, when videos of the participant-confederate interactions were rated by outside observers blind to the study's purpose, women who believed that they had received alcohol were rated as more uncomfortable than women who believed that they had not received alcohol. No effects of pharmacology or expectancy by pharmacology interactions were observed on either dependent measure. In sum, these findings support an expectancy effect of alcohol in women opposite to that found in men by Wilson and Abrams (1977) such that the belief that one had consumed alcohol was associated with increased anxiety as assessed by physiological and behavioural observations (but not self-report) in the women. The authors discuss these findings in women as demonstrating a possible "reverse-placebo" effect. This is described as occurring when individuals expect to experience anxiety reduction when they receive alcohol, but then when they do not (because they have actually consumed placebo), they instead experience an increase in

anxiety. Another related explanation for these findings discussed by the authors is that being intoxicated may have been perceived as being less socially acceptable for women compared to men when these studies took place in the 1970s given the greater social sanctions against heavy drinking among women vs. men that were present at that time (see Stewart, Gavric, & Collins, 2009 for a review). Therefore, women may have felt anxious about appearing intoxicated in the context of the study. Given that drinking norms have changed for women over time and the evidence for some gender convergence in heavy drinking (Stewart et al., 2009), the finding that alcohol led to increased state social anxiety may be specific to these older studies.

In another study, Sayette and colleagues (1992) examined alcohol's effect on a behavioural measure of anxiety among male and female undergraduate students in anticipation of giving a self-disclosing speech after consuming an assigned beverage (i.e., alcohol, placebo, or control). When videos of the participants were rated by outside observers blind to the study's hypotheses, it was found that participants who drank alcohol showed fewer negative facial emotions while *anticipating* the speech (i.e., immediately after being told about the upcoming speech that they would have to give) than participants in both the placebo and control conditions. In this case, a pharmacological effect of alcohol was found where those who actually received alcohol displayed fewer negative facial emotions during their initial appraisals of the speech task than those who did not receive alcohol, regardless of expected drink content. Hence, this study found support for Hypothesis A among an unselected sample of students. It is unknown, however, if this pattern persisted *during* the actual speech task that participants completed, as this was not coded.

In a balanced placebo study examining both male and female undergraduate student participants, deBoer, Schipper, and van der Staak (1993) had participants take part in a social interaction with an opposite-gender confederate. The interaction was interrupted to take measures of anxiety, while having participants believe that the interaction was to continue. Researchers found a main effect for drink content where participants who actually consumed alcohol had lower self-reported anxiety scores (controlling for pre-interaction scores) than participants who did not consume alcohol. An interaction effect between expectancy and gender was also found, indicating that women who believed that they had received alcohol reported less subjective anxiety after taking part in the social interaction than women who believed that they had not received alcohol. This expectancy effect, however, was not found in male participants. These findings indicate a pharmacological anxiety-reducing effect of alcohol in both men and women, but an additional anxiety-reduction alcohol expectancy effect in women only.

In summary, there is some support for Hypothesis A as evidenced by results indicating a pharmacological anxiety-reducing effect of alcohol when considering self-reports (de Boer et al., 1993) and behavioural indices of anxiety (Sayette et al., 1992) in men and women. There is also evidence that the expectation of alcohol may lead to decreased social anxiety in undergraduate men who are *anticipating* an anxiety-provoking task when anxiety is measured physiologically (Wilson & Abrams, 1977) and behaviorally (Sayette et al., 1992), and decreased anxiety *during* the anxiety-provoking task when anxiety is measured behaviorally (Woolfolk et al., 1979). When social anxiety has been measured using self-report, an anxiety-reducing expectancy effect of alcohol has not been found for men during a social interaction (de Boer et al., 1993; Wilson &

Abrams, 1977). The findings regarding women are mixed, however, with de Boer and colleagues (1993) finding decreases in self-reported anxiety during a social anxiety-provoking task, but Abrams and Wilson (1979) finding no differences in self-reported anxiety and an *increase* in anxiety measured physiologically (in anticipation of or during a social interaction) for women who believed that they were drinking. Sayette and colleagues (1992) found no expectancy effects of alcohol on anxiety measured behaviorally in anticipation of a speech for men or women. It should be noted that an expectancy effect of alcohol has been found more consistently than a pharmacological effect, which is not what would be expected based on Tension Reduction Theory, which generally attributes anxiety reduction to the pharmacological properties of alcohol. Expectancy effects are important in that they imply that the pharmacological effects of alcohol may not be as important in social anxiety reduction as the *belief* that one has consumed alcohol.

2.3.2 Individuals Diagnosed with Social Anxiety Disorder

Himle and colleagues (1999) recruited a sample of treatment-seeking individuals with social anxiety disorder. All participants drank placebo beverages and then engaged in a speech task. After a 1-hour waiting period, participants completed a second drinking phase, but this time half of the participants received alcohol and half received placebo beverages. Then, all participants took part in a second speech task identical to the first one that they had completed. Based on measures of heart rate, self-reported social anxiety, and cognitions related to the speech, no differences emerged between the alcohol and placebo groups. The researchers also compared participants who actually believed that they had received alcohol before the first speech task (note that before this speech

task, all participants received placebo beverages), and participants who did not believe that they had received alcohol. Those who believed that they had received alcohol experienced more anxiety while anticipating the speech task, but then had less of an increase in anxiety while actually doing the speech task as compared to those who did not believe that they received alcohol. The authors conclude that the expectancy of alcohol may have lead to increased anticipatory anxiety, but then ameliorated increases in anxiety during the actual speech task by allowing participants to “blame” performance deficits on the effects of alcohol.

Abrams and colleagues (2001) recruited a sample of individuals who met the *Diagnostic and Statistical Manual of Mental Disorders- Fourth Edition* (DSM-IV; American Psychiatric Association, 1994) criteria for social anxiety disorder. They also included some individuals who met all but Criterion E (i.e., significant impairment in their life as a result of their social anxiety) of the DSM-IV criteria for social anxiety disorder. Participants took part in two speech tasks. First, all participants gave a self-disclosing speech while they were sober. Next, participants were randomly assigned to drink control, placebo, or alcohol beverages, and then completed the same speech task again. Findings revealed that while *anticipating* the speeches, no differences were found among the groups regarding their heart rate or self-reported social anxiety. However, when considering levels of social anxiety measured *during* the second speech, the alcohol and placebo conditions experienced greater reductions in self-reported anxiety from the first to the second speech compared to the control condition, and no differences were found between the alcohol and placebo group. Similarly, the alcohol and placebo groups

reported a greater increase in positive thoughts from the first to second speech compared to the control condition.

In summary, Himle et al. (1999) failed to find anxiety reduction in a sample of individuals with social anxiety disorder using a within-subjects design, comparing placebo and alcohol conditions. However, when they divided their sample into those who believed that they had received alcohol and those that did not during the first placebo phase, they found that individuals who believed that they had received alcohol reported more anxiety while anticipating a speech task, but less anxiety while actually engaged in the speech task compared to individuals who did not believe that they had received alcohol. However, Abrams et al. (2001) included a control condition of participants who did not drink alcohol and were not led to believe that they were drinking alcohol, and found anxiety reduction *during* a speech task only for participants who consumed alcohol or placebo beverages. Taken together, these studies indicate that in individuals with social anxiety disorder, anxiety-reduction may be primarily due to an expectancy effect of alcohol since both studies failed to find differences between the alcohol and placebo groups. These results, therefore, do not support the hypothesis that alcohol leads to anxiety-reduction directly. Instead, these findings emphasize the importance of considering cognitive mechanisms including alcohol expectancies when examining the effects of alcohol on state social anxiety among individuals with social anxiety disorder.

2.4 HYPOTHESIS B: INDIVIDUALS SHOULD LEARN TO DRINK FOR STATE SOCIAL ANXIETY REDUCTION EFFECTS

In a study that used female undergraduate participants unselected for social anxiety, McNair (1996) randomly assigned women to one of four cells in a 2 x 2 between subjects design. Participants were randomly assigned to either a low social anxiety

induction condition where they read magazines, or a high social anxiety induction condition where they were required to give a speech in front of a video camera. The timing of each task was also manipulated such that half of the participants in each social anxiety induction condition were given the chance to drink alcohol before completing their task, while the other participants were given the chance to drink alcohol after completing their given task (i.e., giving a speech or reading magazines). The drinking phase of the study was set up as an unobtrusive taste-rating task where women could drink as much or as little wine as they wanted under the guise that they were to rate the taste of the wine on a number of adjectives. The actual dependent variable of interest was the amount of wine consumed. Findings revealed that all groups chose to drink similar amounts of wine, regardless of whether they were in the high social anxiety or low social anxiety induction condition and regardless of whether they were given the chance to drink before or after their task. Further, a manipulation check was included and revealed that participants in the high social anxiety induction condition (i.e., giving a speech) did in fact, report significantly higher levels of state social anxiety compared to participants in the low social anxiety induction condition (i.e., reading magazines). These findings, therefore, do not support the predictions outlined for hypothesis B. However, as noted above, participants were not selected for social anxiety status, and as applied to explaining the relation of social anxiety disorder to alcohol abuse, according to the Stress Response Dampening model (Sher & Levenson, 1982), it may be that individuals high in trait social anxiety would drink more wine when assigned to the high social anxiety manipulation. A further limitation of this study is that only women were tested leaving open the possibility that the expected results may have been observed among men.

In a similar study that used clinical participants, Abrams, Kushner, Medina, and Voight (2002) recruited a sample of men and women diagnosed with social anxiety disorder. All participants took part in two experimental sessions, spaced one week apart. During one of the sessions, participants engaged in a social anxiety-provoking task (solving moral dilemmas with another participant) and in the other session (order randomly determined), they engaged in a neutral task (reading magazines). Participants were also randomly assigned to drink alcohol either *before* each of the sessions or *after* each of the sessions. During the drinking phases, participants could choose to drink weak, moderate, or strong drinks, and the strength of drinks chosen was used as the dependent variable. It was found that the socially phobic participants, especially men, who were assigned to drink before each task, tended to drink *lower* strength drinks before the anxiety-provoking task compared to the neutral task. Thus, on the anticipatory drinking dependent variable, results in direct opposition to those predicted by hypothesis B were observed, at least for socially phobic men. However, when considering participants who were given the opportunity to drink *after* completing each task, both men and women drank stronger drinks *after* completing the anxiety-provoking task as compared to the neutral task. This latter finding generally supports predictions outlined for hypothesis B, but qualifies that socially phobic individuals may drink *following* socially stressful situations (e.g., to deal with residual anxiety) rather than *in anticipation* of them (i.e., to avoid anxiety) as is predicted in the traditional Tension Reduction Theory. An advantage of this study is that it used clinically diagnosed individuals from the community rather than an analogue sample of socially anxious undergraduates. However, a limitation is that no non-socially phobic control group was included, so it is not possible to determine if

the findings are unique to socially phobic individuals (as would be expected based on the Stress Response Dampening model).

De Wit et al. (2003) examined the effects of a social anxiety induction on alcohol consumption in a community sample. Using a within-subjects design, participants completed a social anxiety induction task (using the Trier Social Stress Test where they had to perform arithmetic problems in front of an observer for 10 minutes; Kirschbaum, Pirke, & Hellhammer, 1993) and a “no-stress” neutral task (relaxing and conversing with the experimenter for 10 minutes) on separate days. After each session, participants were given a low dose of a placebo or alcohol beverage prime and then allowed to drink up to six more beverages of the same type. Results indicated that participants in both beverage conditions consumed more after the social stressor than the neutral task. These findings are consistent with Tension Reduction Theory based on expected effects, but it is not possible to rule out other factors (e.g., increased thirst or stimulation of ongoing activity) that could contribute to increased drinking behavior after a social stressor.

In summary, there is mixed evidence regarding the hypothesis that individuals will choose to consume more alcohol when anticipating or engaging in a social anxiety-provoking task. Findings did not support this hypothesis when using an unselected sample of female undergraduate students (McNair, 1996). However, although individuals with social anxiety disorder were not found to choose stronger drinks when *anticipating* a social anxiety-provoking task, Abrams, Kushner, Medina, et al. (2002) did find that such participants chose to drink stronger alcoholic beverages *after* they had engaged in a socially anxiety-provoking task compared to those who had engaged in a neutral task. Similarly, de Wit et al. (2003) found that an unselected sample of participants from the

community chose to drink more alcohol or placebo beverages after a social anxiety-provoking task compared to when they engaged in a neutral task. One possible explanation for these differences in findings may be gender. It is possible that gender may moderate the relationship between social anxiety and alcohol consumption such that women may be less likely to drink before a socially stressful task (as was found by McNair, 1996) compared to men. This possibility has not yet been examined directly. Another possible limitation of the aforementioned studies is that they did not look at whether individuals would choose to drink alcohol *during* the social anxiety-provoking task. It is possible that while anticipating a social anxiety-provoking task, the consumption of alcohol may be viewed as performance-impairing, whereas during the actual task, individuals may habituate to the situation and be more comfortable consuming alcohol.

2.5 HYPOTHESIS C: INDIVIDUALS WITH HIGH LEVELS OF CERTAIN SOCIAL ANXIETY-RELEVANT INDIVIDUAL DIFFERENCE CHARACTERISTICS SHOULD EXPERIENCE GREATER STATE SOCIAL ANXIETY REDUCTION FROM CONSUMING ALCOHOL COMPARED TO INDIVIDUALS WITH LOWER LEVELS OF THESE INDIVIDUAL DIFFERENCE CHARACTERISTICS

The first step in exploring this hypothesis is to consider studies that have recruited and compared samples of individuals who differed with regards to their levels of trait social anxiety. Naftolowitz and colleagues (1994) recruited a small sample of individuals diagnosed with social anxiety disorder ($n = 9$), as well as a control sample of individuals without social anxiety disorder ($n = 9$). All participants took part in two speech tasks on separate days; the first one after they consumed alcohol, and the second one after they consumed placebo beverages. In this study, no pharmacological effects of alcohol were found for participants with social anxiety disorder or the control participants when

looking at measures of heart rate, self-reported anxiety, or endocrine indices of the stress response (e.g., cortisol). This study was limited, however, because of its small sample size, lack of a no alcohol control condition to test whether both the alcohol and placebo beverages led to decreased anxiety relative to no alcohol, and failure to randomize the order of the type of beverage consumed before each of the speech tasks (i.e., alcohol was always consumed first and placebo second).

Another social anxiety relevant individual difference variable that has been considered is anxiety sensitivity, which is defined as the fear of anxiety-related sensations due to beliefs that these sensations could lead to harmful consequences (Reiss, Peterson, & Gursky, 1988). Research has shown that anxiety sensitivity contains three lower-order components: physical concerns, psychological concerns, and social concerns (Stewart, Taylor, & Baker, 1997). Anxiety sensitivity has been found to be elevated in individuals with social anxiety disorder (e.g., Taylor, Koch, & McNally, 1992), with particular elevations found on the social concerns component (Rector, Szacun-Shimizu, & Leybman, 2007). Lewis and Vogeltanz-Holm (2002) recruited two groups of participants: individuals high or low in anxiety sensitivity. After random assignment to an alcohol or placebo condition, participants took part in a speech task. Findings showed that during the anticipation phase, individuals high in anxiety sensitivity who were in the alcohol condition compared to the placebo condition, experienced less of an increase in heart rate, but no differences were found looking at self-reports of anxiety. However, during the actual speech, no differences between groups were found in heart rate or self-reported anxiety. It is difficult to draw conclusions based on this study since the “high” AS group was not as high in AS as is typically used in this literature and truly high AS individuals

are those most relevant to the understanding of the relationship between social anxiety and alcohol use. Moreover, it was total AS scores that were used to recruit participants. Scores on the AS social concerns component are more specifically relevant for understanding the relationship of social anxiety disorder to alcohol abuse (Rector et al., 2007).

Alcohol expectancies (i.e., positive and negative beliefs regarding the effects of alcohol) are also commonly examined to determine whether particular beliefs about alcohol's effects have an influence on how alcohol actually affects participants in the lab. Alcohol expectancies can be conceptualized as an individual difference variable given findings supporting the stability of expectancies over time (e.g., Brown, Christiansen, & Goldman, 1987; Fromme, Stroot, & Kaplan, 1993) and studies showing that alcohol expectancies may be influenced by both environmental and genetic factors (e.g., Vernon, Lee, Harris, & Jan, 1996). Of particular interest for understanding the social anxiety – alcohol abuse relationship are tension-reduction expectancies where individuals may believe that alcohol will lead to decreased social anxiety and social lubrication expectancies where individuals may believe that alcohol will lead to improved social functioning (e.g., Ham, et al., 2002; Tran, Haaga, & Chambless, 1997). Some laboratory-based studies have included a measure of alcohol expectancies so that participants' scores on social anxiety relevant expectancies can be taken into account when examining how alcohol or placebo beverages affected participants' levels of social anxiety. de Boer, Schippers, and VanDerstaak (1994) found that alcohol expectancies moderated the relationship between alcohol and self-reported social anxiety. Among women who thought that they had consumed alcohol, those who believed that alcohol would have a

positive influence on their social behaviour (i.e., those with stronger social lubricant expectancies) were less anxious than women who did not expect alcohol to improve their social behaviour.

Abrams and Kushner (2004) found that men who held strong tension reduction expectancies experienced greater anxiety reduction when anticipating a speech task after consuming placebo beverages as compared with men who did not hold strong tension reduction expectancies. This relationship, however, was not found in women. In a sample of male and female students, Sayette, and colleagues (1994a) looked at all types of alcohol expectancies (including tension-reduction expectancies and increased social assertiveness expectancies which are similar to social lubrication expectancies) and did not find that alcohol expectancies influenced participants' levels of anxiety-reduction in response to alcohol or placebo beverages when anticipating a speech task.

In summary, there is some evidence that it may be important to measure relevant individual difference variables when examining the link between social anxiety and alcohol. Specifically, there is some evidence that increased levels of anxiety sensitivity (Lewis & Vogeltanz-Holm, 2002), and tension-reduction or social lubricant alcohol expectancies (Abrams & Kushner, 2004; de Boer et al., 1994), may be associated with greater drinking-induced anxiety-reduction. However, surprisingly, no studies have examined trait social anxiety specifically.

2.6 HYPOTHESIS D: INDIVIDUALS WITH HIGHER LEVELS OF TRAIT SOCIAL ANXIETY-RELATED INDIVIDUAL DIFFERENCE FACTORS SHOULD ALSO BE MORE MOTIVATED TO CONSUME ALCOHOL WHEN ANTICIPATING A STATE SOCIAL ANXIETY PROVOCATION TASK, COMPARED TO INDIVIDUALS WHO HAVE LOWER TRAIT LEVELS OF THESE INDIVIDUAL DIFFERENCE FACTORS

In 1978, Holroyd recruited a sample of trait socially anxious and non-socially anxious male undergraduate students according to their scores on the Social Avoidance and Distress Scale (Watson & Friend, 1969). Each participant took part in an informal get-together situation with three other participants. Prior to taking part in the get-together, participants randomly received either a negative report about their social skills (telling them that they had problems with social interactions and personal relationships) or a positive report (telling them that they had above average abilities in handling interpersonal situations). During the get-together, participants had unlimited access to beer and could consume as much or as little as they wanted. Findings revealed that even though the trait socially anxious group and the group that received a negative report went into the get-together with higher levels of state social anxiety, it was actually the non-socially anxious participants and the participants that received a positive report that consumed the most alcohol. Furthermore, a negative correlation was found between levels of state social anxiety going into the get-together and subsequent alcohol consumption. This study thus produced results in direct contrast to hypothesis D. Limitations were the exclusive use of male participants and the analogue non-clinical sample. Further, since the study focused on drinking *during* the social interaction, it is impossible to know if the high social anxiety participants or the negative feedback participants would have chosen to drink either in *anticipation* of the social stressor or *following* it to cope with anticipatory or residual anxiety, respectively.

In a similar study, Kidorf and Lang (1999) used a within-subjects design to investigate whether participants would drink more while anticipating a social anxiety-provoking task as compared to baseline, when they were not anticipating any task. The

sample consisted of male and female undergraduates who were not pre-selected to be high or low in trait social anxiety; nonetheless, a measure of trait social anxiety (The Social Avoidance and Distress Scale; Watson & Friend, 1969) was administered to all participants to examine moderating effects of trait social anxiety levels. Participants took part in two experimental sessions, spaced two to five days apart. The order of the two sessions was not counterbalanced. During the first session, participants sat comfortably and were given unlimited access to their preferred alcoholic beverage. During the second experimental session, participants were first informed that after drinking their preferred beverages, they would have to give a self-disclosing speech. Then, once again, they were given unlimited access to their preferred alcoholic beverage. Contrary to what was found by Holroyd (1978), participants consumed more alcohol when they were anticipating the speech task compared to baseline (when they were not anticipating any upcoming tasks), and this was especially true among participants who scored higher on the measure of trait social anxiety. Thus, the Kidorf and Lang (1999) study did produce findings consistent with the predictions set forth in Hypothesis D.

Samloluk and Stewart (1996) examined a sample of individuals either high or low in anxiety sensitivity (see above under *Hypothesis C* for a definition of this construct). Participants were told that they would be taking part in an upcoming interview where they would have to answer specific questions. Half of the participants were told that they would be discussing their sensations related to anxiety during the interview (e.g., “what kinds of thoughts and physical sensations do you experience when tense or anxious?”), and the other half of participants were told that they would discuss neutral topics (e.g., “what activities do you enjoy in your spare time?”). Although not originally

conceptualized as a social anxiety-provoking task, the former task can be considered a social anxiety trigger because it concerns a social interaction involving personal disclosure. Before doing the interview, participants were given the opportunity to sample as much or as little alcohol as they wanted for 15 minutes in the guise of an unrelated taste rating task (Higgins & Marlatt, 1975). Contrary to what would be expected based on Hypothesis D, participants high in anxiety sensitivity did not choose to drink more alcohol than participants low in anxiety sensitivity when they were anticipating doing the interview related to their anxiety. However, with respect to participants who were anticipating participating in the neutral interview, individuals high in anxiety sensitivity drank more than those low in anxiety sensitivity. Perhaps the neutral interview might be more similar to the types of social situations one would typically drink in (e.g., small talk) as compared to self-disclosing anxiety-relevant information. It should also be noted that compared to participants low in anxiety sensitivity, participants high in anxiety sensitivity did not report higher levels of state anxiety when they were anticipating either of the interviews, indicating that the anxiety-relevant interview may not have been effective at inducing a sufficient level of state social anxiety to promote an increased level of alcohol consumption relative to the neutral interview.

Regarding alcohol expectancies, Knight and Godfrey (1993) had a sample of male participants engage in a social interaction with a female confederate. Among participants who were given unlimited access to alcohol before completing the social interaction, it was found that increased social anxiety reduction expectancies (i.e., the belief that alcohol would alleviate social avoidance and distress; similar to tension reduction expectancies), and increased social assertiveness expectancies (i.e., the belief that alcohol

would lead to increased confidence and ability to talk to others; similar to social lubrication expectancies) were associated with increased alcohol consumption. Further, those who consumed alcohol were rated as more socially skilled by outside observers than those in a control group who did not consume alcohol. Therefore, this study found support for the prediction that those who expect alcohol to improve social performance may actually choose to drink more when anticipating a social interaction, and these individuals may be accurate in that alcohol may lead to improved social skills at least in the short term and with moderate quantities of alcohol. Moreover, it is possible that these improvements in social skills lead others to react more positively, which would provide a form of social reinforcement for drinking.

Overall, there are mixed findings regarding whether individuals high in trait social anxiety will choose to consume more alcohol when anticipating an anxiety-provoking task with Holroyd (1978) finding less alcohol consumption in a socially anxious group of males, and Kidorf and Lang (1999) finding increased alcohol consumption in a mixed gender sample of students. Further, there is some evidence that females high in anxiety sensitivity may choose to consume more alcohol when anticipating a particular type of social interaction (i.e., a “small talk” type of social interaction). Finally, Knight and Godfrey (1993) found that males who expected alcohol to improve their social skills and alleviate their social anxiety chose to consume more alcohol before taking part in a social interaction than males who did not hold these expectancies. Taken together, these findings emphasize the importance of considering the specific type of anxiety-provoking task that participants will be engaging in as well as the drinker’s alcohol expectancies. It may be the case that socially anxious individuals will choose to drink more before some

tasks (e.g., if they believe that drinking will help their performance) and not others (e.g., if they believe that drinking will harm their performance).

2.7 HYPOTHESIS E: DECREASES IN STATE SOCIAL ANXIETY AFTER CONSUMING ALCOHOL SHOULD BE MEDIATED BY DECREASES IN SELF-AWARENESS

There have been a number of studies that have empirically examined whether alcohol reduces levels of self-awareness (e.g., Hull, Levenson, Young, & Sher, 1983). Although useful in supporting some of the main tenants of Hull's self-awareness model (Keane & Lisman, 1980), these studies have not examined how changes in levels of self-awareness are associated with changes in state social anxiety. The studies discussed in this section have specifically investigated the effects of alcohol on state social anxiety, while also measuring participant's self-perceptions while engaged in an anxiety-provoking task.

Keane and Lisman (1980; Study 1) had a sample of 32 males seeking dating skills treatment take part in a videotaped interaction with a female confederate after having consumed either alcohol or placebo beverages. The videos were then watched by independent observers who rated participants on a number of criteria considered to be behavioural indices of anxiety (e.g., amount of time speaking). Participants who had consumed alcohol were rated as less socially skilled by the independent observers than participants who consumed placebo beverages. However, when participants were asked about their own performance during the social interaction, no differences in self-perceptions were found between the alcohol and placebo group. This could be an indication that alcohol interfered with participants' levels of self-awareness. However, when examining heart rate measures or self-reported anxiety throughout the study,

differences between the alcohol and placebo group were not found. Furthermore, when Keane and Lisman (1980) conducted a nearly identical study (Study 2) in a sample of non-socially anxious males, similar results were found regarding behavioural ratings of the participants (i.e., participants who consumed alcohol were rated as more anxious and less socially skilled than participants who had consumed placebo). However, when considering participants' ratings of their own performance, the alcohol group did rate their performance as weaker than the placebo group. Hence, this may be an indication that it is socially anxious individuals who specifically experience decreased self-awareness when consuming alcohol.

Yankofsky and colleagues (1986) recruited a sample of male undergraduates and had them take part in two videotaped social interactions with a female confederate. For the first interaction, all participants were sober and the confederate acted friendly and responsive towards the participant. Then, after consuming either alcohol or placebo beverages using a balanced placebo design, participants took part in a second interaction with the same confederate. This time the confederate acted unfriendly and bored during the interaction. After both interactions, while those who had been administered alcohol were still under the influence, participants watched videos of the interactions and rated themselves on a number of adjectives and behaviours. Participants who consumed alcohol rated themselves similarly across both interactions, whereas participants who consumed placebo rated themselves more negatively after the second interaction (i.e., when the confederate was not acting friendly). This finding could not be attributed to actual performance differences between the alcohol and placebo group since outside observers rated the two groups as equivalent in social performance when they watched

videotapes of the interactions. Despite these changes in self-perception, consistent with the findings of Keane and Lisman (1980; Study 1), levels of self-reported anxiety were not different across the groups. It should also be noted that Sher and Walitzer (1986) similarly did not find levels of self-consciousness (which can be considered a trait measure of self-awareness) to be associated with levels of alcohol-induced anxiety-reduction in a sample of males.

In summary, there is evidence that alcohol consumption may lead to decreased self-awareness in socially anxious men (Keane & Lisman, 1980, Study 1). The findings are mixed, however, when considering non-socially anxious individuals. Yankofsky and colleagues (1986) found that alcohol interfered with non-socially anxious participants' perceptions of their own performance, as evidenced by alcohol condition participants rating themselves similarly across positive and negative feedback conditions. Keane and Lisman (1980, Study 2), however, found that non-socially anxious participants who consumed alcohol rated their performance during the interaction in line with how outside observers had rated them (i.e., as more impaired). Further, consistent across studies, differences in self-reported state social anxiety were not found across groups. Although these studies did not directly test whether changes in self-awareness mediated the relationship between alcohol and social anxiety, these findings are an indication that although alcohol may have led to a decreased self-awareness, this decreased self-awareness was not associated with state social anxiety-reduction.

2.8 HYPOTHESIS F: ALCOHOL SHOULD REDUCE STATE SOCIAL ANXIETY ONLY IF THE INDIVIDUAL IS ATTENDING TO CUES UNRELATED TO HIS/HER SOCIAL ANXIETY

Steele and Josephs (1988, Study 1) explored this hypothesis by randomly assigning university students to an alcohol or placebo condition and then telling them that they would have to take part in a speech task – a task commonly used to induce state social anxiety. While participants were waiting to give the upcoming speech, half of them engaged in a distraction task (rating art slides) and half of them did nothing alone in a room for seven minutes. Findings indicated that the greatest anxiety reduction was found in those who consumed alcohol and engaged in the distraction task. Moreover, those who consumed alcohol, but did *not* engage in the distraction task, showed an increase in anxiety. These findings were replicated by Josephs and Steele (1990), in that a moderately demanding distraction task led to more anxiety reduction than a low demand distraction task, and no distraction again led to increased anxiety in participants who had consumed alcohol and were anticipating an upcoming speech task.

Abrams, Kushner, and Reinertsen (2002b) recruited a sample of individuals with social anxiety disorder and had them engage in a speech task after consuming either alcohol or placebo beverages. Participants also recorded their positive and negative cognitions related to the speech task. Findings revealed that cognitions mediated the effects of alcohol on self-reported state social anxiety such that those who reported fewer negative cognitions and more positive cognitions regarding the task experienced greater alcohol-induced subjective anxiety reduction. This may be an indication that participants who had consumed alcohol were attending to fewer cues associated with their social anxiety during the task (and hence, had fewer negative thoughts and more positive thoughts about their performance), which then led to decreased state social anxiety.

However, this explanation remains speculative since attention allocation was not specifically assessed.

In a more recent investigation, Sher and colleagues (2007) specifically tested whether attention mediated the relationship between alcohol and state social anxiety-reduction using a community-recruited sample. It was found that attention (measured using a continuous performance task where participants had to quickly press a button every time specific letters were flashed on a computer screen; Conners, 1994) partially mediated alcohol's effects on reducing state social anxiety when participants were anticipating a speech task as measured with skin conductance. This same result was not found when alcohol's effects on state social anxiety were measured via heart rate or self-reports.

In summary, there is evidence that in community-recruited (Sher et al., 2007) and university student samples (Josephs & Steele, 1990; Steele & Josephs, 1988), state social anxiety-reduction is more likely to occur when a drinker's attentional resources are compromised. There is also evidence that in individuals with social anxiety disorder, alcohol may lead to fewer negative cognitions about one's performance, which may decrease state social anxiety (Abrams et al., 2002b). However, it is unclear whether changes in cognitions are due to changes in attention as it is possible that changes in self-awareness (see hypothesis E) lead to fewer negative thoughts about one's performance.

2.9 HYPOTHESIS G: STATE SOCIAL ANXIETY REDUCTION SHOULD OCCUR WHEN A SOCIALLY STRESSFUL OR ANXIETY-PROVOKING SITUATION IS ENCOUNTERED AND APPRAISED WHILE THE INDIVIDUAL IS ALCOHOL INTOXICATED RELATIVE TO WHEN THAT SOCIAL SITUATION IS ENCOUNTERED WHEN THE INDIVIDUAL IS SOBER

A number of studies have investigated this hypothesis by altering the temporal sequencing of stress exposure and alcohol consumption (e.g., Sayette, et al., 2001; Sayette & Wilson, 1991; Sayette, Wilson, & Carpenter, 1989; Zack, Poulos, Aramakis, Khamba, & MacLeod, 2007). In these studies, participants are told about an upcoming social stressor (e.g., a speech task) either before or after consuming alcohol or placebo beverages. Findings have generally supported the hypothesis that learning about a stressor after drinking alcohol leads to greater anxiety reduction than learning about the stressor before drinking alcohol. This pattern seems to hold most consistently when examining heart rate, as compared to when examining self-reported anxiety (Sayette et al., 1989; Sayette et al., 2001; Sayette & Wilson, 1991).

Zack and colleagues (2007) also looked at how levels of anxiety sensitivity affected this relationship. A sample of high and low anxiety sensitive male and female undergraduate students were selected. Men high in anxiety sensitivity who were in the alcohol condition relative to placebo, experienced greater anxiety reduction (as measured with self-reports) if they learned about an upcoming speech after drinking alcohol as opposed to before. This pattern of results, however, was not found in women who were high in anxiety sensitivity. In fact, women high in anxiety sensitivity actually showed the opposite pattern: those high anxiety sensitive women in the alcohol relative to placebo condition had greater anxiety reduction if they were told about the stressor before they consumed alcohol as opposed to after. It should be noted that this study is not directly relevant to the social anxiety and drinking issue, since participants were high in global anxiety sensitivity, as opposed to anxiety sensitivity social concerns – the component of anxiety sensitivity most closely linked to social anxiety (see Zinbarg et al., 2009).

Employing a different methodology, Gerlach and colleagues (2006) examined the Appraisal Disruption Model by having participants take part in an emotional Stroop task (e.g., Amir et al., 2002) to test whether alcohol interfered with the processing of social threat related words. Women diagnosed with social anxiety disorder and a control sample of women without social anxiety disorder completed the emotional Stroop task after consuming a moderate dose of alcohol or consuming a non-alcoholic control beverage. In the control group (i.e., those without social anxiety disorder), the colour-naming latencies for the social threat related words were similar to response latencies of the neutral words after consuming alcohol, but response latencies for social threat related words were higher than for neutral words after consuming the control beverage, suggesting less selective attention to and processing of the social threat words after drinking. However, in the group of individuals with social anxiety disorder, this effect was not found – these women still exhibited longer latencies for social anxiety related words relative to neutral words after consuming alcohol. These findings indicate that although non-socially anxious individuals may attend less to social anxiety-related stimuli after consuming alcohol, those with social anxiety disorder may not. It should be noted, however, that this study did not find self-reported anxiety-reduction in those who consumed alcohol for either the individuals with social anxiety disorder or the control participants suggesting the possibility that the dose of alcohol used may not have been sufficient to result in effects on attentional bias among the socially phobic women.

Stevens, Gerlach, and Rist (2008) recruited a sample of men and women with social anxiety disorder as well as a control sample and had them rate pictures of faces displaying a variety of emotions after consuming either alcohol or no alcohol beverages.

Overall, those with social anxiety disorder rated neutral faces and happy faces (but not angry faces) as more negative than those without social anxiety disorder, regardless of whether or not alcohol was consumed. However, both the socially anxious participants and the control participants rated angry faces as less threatening when they had consumed alcohol compared to participants who did not consume alcohol. Therefore, this study found some support for the appraisal-disruption model in that the processing of angry (i.e., threatening) faces was found to be affected by alcohol, but this effect was not specific to individuals with social anxiety disorder. The lack of support for a greater effect of alcohol on the processing of angry (threatening) faces among the socially phobic group compared to controls may have been secondary to the failure to observe greater negative appraisals of the angry faces by the socially phobic patients compared to the controls, overall.

In summary, there is evidence that the temporal sequence of drinking relative to learning about a social stressor can play a role in state social anxiety reduction. It has been found that when a social stressor is presented to participants *after* they have been drinking, greater state social anxiety reduction occurs compared to when the social stressor is presented *before* drinking (Sayette et al., 1989; Sayette et al., 2001; Sayette & Wilson, 1991). There is also evidence that some individual difference variables (e.g., gender and anxiety sensitivity) may play a moderating role in this relationship (Zack et al., 2007). On the other hand, this hypothesis was not supported in a sample of women with social anxiety disorder (Gerlach et al., 2006). It should be noted, however, that this study used words as social threat cues rather than employing an actual state social anxiety induction task.

2.10 METHODOLOGICAL CONSIDERATIONS

As seen in the previous section reviewing the empirical studies of the relation of social anxiety and alcohol using lab-based methods, results have not been consistent. Some studies appear to support hypotheses derived from the major theoretical perspectives in this area, but many studies do not lend support to these models. In this section, I review relevant methodological characteristics of studies that may help explain the variability in findings. Specifically, participant characteristics (e.g., gender), study selection criteria (e.g., use of students versus community recruited individuals), alcohol administration procedures (e.g., dose and type of alcohol used), the nature of the anxiety-inducing task (e.g., social performance versus social interaction tasks) and the outcome measures that are typically used (e.g., subjective-emotional, physiological, cognitive, and behavioural indices) are reviewed

2.10.1 Gender

Many early studies that involved alcohol administration used only male participants (e.g., Holroyd, 1978; Wilson & Abrams, 1977), and some more recent studies have also chosen to use only male participants (e.g., Sher et al., 2007). On the other hand, some studies have focused solely on examining the effects of alcohol on female participants (e.g., Abrams & Wilson, 1979; Gerlach, et al., 2006; Lewis, & Vogeltanz-Holm 2002; McNair, 1996). This distinction may be important given that there is research indicating that males and females may hold different expectancies regarding alcohol effects (e.g., Abrams & Kushner, 2004; McNair, 1996). There have also been findings showing that men and women may experience different physiological effects from alcohol (e.g., Abrams & Wilson, 1979; Wilson & Abrams, 1977). Furthermore, men

are more likely to experience an alcohol use disorder than women, whereas women may be more likely to experience social anxiety disorder and alcohol use disorder comorbidity than men (Kushner, Krueger, Frye, & Peterson, 2008). Given that there may be gender differences in this area of research, many studies have controlled for gender in their analyses (Abrams et al., 2001; Kidorf & Lang, 1999; Sayette et al., 2001). To provide a more comprehensive analysis of the role of gender in the social anxiety and alcohol use relationship, it is important that both men and women are sampled and researchers consider gender as a possible moderator variable to determine if gender differences exist. This may require larger sample sizes in order to ensure adequate power for such analyses.

2.10.2 Selection Criteria

University versus Community Recruited Participants. In the studies that were reviewed, I made the distinction between university student samples (e.g., Kidorf & Lang, 1999; Yankofsky et al., 1986) and community recruited samples (e.g., Sher et al., 2007). This distinction is important given that some studies examining the relationship between social anxiety and alcohol using self-report questionnaires have actually found an inverse relationship between the two in university samples where greater social anxiety is related to lesser drinking behavior (e.g., Eggleston et al., 2004; Ham et al., 2007; Ham & Hope, 2005). It has been suggested that the relationship between social anxiety and alcohol use in university students may be affected by a number of other relevant variables (e.g., drinking norms, alcohol expectancies) given the unique social aspects of college settings (see Ham & Hope, 2006). Therefore, when designing lab-based studies, researchers should consider whether it is appropriate to use university samples (i.e., if there is an inverse relationship between social anxiety and alcohol use,

then would alcohol be expected to reduce social anxiety in these studies?) When university students are used in this area of work, consideration should be given to other variables that may be affecting this relationship. For example, many studies have focused on drinking frequency or amount (e.g., Eggleston et al., 2004) when looking at the association between social anxiety and drinking in students. It may be the case, however, that socially anxious students tend to avoid situations where heavy drinking occurs and therefore, would thus generally be considered lighter drinkers. But, they still may have problems related to their alcohol use when they do drink if they are drinking to cope with their social anxiety (Morris et al., 2005).

Selecting for Social Anxiety. The lab-based studies to date that have looked at the effects of alcohol on social anxiety have either (a) recruited individuals who meet diagnostic criteria for social anxiety disorder (e.g., e.g., Abrams et al., 2001; Abrams, Kushner, Medina, et al., 2002; Abrams, Kushner, & Reinertsen, 2002; Himle et al., 1999; Himle et al., 1999) or (b) used individuals who meet a high anxiety cutoff point on a trait social anxiety scale (e.g., Holroyd, 1978) or (c) used individuals with a wide range of social anxiety scores (e.g., Abrams & Wilson, 1979; Kidorf & Lang, 1999; Wilson & Abrams, 1977).

In regards to recruiting socially anxious participants (using either diagnostic criteria or questionnaires using cutoff scores), it can be argued that these particular individuals may not be representative of typical socially anxious individuals who would likely avoid taking part in experimental research on account of being socially anxious. In fact, some researchers (e.g., Abrams et al., 2001; Abrams, et al., 2002a; Abrams, et al., 2002b) have alluded to this concern and noted that their participants had relatively low

social anxiety scores as measured with the Social Phobia Scale (Mattick & Clarke, 1998) compared to the norms for outpatients with social anxiety disorder. Furthermore, during recruitment, potential participants are excluded if they are currently taking any medications that could interact with alcohol given ethical guidelines of the National Advisory Council on Alcohol Abuse and Alcoholism Recommended Council Guidelines on Ethyl Alcohol Administration in Human Experimentation (National Institute of Alcohol Abuse and Alcoholism [NIAAA], 2005). Given that most anti-anxiety medications are not to be combined with alcohol, this exclusion criterion may also lead to obtaining a less severe socially anxious sample.

The use of individuals with a wide range of social anxiety scores, on the other hand, is also limited if researchers do not measure levels of trait social anxiety and include them as a moderator in their analyses. It is unclear whether those with lower levels of social anxiety respond to alcohol the same way that those with high levels of social anxiety do. Given past epidemiological findings (e.g., Grant et al., 2004; Himle & Hill, 1991; Kessler, et al., 1997; Ross, 1995), it is apparent that individuals with social anxiety disorder are at particular risk for alcohol problems. It may be the case then that inducing state social anxiety among those with low levels of trait social anxiety is not indicative of how those with high levels of trait social anxiety or those with clinical social anxiety disorder would respond. There is research indicating that those with high levels of anxiety experience more intense stress responding, which may involve different brain systems than those with normal or low levels of anxiety (Liebowitz, Gorman, Fyer & Klein, 1985). Moreover, those high in social anxiety and related constructs have been found to respond differently to alcohol as compared with those scoring low on these

measures (e.g., Holroyd, 1978). It is, therefore, essential that researchers treat social anxiety as another potential moderating variable in their research design in order to examine whether levels of trait social anxiety interact with alcohol condition in affecting state social anxiety levels. Further, it may be important to separate social anxiety into a social fear component and an avoidance component as there is evidence to suggest that each of these components may be differentially related to alcohol use and/or problems (e.g., Stewart et al., 2006). Similarly, the division of social anxiety into interaction versus performance fears may be important in light of mixed findings regarding which component may be more strongly related to problematic alcohol use. For example, Thomas et al., (1999) found that socially anxious individuals reported drinking during interaction-based situations more so than performance situations. On the other hand, Buckner and Schmidt (2009) found that performance (but not interaction) concerns were prospectively related to alcohol problems. Further research is needed to help clarify these relationships.

Selecting for Level of Experience with Alcohol. Another consideration in any study that involves the administration of alcohol is whether or not to include participants who have drinking problems and/or who meet criteria for an alcohol use disorder. This consideration is important when studying how alcohol affects social anxiety since a primary goal of this research area is to determine why social anxiety disorder and alcohol use disorders tend to co-occur (Grant et al., 2004; Kessler et al., 1997). The exclusion of individuals with alcohol use disorders has been criticized in the past (e.g., Carrigan & Randall, 2003) due to findings indicating that heavy and/or problem drinkers use and respond to alcohol differently than light drinkers (e.g., Eddy, 1979; Zarantonello, 1986).

Others have argued that by excluding those with alcohol use disorders, researchers can target how the development (as opposed to the maintenance) of an alcohol use disorder may occur in those with social anxiety disorder (Abrams et al., 2001). Regardless of the theoretical rationale for including or not including those with alcohol use disorders, ethical considerations make the inclusion of those with an alcohol use disorder difficult. For example, the National Advisory Council on Alcohol Abuse and Alcoholism (NIAAA, 2005) recommends that alcohol-dependent participants be medically examined and screened before taking part in research to rule out conditions that could be worsened by consuming alcohol. They also recommend that treatment-seeking status, and duration of abstinence be assessed. Taken together, including participants with alcohol use disorders is simply not feasible at many research institutions.

The result is that most alcohol administration studies recruit “social drinkers” often defined as those who consume at least one drink per month (e.g., Abrams et al., 2001; Abrams et al., 2002a; Abrams, et al., 2002b; Kidorf & Lang, 1999). However, typical alcohol consumption is not assessed in some of the experiments, making it impossible to know the specific level of alcohol consumption present in these samples. In studies that have included such measures, there is considerable variability regarding how much participants drink. For example, in Kidorf and Lang’s (1999) study, university-recruited participants reported consuming an average of 13.3 drinks per week (an average of nearly 2 drinks per day), whereas in Himle and colleagues’ (1999) study examining treatment-seeking individuals with social anxiety disorder, only 12% of the sample reported consuming more than 2 drinks per day. Given that there may be differences in how heavy drinkers respond to alcohol as compared to light drinkers, it is important that

studies collect information about typical drinking patterns. This information can then be used to control for typical alcohol consumption in the analyses if necessary and/or to provide sample description information that may be useful in comparing the results with other previous studies.

2.10.3 Alcohol Administration

Dose. The administration of alcohol in the lab generally takes one of two forms. Participants are either given a specific dose of alcohol with the goal of targeting a particular blood alcohol concentration (e.g., Abrams et al., 2001) or participants choose how much alcohol they would like to drink (e.g., Abrams et al., 2002; Holroyd, 1978; Kidorf & Lang, 1999; Samoluk & Stewart, 1996). In the former, the administration of alcohol is being manipulated as an independent variable, while in the latter, alcohol consumption is measured as a dependent variable. In studies that have used a specified amount of alcohol, the average blood alcohol concentrations reached by participants have varied widely across studies, ranging from 0.030% (Himle et al., 1999) to 0.074% (Steele & Josephs, 1988). According to Tension Reduction Theory, a dose response effect is predicted such that the drinker should experience increased anxiety-reduction as blood alcohol concentration increases. However, the situation may be more complicated in individuals with high levels of social anxiety as light drinking may lead to anxiety-reduction, whereas heavy drinking may lead to increased anxiety if the socially anxious individual fears appearing intoxicated and being judged negatively by others as a consequence. It is therefore important to consider how different aspects of the state social anxiety response may be affected at different dose levels in socially anxious individuals.

When participants choose how much alcohol they would like to consume (i.e., when amount of alcohol consumed is the study dependent variable), a number of different approaches have been taken. One such approach involves deception in that participants are told a cover story that they are taking part in a taste-rating task (e.g., Higgins & Marlatt, 1975; Samoluk & Stewart, 1996). In a taste-rating task, participants are told that they can consume as much or as little of the given alcoholic beverages as they like while they rate the beverages on a number of taste characteristics. In studies that have used this type of task, the blood alcohol concentrations reached are generally lower than when participants are required to drink a specific amount of alcohol (i.e., than in the alcohol challenge studies where alcohol administration is the independent variable). For example, Samoluk and Stewart (1996) found that participants high and low in anxiety sensitivity had an average blood alcohol concentration of only 0.01%. While overall levels of consumption in the taste-rating task may be low, it should be noted that there has been research indicating that the amount of alcohol participants consume during a taste-rating task is positively correlated with their typical alcohol consumption (Conrod, Stewart, & Pihl, 1997). On the other hand, when studies have allowed participants to choose how much alcohol to drink using a different approach, higher blood alcohol concentration levels have been found. For example, Holroyd (1978) gave participants unlimited access to beer while they were taking part in a social interaction and found that these participants achieved a mean BAC of 0.06%. These two studies differed in the amount of time that participants had to consume alcohol (15 minutes versus 1 hour), so this may partially explain why BAC was so variable across studies. The differences found in how much individuals chose to consume may also be related to whether or not they believed

that their drinking was being monitored due to potential reactivity effects (e.g., Kazdin, 1974).

As discussed above, consideration of the variability in BACs achieved across studies is important because differing doses of alcohol may uniquely affect levels of state social anxiety, and similarly, individuals may choose to consume differing levels of alcohol depending on their expectations of how different doses of alcohol will affect their state social anxiety.

A final point worth considering is the effectiveness of the expectancy condition manipulation when a balanced placebo design is used. It is important to determine whether participants who were told they were drinking actually *believed* that they had consumed alcohol. This has usually been addressed by including an overall manipulation check for the study asking participants what type of beverages they consumed, having them rate their subjective level of intoxication, having them estimate the amount of alcohol they consumed and/or their BAC, and/or asking them if they thought the experimental procedure deviated in any way from what they had been told (e.g., Abrams & Wilson, 1979; deBoer et al., 1994). In addition to conducting such overall manipulation checks, researchers should also consider analyzing data both with and without those who did not believe in the expectancy manipulation to see if this has an effect on the outcomes.

Types of Alcohol Used. In the majority of studies involving alcohol administration with the goal of targeting a specific BAC, vodka has been the type of alcohol employed (e.g., Abrams & Wilson, 1979; Abrams et al., 2002a; Abrams et al., 2002b; Himle et al., 1999; Wilson & Abrams, 1977). Vodka is often chosen because of

its relatively innocuous smell and taste, which allows for its effective use in studies that employ a placebo condition. In studies that have involved allowing participants to choose the amount of alcohol that they would like to consume, a variety of alcohol types have been used, including beer (e.g., Holroyd, 1978), wine (e.g., McNair, 1996), and various distilled spirits (e.g., Samlouk & Stewart, 1996). It is important to note that there is some evidence indicating that people hold different attitudes towards types of alcohol and may associate types of alcohol with specific consequences (Klein & Pittman, 1990) or hold different expectancies depending on the type of alcohol (Devoulyte, Stewart, & Theakston, 2006). Of particular relevance here, Klein and Pittman (1990) found that individuals reported believing that drinking distilled spirits was not appropriate during social occasions when the goal was to reduce anxiety.

Drinking Context. A further consideration worth noting in studies that involve alcohol administration is the context in which the drinking occurs. Some studies (e.g., Abrams et al., 2001; Abrams et al., 2002; Holroyd, 1978) have run participants in groups and therefore, participants were drinking in the presence of others. On the other hand, many studies have run participants individually (e.g., Abrams & Wilson, 1979; Wilson & Abrams, 1977). In some cases, participants watch an emotionally neutral film while they consume their beverages (Abrams et al., 2001), or look at magazines (Josephs & Steele, 1990). There is evidence indicating that both the likelihood of consuming alcohol and alcohol's effects on state social anxiety may vary depending on the context in which the individual is drinking. For example, Wigmore and Hinson (1991) found that individuals tend to consume more alcohol in naturalistic settings than in laboratory or hospital settings. Wall, McKee, and Hinson (2000) found that drinkers' beliefs about the effects of

alcohol varied by the context in which the alcohol outcomes expectancies measure was completed. Undergraduate participants who were tested in an on-campus bar expected more positive alcohol-related outcomes (i.e., stimulation/perceived dominance and pleasurable disinhibition) than those tested in a laboratory setting. It is possible that these differences in expectancies could affect likelihood of consuming alcohol and the amount of alcohol consumed, as well as the experienced effects of alcohol on state social anxiety. In a meta-analysis of alcohol cue reactivity in balanced placebo studies, McKay and Schare (1999) found the greatest pharmacological and expectancy effects in the natural environment (i.e., an easy chair or similar to a home context) setting ($n = 14$) as compared to experimental laboratory ($n = 40$) or bar-laboratory ($n = 10$) settings. Given these differences, careful consideration of the drinking environment for use in alcohol administration research is warranted. Based on the limited empirical evidence available, such research should be conducted in naturalistic or ecologically-valid laboratory settings that most closely resemble those situations in which participants themselves are likely to consume alcohol. Specific to social anxiety, it would be important to include a drinking context that either is a social anxiety-provoking situation in which the person often drinks in an effort to reduce state social anxiety or a context in which he or she typically consumes alcohol in anticipation of or following a socially stressful situation (e.g., at home prior to a social gathering).

2.10.4 Tasks Used to Induce Social Anxiety

The types of state social anxiety-provoking tasks used in this area of alcohol research include giving a self-disclosing speech (Himle et al., 1999; Lewis & Vogeltanz-Holm, 2002; McNair, 1996); talking to a confederate (Abrams & Wilson, 1979; Wilson

& Abrams, 1977); informally talking to other participants (Holroyd, 1978); and resolving moral dilemmas in a public context (Abrams et al., 2001). The length of time that participants engage in these activities has ranged from 60 seconds (Abrams et al., 2001) to 60 minutes (Holroyd, 1978), with the majority lasting for about 3 minutes (e.g., Josephs & Steele, 1988; Sayette, Contrada, & Wilson, 1990). Although this is a relatively short amount of time, it has been shown that these tasks effectively induce state social anxiety in sober participants. These tasks are also typically videotaped, and participants are often told that their performance will be evaluated (e.g., Abrams et al., 2002a; Lewis & Vogeltanz-Holm, 2002).

The two main types of social situations feared by socially anxious individuals can be classified as social performance situations and social interaction situations (e.g., Heimberg et al., 1999). Most of the aforementioned tasks can be considered performance-based tasks. Even when talking to a confederate has been used as a task (e.g., Wilson & Abrams, 1977), in most studies the interaction is structured such that the participant talks, while the confederate simply sits and listens with a neutral expression on his/her face. It is important to consider the external validity of these performance-based tasks. There is evidence to suggest that individuals with social anxiety disorder drink to cope with social interactions more often than they drink to cope with performance situations (Thomas et al., 1999). Furthermore, it was found by Abrams and colleagues (2002a) that participants reported concerns that consuming alcohol prior to giving a speech would impair their performance on the speech. Taken together, it is important that researchers use more interaction-based anxiety-provoking tasks in this area of research as these may be more

representative of the types of situations that would motivate socially anxious individuals to drink alcohol.

2.10.5 Social Anxiety Outcome Measures

Physiological measures. In order to measure levels of physiological responses thought to be associated with anxiety, researchers have monitored participants' heart rate (e.g., Abrams et al., 2001; Sher et al., 2007), and/or skin conductance (e.g., Sher et al., 2007). Theoretically, it is important to consider how well these physiological measures correspond to social anxiety. Measures such as heart rate are influenced by a number of factors and may not be due to one's level of state anxiety. Fowles (1983) suggested that skin conductance was a better indicator of state anxiety than heart rate; however, it seems that many researchers in this area have continued to look at heart rate as an indicator of state social anxiety. Future research could explore how alcohol affects other physiological indices that are closely linked to state social anxiety (e.g., blushing; Hofmann, Moscovitch, & Kim, 2006).

Sayette (1993b) provides a review of some important considerations when using heart rate as a measure of stress in alcohol research. These considerations will not be discussed in detail here, but a few important points should be noted. First, consuming a moderate dose of alcohol can lead to *increased* baseline heart rate when measured after a sufficient absorption time (30-40 minutes) and with more time, heart rate begins to decrease. This is important to consider in relation to the timing of the anxiety manipulation in most studies, which is usually implemented right after the absorption period. This is problematic because when heart rate is measured at this time, it is unclear whether heart rate is decreasing after initial increases due to alcohol or if alcohol is

creating an anxiety-reducing effect when participants are exposed the stressor. Therefore, it is important to include post-drinking baseline measures of heart rate *after* participants have consumed alcohol so that researchers can determine how the introduction of their anxiety manipulation affected heart rate, independent of alcohol's effects. A second important point to note is that the expectation that one is consuming alcohol when they actually are not (i.e., in placebo conditions) can lead to an initial *decrease* in heart rate (e.g., Stewart, Finn & Pihl, 1992).

A potential explanation for this initial decrease in heart rate is that a *compensatory response* has been conditioned such that when a drinker anticipates drinking alcohol, his or her body prepares for the expected increase in heart rate by producing the opposite reaction. Furthermore, the decreases in heart rate seen in placebo conditions then increase and return to baseline levels over time. Hence, when the stressor is introduced, one needs to determine whether increases in heart rate are due to the stressor or due to the return of heart rate to baseline levels. To help eliminate these potential confounds, researchers have typically ensured that a sufficient amount of time has elapsed since the alcohol administration so that heart rate adjusts to baseline levels before introducing the stressor (e.g., Sher et al., 2007).

Similar to heart rate, skin conductance has also been found to initially increase after alcohol consumption and to decrease when one is in the placebo condition (Sher et al., 2007) probably through some of the same mechanisms as the effects on heart rate. Sayette (1993b) suggested that studies should include no-stress control groups, or participants who undergo the alcohol or placebo manipulation, but then do not receive the stressor. Then, investigators could compare these groups (whose changes in heart

rate/skin conductance would be solely due to the alcohol manipulation) to groups who receive the stressor (whose heart rate/skin conductance would be affected by both the alcohol manipulation and the stressor manipulation). Unfortunately, few researchers in the social anxiety and alcohol area have followed Sayette's (1993) suggestion and included a means of examining which physiological changes are due to the effects of alcohol and which are due to the introduction of the stressor.

Self-Report Measures. The most common self-report measure of state anxiety that is used in lab-based alcohol studies is the State form of the State-Trait Anxiety Inventory (STAI-S; Spielberger, Gorsuch, & Lushene, 1970). This scale contains 20 items designed to assess anxiety-related symptoms rated on a 4-point scale ranging from *not at all* to *very much so*. Some researchers have altered the 4-point rating scale to contain 7-points in order to make the scale more discriminative (e.g., Sayette et al., 1992; Steele & Josephs, 1988). Other measures of state social anxiety that have been used include: The Subjective Units of Distress (SUDS; Wolpe, 1958), the Audience Anxiousness Scale (AAS; Leary, 1983), and the Multiple Affect Adjective Checklist (Zuckerman & Lubin, 1965). Some studies (e.g., Abrams et al., 2001) have also used visual analogue scales that have participants rate their somatic distress, mental distress, and fear of negative evaluation on scales anchored at 0 (*not at all*) and 100 (*severely*). Researchers may consider matching their state social anxiety measure with the type of anxiety-provoking task that is to be used in the study. For example, if a social interaction is to be used, then administering a measure of social anxiety that targets interaction-based fears may be appropriate. Additionally, since the issue of how different aspects of trait social anxiety are related to drinking is only beginning to be addressed, future studies

may consider incorporating a multi-dimensional assessment of various aspects of social anxiety in order to continue to clarify which aspects are most closely and uniquely predictive of heavy/problem drinking.

One caution against the use of self-reports in this area of research is that alcohol may lead to an impaired ability to be introspective (Sayette, 1993). However, one should also note that an impaired ability to be introspective (i.e., decrease self-awareness) has also been proposed as a potential mechanism by which alcohol reduces state anxiety (Hull, 1981). A further caution is that scores on a measure of social desirability were found to be related to decreased self-reported anxiety irrespective of whether or not participants had consumed alcohol (Sayette, et al., 1990) suggesting that these self-reports are heavily influenced by demand characteristics. For these reasons, it is recommended that self-reports be accompanied by other measures of state social anxiety (physiological, behavioural, and/or cognitive) in order to confirm participants' subjective reports.

Behavioural Measures. The use of behavioural ratings to assess levels of anxiety in participants is less common than the use of physiological and self-report measures. Since many researchers videotape the anxiety-provoking task that they have participants engage in, it is feasible to have raters blind to the purpose of the study watch the tapes and rate participants on a number of factors. For example, Abrams and Wilson (1979) had observers rate participants on ten bipolar adjectives (e.g., *extremely anxious-not at all anxious; spontaneous-inhibited; totally relaxed-extremely tense*). Facial affect coding is another method that has been used to behaviourally rate participants (Sayette et al., 2001). Finally, some have included an assessment of social skills as a behavioural

measure (e.g., Keane & Lisman, 1980). Future researchers should explore other behavioural indices of state social anxiety such as gaze aversion (Hofmann, Gerlach, Wender, & Roth, 1997), and “masking” (face covering to hide emotions from others; Kushner et al., 1997) in order to more comprehensively understand how alcohol affects state social anxiety. It may also be important to explore how alcohol affects the use of the safety behaviours (i.e., attempts to hide social anxiety such as nervous laughter; Clark & Wells, 1995) that are common among individuals with social anxiety. This could be achieved using behavioural observations of participants who are engaged in a social anxiety-provoking task. This topic is explored in Study 1 of the present dissertation (see Chapter 4).

Cognitive Measures. Researchers have also looked directly at how alcohol may affect a number of cognitive variables. These have included self-reports of negative and positive thoughts related to a social anxiety-provoking task (Abrams et al., 2002b), general attentional processes (i.e., performance on a continuous performance task; Sher et al., 2007), attentional processes specific to social threat (i.e., performance on an emotional Stroop task involving social threat words; Gerlach et al., 2006), and interpretation of social anxiety relevant stimuli (i.e., ratings of facial emotions; Stevens et al., 2008). These measures are important because they may tap into cognitive mechanisms that help explain how alcohol leads to decreased state social anxiety. Moreover, cognitive variables are particularly relevant in the area of social anxiety as there is a large amount of research indicating that cognitive factors play a role in maintaining social anxiety (Clark & Wells, 1995; Rapee & Heimberg, 1997). For example, post-event processing (i.e., dwelling on events after they happen) has been

found to contribute to the maintenance of social anxiety (see Brozovich & Heimberg, 2008 for a review). Recently, research (e.g., Battista & Kocovski, 2007) has begun to explore how alcohol may affect post-event processing using experimental designs. This is also the topic of Study 2 in the present dissertation (see Chapter 6). Studies of this nature may be important in providing a more comprehensive examination of how alcohol affects processes that persist long after the individual has left the social situation and/or is no longer intoxicated. Further, more sophisticated methods of assessing the processing of social threat information are available (e.g., the Dot Probe task; Mogg & Bradley, 1999) and should be considered for future studies on the relationship of social anxiety and alcohol (e.g., see Cisler, Bacon, & Williams, 2009).

Drinking Outcome Measures. In lab-based studies where social anxiety is manipulated and effects on drinking are examined, it may be important for future research to make the distinction between *quantity* of alcohol consumed and *problems* associated with alcohol use. When considering questionnaire-based methods, as was discussed in the introduction, there have been inconsistent findings regarding the relationship between social anxiety and alcohol use in non-clinical samples. Some studies have reported a positive correlation between social anxiety and alcohol consumption (e.g., Buckner, et al., 2006; Kushner & Sher, 1993; Lewis & O'Neill, 2000; Neighbors, et al., 2007), while some have reported no significant relationship (e.g., Bruch, et al., 1992; Bruch, et al., 1997; Buckner et al., 2006; Gilles et al., 2006; Ham, Hope, White, & Rivers, 2002; Lewis et al., 2008; Thomas, et al., 1999), and still others have found social anxiety to be negatively related to alcohol consumption (e.g., Eggleston, et al., 2004; Ham, et al., 2007; Ham & Hope, 2005; Holle, et al., 1995; Lewis et al., 2008; Myers, et

al., 2003). However, when researchers have considered problematic alcohol use rather than frequency or quantity of use, findings have consistently shown a positive relation between social anxiety and alcohol *problems* (e.g., Buckner & Schmidt, 2009; Buckner, et al., 2006; Buckner et al., 2008; Buckner & Turner, 2009; Gilles, et al., 2006; Grant, et al., 2005; Lewis et al., 2008; Stewart, et al., 2006). These findings have led some researchers to propose that perhaps individuals with social anxiety do not drink alcohol more frequently or in greater quantities, but rather, their drinking may result in more negative consequences. Given this consideration, it is important to examine both alcohol use (e.g., frequency and quantity) and misuse (e.g., problems related to drinking) as separate constructs. In lab-based studies, this may involve developing and implementing methods that capture problematic alcohol use rather than focusing solely on quantity. For example, researchers could include self-report or behavioral measures of risk-taking while intoxicated to determine if trait social anxiety is associated with a greater likelihood of engaging in risky behaviors after consuming alcohol.

2.11 SUMMARY AND FUTURE DIRECTIONS

Though there have been a large number of studies examining the relationship between social anxiety and alcohol, the majority of published work in the area has not employed laboratory-based methodologies. Thus, I have reviewed the lab-based studies that have been conducted to examine how drinking affects social anxiety and vice versa – how social anxiety affects drinking. The review was divided into sections based on the most prominent theories that have been proposed in this area.

When considering the Tension Reduction Theory, it would be expected that alcohol would lead to decreased social anxiety and that individuals would chose to

consume alcohol when feeling socially anxious. At the core of this theory is the view that alcohol's pharmacological properties are responsible for anxiety-reduction. However, in the studies that were reviewed, there is limited evidence that alcohol leads to pharmacological anxiety-reduction (deBoer et al., 1993 found a pharmacological effect when looking at self-reports and Sayette et al., 1992 found an effect when considering behavioural indices of anxiety). On the other hand, it has been found that the expectation of alcohol may lead to decreased social anxiety in undergraduate men (Sayette et al., 1992; Wilson & Abrams, 1977; Woolfolk et al., 1979), undergraduate women (de Boer et al., 1993), and in individuals with social anxiety disorder (Abrams et al., 2001). In sum, these studies suggest that anxiety-reduction may be primarily due to an expectancy effect of alcohol, rather than a primarily pharmacological effect.

In relation to the second prediction made by Tension Reduction Theory-- that individuals will choose to consume alcohol when they feel socially anxious -- there are mixed findings. This hypothesis was not supported in a sample of female undergraduate students (McNair, 1996). On the other hand, it was found that individuals with social anxiety disorder (Abrams et al., 2002b) and community-recruited individuals (de Wit et al., 2003) chose to drink stronger or more alcohol beverages after they had engaged in a social anxiety-provoking task compared to a neutral task. Taken together, these findings do not support the notion that individuals will choose to consume alcohol when they are experiencing social anxiety. Rather, it may be important to consider the nature of the task that participants are to engage in. If alcohol is believed to impair performance on the task, then participants may choose not to consume alcohol before doing the task, but rather, may drink afterwards to help cope with residual state social anxiety.

I then reviewed studies that examined the Stress Response Dampening model, which predicts that the effect of alcohol on social anxiety would be affected by individual difference variables and similarly, the choice to consume alcohol when experiencing social anxiety would also be affected by these same individual difference variables. When considering individual difference variables, there is evidence that increased levels of anxiety sensitivity (Lewis & Vogeltanz-Holm, 2002), and tension-reduction or social lubrication alcohol expectancies (Abrams & Kushner, 2004; de Boer, et al., 1994), may be associated with greater anxiety-reduction. However, surprisingly no studies have examined trait social anxiety specifically. In one study (Naftolwitz et al., 1994) that compared a sample of individuals with social anxiety disorder to control participants, unexpectedly, no differences in alcohol-induced anxiety-reduction were found.

Findings regarding whether individuals with certain individual difference characteristics will choose to consume more alcohol when anticipating an anxiety-provoking task are mixed. When looking at trait levels of social anxiety, Holroyd (1978) found that when compared to non-socially anxious participants, a socially anxious group of males chose to drink *less* alcohol while engaged in a social interaction. Conversely, Kidorf and Lang (1999) found *increased* alcohol consumption in a sample of males and females who were anticipating a social anxiety-provoking task compared to a neutral task and that this was especially true in participants who scored higher on a measure of trait social anxiety. Further, females high in anxiety sensitivity may choose to consume more alcohol when anticipating a particular type of social interaction – one resembling “small talk” (Samluluk & Stewart, 1996). Finally, it was found that males who expected alcohol to improve their social skills consumed more alcohol before taking part in a social

interaction (Knight & Godfrey, 1993). In sum, it is important to consider individual difference variables in this area of research given findings that trait social anxiety, anxiety sensitivity, and relevant positive alcohol outcome expectancies can all influence the link between social anxiety and alcohol intake.

In relation to the more cognitively-based theories that describe how alcohol may lead to decreased social anxiety, there is some evidence that alcohol consumption may lead to decreased self-awareness in socially anxious men (Keane & Lisman, 1980, Study 1) and men and women not specifically chosen for social anxiety levels (Yankofsky et al., 1986). However, despite changes in self-awareness in each of these studies, differences in self-reported state social anxiety were not found across groups. This may be an indication that although alcohol may interfere with self-awareness, these changes in self-awareness may not necessarily lead to reductions in state social anxiety.

There is also evidence from community-recruited (Sher et al., 2007) and university student samples (Josephs & Steele, 1990; Steele & Josephs, 1988) that state social anxiety-reduction from alcohol is more likely to occur when the drinker is attending to other (non-social anxiety relevant) cues in the environment. Further, it has been found that in individuals with social anxiety disorder, alcohol may lead to fewer negative thoughts about their performance, which may be an indication that their attention shifts when consuming alcohol (Abrams et al., 2002).

Finally, research consistently supports that the temporal sequence of drinking relative to learning about a social stressor plays a role in anxiety reduction such that when a social stressor is presented to participants after they have been drinking, greater anxiety reduction occurs compared to when the social stressor is presented before drinking

(Sayette et al., 1989; Sayette et al., 2001; Sayette & Wilson, 1991; Zack et al., 2007).

This is believed to occur because alcohol interferes with the initial appraisal of potentially threatening information, therefore, rendering social information less threatening. It should be noted, however, that in a sample of women with social anxiety disorder, alcohol was not found to interfere with selective attention toward social threat words (Gerlach et al., 2006). Therefore, it may be important to further explore the Appraisal Disruption model in samples of individuals with high levels of social anxiety.

In this review, I have outlined a number of methodological considerations relevant to lab-based experimental studies examining the relationship between social anxiety and alcohol. Based on the considerations that were discussed above, I have a number of recommendations for future research in this area. First, it is important to consider the type of sample that is being used. The decision to use student samples or community-recruited samples can have important implications given that the relationship between social anxiety and alcohol use may not be the same across these samples. Researchers also need to consider whether to recruit participants who have high levels of social anxiety and how representative these participants are of a typical socially anxious individual (i.e., many of whom would not volunteer to take part in research). Further, researchers should consider how much alcohol participants typically drink. It is recommended that all studies in this area include both a measure of trait social anxiety and a measure of typical alcohol consumption so that the impact of these variables can be examined and the average levels and range on these variables can be reported for the overall sample to allow for ready comparison across studies.

Regarding the alcohol administration process, researchers should use standardized formulas to determine how much alcohol is needed to achieve a desired blood alcohol concentration (BAC) and should also report in their findings what the actual BAC was when they introduced their anxiety manipulation. In studies that allow participants to choose how much they would like to drink, it is also important to consider that different procedures may lead participants to achieve different BACs and again, these should be reported. The type of alcohol given should also be carefully considered given that individuals may have different attitudes and expectancies depending on the type of alcohol used (Devoulyte et al., 2006; Klein & Pittman, 1990). Finally, contextual variables such as whether the drinking occurs alone or in a group, and where the drinking takes place (e.g., sterile lab versus naturalistic setting) need to be considered. I recommend that the lab setting be set up to be as similar as possible to the type of setting where participants would normally drink (e.g., creating a comfortable area that resembles a living room or creating a bar setting).

Researchers must also carefully consider what type of social anxiety-inducing task to use. To date, most research has used performance-based tasks (e.g., Himle et al., 1999; McNair, 1996). It has been found that individuals with social anxiety disorder drink to cope with social interactions more so than social performance situations (Thomas et al., 1999). Further, experimental findings indicate that alcohol decreased social anxiety in anticipation of a social interaction, but not in anticipation of a speech task (Ham, 2009). Given these findings, I recommend that future researchers employ more interaction-based, rather than performance-based, tasks. This could include taking part in a conversation with a confederate or with another participant.

When examining how alcohol affects social anxiety, a number of different outcome measures have been used including physiological, behavioural, subjective-emotional, and cognitive indices. Although each of these measures has its limitations, I recommend that researchers consider using multiple outcome measures and/or consider outcomes that have not been previously investigated (e.g., behavioural and cognitive measures that may be particularly relevant to those with social anxiety).

Despite decades of empirical work examining the connection between social anxiety and alcohol using laboratory-based methods, it is still difficult to draw solid conclusions that explain when, why, and for whom alcohol leads to decreased state social anxiety and vice versa- when, why, and for whom state social anxiety leads to increased alcohol consumption. There is still a great deal of research to be done in this area to help gain a better understanding of the high comorbidity between social anxiety disorder and alcohol use disorders. Clinically, individuals with both social anxiety disorder and an alcohol use disorder are more impaired and have less treatment success than those with either disorder alone (e.g., Randall et al., 2001; Schneier, Martin, & Liebowitz, & Gorman, 1989). With further research, one can begin to consider treatment programs that target socially anxious individuals' motivations for using alcohol and what they specifically find reinforcing about the effects of alcohol. Treatment can then be focused on reducing the need to use alcohol for its reinforcing effects and fostering other means of successfully navigating social situations. I have outlined a number of methodological considerations and given some suggestions for future research that I hope will help to guide the next generation of researchers in this complex and important clinical area.

CHAPTER 3: PROLOGUE TO STUDY 1

As discussed in the previous comprehensive review paper (Chapter 2), there are numerous theories that make predictions regarding the association between social anxiety and alcohol. According to Tension Reduction Theory (Conger, 1951), one would expect individuals to consume alcohol when feeling socially anxious and to also experience decreased state social anxiety when consuming alcohol. The findings with regards to these predictions are, however, mixed. There is little evidence that people will choose to consume more alcohol when *anticipating* an upcoming anxiety-provoking task, but they may drink more alcohol *after* completing the task (e.g., Abrams et al., 2002a; de Wit et al., 2003; McNair, 1996). When considering the effect of alcohol on state social anxiety *during* an anxiety-provoking task, there is evidence that it results in a dampening of social anxiety when measured via self-reports (e.g., Abrams et al., 2001), physiological measures (e.g., Wilson & Abrams, 1977), and behavioral indices (e.g., Woolfolk et al., 1979). But again, the findings are not always consistent with many studies failing to find these effects (e.g., Himle et al. 1999).

Given mixed findings in this area, the Stress-Response Dampening Model (Sher & Levenson, 1982) was developed to explore a number of individual difference variables that may influence the social anxiety-alcohol link. Of note, trait social anxiety (e.g., Kidorf & Lang, 1999), anxiety sensitivity (e.g., Lewis & Vogeltanz-Holm, 2002; Samoluk & Stewart 1996), and alcohol expectancies (e.g., Knight & Godfrey, 1993) are three variables that may be associated with how much individuals choose to consume before engaging in anxiety-provoking tasks and also the amount of anxiety-reduction experienced when consuming alcohol.

A number of theories have also discussed the specific mechanism by which alcohol may lead to social anxiety reduction. Namely, Hull's (1981) Self-awareness Model has received some support for the hypothesis that alcohol results in decreased self-awareness (e.g., Keane & Lisman, 1980; Study 1), but changes in self-awareness have not been specifically examined as a mediator of the relationship between alcohol and state social anxiety reductions. The Attention-Allocation Model (Steele & Josephs, 1980) has been well-supported in studies indicating that when one's attention is directed towards a distraction task, alcohol is more likely to result in anxiety reduction than when no distraction is given (Josephs & Steele, 1990; Sher et al., 2007). Finally, the timing of alcohol consumption relative to exposure to the anxiety-provoking task may be important as outlined in Sayette's (1993) Appraisal Disruption Model. When the anxiety-provoking task is presented to participants after they have consumed alcohol, then greater anxiety-reduction has been found compared to when it is presented before consuming alcohol (e.g., Sayette et al., 1989).

Despite the multitude of studies conducted in this area, there are a number of important considerations and limitations that still need to be addressed in future research. One goal of the current dissertation was to expand on previous work, while focusing closely on improving methods to respond to some of the limitations in the extant research outlined in Chapter 2. As such, Chapter 4 describes a lab-based, experimental study that was conducted to examine the effects of alcohol on state social anxiety in a socially anxious sample. This study builds on existing research by not only examining subjective state social anxiety, but also looking specifically at four behavioral indices that are relevant to those who experience social anxiety. This study is also relatively unique in

that it used an anxiety-provoking task that was interaction-based (i.e., having a conversation) rather than performance-based (i.e., giving a speech). Findings from this study contribute to understanding of how alcohol affects the behavior of socially anxious individuals in situations that they are likely to encounter in their day-to-day life.

CHAPTER 4: STUDY 1- THE EFFECTS OF ALCOHOL ON SAFETY BEHAVIORS IN SOCIALLY ANXIOUS INDIVIDUALS²

Abstract

Experimental studies have assessed alcohol's effects on state social anxiety using self-reports or physiological indices. This study investigated whether alcohol affected observer-rated 'safety behaviors' in a sample of socially anxious participants. It was hypothesized that alcohol would lead to increased eye contact and speaking time, and decreased nervous laughter and latency to respond to questions during a social interaction. Eighty-eight high social anxiety participants were randomly assigned to an alcoholic or non-alcoholic beverage condition and then took part in a videotaped social interaction with a trained confederate. Videos were coded for participant safety behaviors as well as confederate behavior. Alcohol had the hypothesized effect of increasing the length of time participants spent speaking during the interaction. Interestingly, confederates interacting with socially anxious participants in the alcohol condition behaved more positively toward them than confederates interacting with control beverage condition participants. Implications for understanding the high comorbidity of social anxiety disorder with alcohol use disorders are discussed.

² Adapted from Battista, S.R., MacDonald, D., & Stewart, S.H. (2012). The effects of alcohol on safety behaviors in socially anxious individuals. *Journal of Social and Clinical Psychology, 31*, 1074-1094. Copyright (2012) with permission from the Guilford Press. As first author of this paper, I designed the study, organized participant recruitment, collected data by running participants through the study protocol, entered all data into the database, conducted the data analyses, wrote the manuscript, and revised the manuscript while incorporating feedback from my co-authors, the peer reviewers and the journal editor.

4.1 INTRODUCTION

Social anxiety disorder and alcohol use disorders have been found to co-occur at rates that exceed chance (e.g., Schneier et al., 2010). This high comorbidity has been explained by mechanisms proposed in the tension reduction hypothesis (Conger, 1951), which postulates that individuals learn to drink alcohol as a means of reducing anxiety. Most experimental investigations in this area have focused on how alcohol affects self-reported (e.g., Abrams et al., 2001) and/or physiological (e.g., heart rate; Abrams & Wilson, 1979) measures of social anxiety. For example, Abrams and colleagues (2001) showed that alcohol dampened self-reported social anxiety in socially anxious participants anticipating an upcoming speech. Such findings suggest that alcohol may provide negative reinforcement by reducing state social anxiety. However, few researchers have examined how alcohol affects observable, behavioral indices of social anxiety.

In particular, few studies have explored whether alcohol affects the use of *safety behaviors*, a set of observable indices of anxiety that are proposed to decrease anxiety in the short-term, but increase and/or maintain it in the long-term (Clark & Wells, 1995). In the case of social anxiety, safety behaviors involve behavioral attempts to hide social anxiety from others (e.g., avoiding eye contact; Clark & Wells, 1995). While socially anxious individuals may use safety behaviors in an attempt to control anxiety, safety behaviors may actually maintain social anxiety in the longer term because they do not allow individuals to disconfirm unrealistic beliefs and/or feared consequences when in social situations (e.g., Salkovskis, 1991).

McManus and colleagues (2008) found that high social anxiety participants used a

larger number and greater diversity of safety behaviors in a broader range of social situations compared to low social anxiety controls. Although both high and low socially anxious individuals believed that their safety behaviors were helpful in reducing anxiety, when participants were specifically instructed to be self-focused *and* engage in safety behaviors during a conversation, they reported *more* social anxiety than when they were asked only to be self-focused. Other studies have shown that reducing the use of safety behaviors during an exposure leads to greater decreases in self-reported anxiety compared to exposure alone (e.g., Kim, 2005; Wells, et al., 1995). Thus, while socially anxious individuals may perceive safety behaviors to be helpful, such behaviors may actually exacerbate or maintain social anxiety.

This study was designed to investigate the effect of alcohol on four social anxiety-relevant safety behaviors (i.e., eye contact, amount of time speaking, latency to respond to a question, and nervous laughter) measured during a social interaction. There is some, albeit limited, evidence to suggest that alcohol may reduce the use of safety behaviors. For example, Kushner and colleagues (1997) found that alcohol decreased the use of a safety behavior called ‘facial masking’ (covering one’s face to hide fear or distress from others) among panic disorder patients undergoing an arousal induction. Further, Caudill, and colleagues (1987; Experiment 1) found that a mild dose of alcohol led an unselected sample of males to engage in more self-disclosure during a social interaction with a female confederate. The goal of the current study was to extend these findings to individuals selected for high trait social anxiety, given that this population is most likely to exhibit social anxiety-relevant safety behaviors (McManus et al., 2008) and is also the most theoretically relevant population for examining the link between social anxiety and

alcohol.

It was hypothesized that socially anxious individuals who consumed alcohol before taking part in a social interaction would engage in fewer safety behaviors than individuals who consumed a non-alcoholic control beverage prior to the interaction. Specifically, it was expected that those who consumed alcohol would exhibit more eye contact, speak for a greater amount of time, respond more quickly to questions, and engage in less nervous laughter than those who consumed a non-alcoholic control beverage. As this was the first alcohol challenge study to examine safety behaviors in socially anxious individuals, I wished to establish the effects of alcohol regardless of whether they were pharmacologically- and/or cognitively-mediated. Thus, I opted for a design where participants were randomized to receive either an alcoholic or a non-alcoholic control beverage (see Ellery, Stewart, & Loba, 2005). Participants were aware of their beverage group assignment and no placebo (expectancy) control was utilized. In addition, a self-report measure of state social anxiety was also administered. Consistent with previous findings (e.g., Abrams et al., 2001), it was expected that alcohol would dampen increases from baseline in self-reported state social anxiety during the social interaction, relative to the non-alcoholic control beverage.

4.2 METHOD

4.2.1 Participants

A total of 555 individuals completed a screening interview for the current study. Of those individuals, 135 (24%) were eligible to participate (see eligibility criteria below). A total of 101 individuals took part in the current study, while 34 of the eligible participants were unavailable or lost interest in the study. Of the 101 who completed the

study, 13 were excluded for various reasons (e.g., technical errors made videos of the interaction unavailable for coding). The final sample consisted of 88 students (46 males and 42 females) between the ages of 19 and 28 ($M = 21.22$, $SD = 2.04$) years. The sample was 90.5% White, with 6.0% identifying as Black, and 3.5% as Asian. In addition, 54.5% of individuals reported that they were single, while the remaining 45.5% indicated that they were in a romantic relationship. Participants did not differ across beverage conditions on demographic variables (see Table 1).

Selection Criteria. Participants were administered a phone screening interview to ensure that they met the following study inclusion criteria: (a) A score of one standard deviation or more above the norm (i.e., females ≥ 29 ; males ≥ 30) on the Social Interaction Anxiety Scale (Mattick & Clarke, 1998); (b) Have consumed two or more alcoholic beverages on a single occasion, at least twice within the last month to ensure that participants had sufficient experience consuming a dose of alcohol comparable to what they would receive in the lab; (c) No allergies or taste aversions to vodka and orange juice; (d) No medical conditions that prohibited drinking alcohol; (e) No use of medications that could interact negatively with alcohol; (f) Scoring 5 or lower on the Brief Michigan Alcoholism Screening Test (Pokorny, Miller, & Kaplan, 1972); and (g) Female participants could not be pregnant, planning to get pregnant, or nursing a baby at the time of participation.

4.2.2 Measures

Demographic Questionnaire (DQ). This author-compiled questionnaire inquired about age, gender, relationship status (single vs. in a relationship), and race.

Daily Drinking Questionnaire (DDQ; Collins, Parks, & Marlatt, 1985). This

questionnaire asked participants how many drinks they typically consumed on each day of a typical drinking week during the past 30 days. This measure has been used previously in a wide range of studies with university students (e.g., Marlatt et al., 1998).

Rutger's Alcohol Problem Index (RAPI; White & Labouvie, 1989). On this 23-item measure, individuals respond using a 5-point Likert scale ranging from 0 ("never") to 4 ("greater than 10 times") to indicate how often they experienced a variety of negative consequences related to alcohol use in the past three years. The RAPI was developed specifically for use with adolescent and young adult populations, and has demonstrated strong internal consistency and convergent validity (White & Labouvie, 1989). It demonstrated good internal consistency in the current study ($\alpha = .84$).

Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998). The SIAS is a 20-item measure that assesses participants' level of anxiety in social situations (e.g., "I worry about expressing myself in case I appear awkward"). Each item is rated on a 5-point Likert scale ranging from 0 ("not at all characteristic or true of you") to 4 ("extremely characteristic or true of you"). This measure has demonstrated good internal consistency ($\alpha = .88-.94$) and test-retest reliability (r 's = .92) after one and three months (Mattick & Clarke, 1998). This measure was used to select for participants in the present study and demonstrated good internal consistency in our sample ($\alpha = .88$).

Social Phobia Scale (SPS; Mattick & Clarke, 1998). The SPS is the companion scale to the SIAS, also consisting of 20 items rated on a 5-point Likert scale. It assesses anxiety in social situations involving observation by others (e.g., speaking in public). This scale has demonstrated good internal consistency ($\alpha = .89-.94$) and test-retest reliability ($r = .91, .93$) at one and three months, respectively (Mattick & Clarke, 1998).

The SPS was used as an additional scale to describe the selected sample in terms of social anxiety levels. It demonstrated good internal consistency in the current study ($\alpha = .85$).

Blood Alcohol Concentration Readings (BAC). Participants provided several BAC readings throughout the experiment. The time points that were analyzed in the current study occurred: (1) immediately after participants consumed and absorbed their beverages (but before they completed the social interaction), and (2) immediately after they completed the social interaction. BAC was measured using a FC20 Lifeloc Breathalyzer, and measurements were in grams of alcohol per 100 ml of blood, expressed as a percentage.

Subjective Intoxication Rating Form (Himle et al., 1999). This measure had participants rate how intoxicated they felt on a scale ranging from 0 (“I feel completely sober”) to 10 (“I feel more drunk than I have ever felt before”) at each time their BAC was measured. This scale was used so that comparisons could be made to other alcohol administration studies regarding how intoxicated participants felt during the study.

Visual Analogue Scale-- State Social Anxiety (VAS; Abrams et al., 2001). Three scales (mental distress, somatic distress, and fear of negative evaluation) were used to measure participants’ subjective state anxiety. Participants were asked to make a mark along three separate 100 mm lines ranging from 0 (“not at all”) to 100 (“severely”) on each of the three scales. State social anxiety was measured at three time points in the current study: (a) *Baseline*: when participants first came to the lab and had not consumed alcohol; (b) *Post-Drinking*: taken 20 minutes after participants had completed consuming their drinks; and (c) *Social Interaction*: taken immediately after participants had taken part in the social interaction, but querying how they felt *during* the

social interaction. At each time point, the three scales were totaled for the subjective state social anxiety measure, which resulted in a possible range of scores from 0 to 300. The three-item scale showed acceptable to good reliability at each assessment point (Baseline $\alpha = .73$; Post-Drinking $\alpha = .74$; Social Interaction $\alpha = .81$). In data analysis, the baseline time point was included to ensure the two beverage conditions were comparable in state social anxiety prior to beverage administration or state anxiety induction, and the post-drinking and social interaction time points were included to assess state anxiety reactivity (i.e., change from post-drinking baseline due to the social interaction task).

Behavioral Coding. Safety behaviors were coded by two undergraduate psychology students who were trained by the first author. The first rater was female and was blind to the experimental conditions to which participants had been assigned. The second rater was male and was blind to both the experimental conditions and the hypotheses of the study. Raters overlapped and coded 16 (18%)³ of the same videos in order to determine inter-rater reliability (described below). Raters watched videos and coded for eye contact (the total length of time in seconds that the participant made eye contact with the confederate during the social interaction), nervous laughter (the amount of time in seconds that the participant engaged in nervous laughter, which was defined as laughter that was not provoked by the confederate during the social interaction), length of time speaking (the total amount of time in seconds spent speaking in response to questions posed by the confederate during the social interaction), and latency to respond

³ Based on sample size guidelines proposed by Walter, Eliasziw, and Donner (1998), it was determined that approximately 12-18 videos would need to be coded by both raters in order to achieve a desired intraclass correlation coefficient of 0.90 (assuming $\alpha = 0.05$, $\beta = 0.20$, $n = 2$ raters, and $\rho_0 = 0.60-0.70$).

(the total time in seconds it took to respond to questions posed by the confederate during the social interaction).

These four behaviors were chosen from the Social Phobia Safety Behavior Scale (SPSBS; Pinto-Gouveia et al., 2003) for several reasons. First, the 17 items on the SPSBS were narrowed down to six behaviors that could be observed in the context of a social interaction. Then, these were further narrowed to four behaviors that could be objectively coded using length of time measurements. Finally, a number of pilot videos were coded to ensure that raters could achieve consistent ratings on the four behaviors.

Confederate Coding. Two different raters (also undergraduate psychology students) who were blind to both the experimental conditions and the hypotheses of the study were trained by the first author to code confederate behaviors. One rater coded all videos, while the other coded a randomly selected subset of the videos (16 videos; 18%) to ensure inter-rater reliability. Raters coded confederates on an 8-point scale ranging from 1 (“not at all”) to 8 (“extremely”) on four adjectives (friendly, anxious, likeable, and cold). In addition, coders measured the amount of time in seconds that confederates made eye contact with the participants.

4.2.3 Procedure

Participants completed the screening interview and if they met inclusion criteria, were scheduled for a lab-based testing session. They were instructed not to consume alcohol or take any medications for 24 hours prior to participating in the study and not to eat for three hours prior to beginning the study.

When participants arrived at the lab, the researcher checked their identification to ensure that they were 19 years of age or older (the legal drinking age in the Canadian

province where this study was conducted). They then provided written informed consent and completed their first (baseline) rating of state social anxiety. Participants were then randomly assigned to either an alcohol or no alcohol control beverage condition. The experimenter then weighed the participant on a standard scale and left the room in order to prepare the participant's beverages.

The amount of alcohol administered to participants was calculated using a modified version of the standard formula developed by Fisher, Simpson, and Kapur (1987) that incorporated gender, body weight, and age (MacDonald, Baker, Stewart, & Skinner, 2000). A BAC of .07% was targeted in order to be consistent with Kushner and colleague's (1997) study. Alcohol was mixed in a 4:1 ratio of orange juice to vodka where the vodka was replaced with additional orange juice for participants in the no alcohol condition. While the experimenter prepared the beverages, participants completed the DQ, DDQ (Collins et al., 1985), RAPI (White & Labouvie, 1989), SIAS (Mattick & Clarke, 1998), and SPS (Mattick & Clarke, 1998) in counterbalanced order.

Once participants completed these measures, they were given 20 minutes to consume their assigned beverages, followed by a 20-minute absorption period. During this total 40-minute period, all participants watched the same nature film, which was selected to be emotionally neutral. BAC readings, subjective intoxication ratings, and state social anxiety measures were taken immediately after the 40-minute drinking and absorption phase of the study.

Participants were then informed that they would be engaging in a 15-minute,

video-taped social interaction with another participant⁴. The other participant was actually an opposite-gendered confederate in the study. Confederates were undergraduate psychology students who had been trained to criterion by the first author, which included behaving in an emotionally neutral manner during the interaction, while following a standard script. Once the confederate arrived, the experimenter gave instructions regarding the social interaction. The participant and confederate were each given a list of 17 questions (selected from a larger set of questions used by Aron, Melinant, Aron, Vallone, & Bator, 1997) that they were to ask each other during the interaction. The final portion of the study consisted of participants watching a movie, and eating a snack as alcohol condition participants' BACs decreased. All participants stayed in the lab for a minimum of four hours, but for participants in the alcohol condition, a BAC of 0.04% or lower was required before they were permitted to leave the lab. Before leaving, participants were debriefed and given monetary compensation (\$40) for their participation.

4.3 RESULTS

4.3.1 Descriptive Statistics

Table 1 provides a summary of the baseline measures of trait social anxiety

⁴ According to Sayette's (1993) appraisal disruption model, alcohol reduces anxiety by interfering with the initial appraisal of a situation as threatening. The model predicts that alcohol will only lead to a reduction in anxiety if the individual learns about a potential stressor after he/she has consumed alcohol and not before. In the current study, participants were only given *details* about the upcoming social interaction after the alcohol consumption phase. However, for ethical reasons, the consent form that participants read at the beginning of the study did briefly mention that participants would be taking part in a social interaction. Therefore, it is difficult to determine when participants made their initial appraisal of the social interaction threat.

(SIAS⁵ and SPS; Mattick & Clarke, 1998), state social anxiety (pre-drinking Baseline VAS; Abrams et al., 2001), typical drinking (DDQ; Collins et al., 1985), and drinking problems (RAPI; White & Labouvie, 1989) across beverage conditions. Independent sample *t*-tests and chi square analyses indicated that there were no significant differences on any of these control variables between the beverage conditions.

4.3.2 Correlations among Baseline Variables

As shown in Table 2, the SIAS was significantly positively correlated with the SPS and state social anxiety, and *negatively* correlated with drinking frequency. Further, the SPS was significantly positively correlated with state social anxiety, while drinking frequency was significantly positively correlated with drinking problems.

4.3.3 BAC and Subjective Intoxication Ratings

The mean BAC reached by participants in the alcohol condition was .056% (*SD* = .018) at the pre-drinking baseline and .059% (*SD* = .02) after completing the social interaction. For those in the no alcohol condition, the mean BAC was .000% at both time points. Further, the mean subjective intoxication ratings for those in the alcohol condition was 2.80 (*SD* = 1.77) before and 2.36 (*SD* = 1.73) after completing the social interaction, which indicates a level of “slight intoxication” similar to that found in other alcohol administration studies using similar alcohol doses (e.g., Abrams et al., 2001). For those in the no alcohol condition, subjective ratings were 0.00 at both time points. BAC and subjective intoxication ratings were compared across the alcohol and no alcohol conditions using independent sample *t*-tests. As expected, those in the alcohol condition

⁵ Trait social anxiety was measured at two time points (once during the screening interview and once when participants came into the lab). The second measure of trait social anxiety was used in the analyses (see Table 1).

had significantly higher BACs, $t(86) = 19.76, p < .001$, and subjective intoxication ratings, $t(86) = 10.32, p < .001$, than those in the no alcohol condition before completing the social interaction. Similarly, they also had higher BACs, $t(85) = 19.16, p < .001$, and subjective intoxication ratings, $t(85) = 8.41, p < 0.001$, after completing the social interaction.

4.3.4 Participant Behaviors

Inter-rater reliability. When considering inter-rater reliability for coding of participant behaviors, the results demonstrated high intraclass correlations (ICCs) between raters for participants' eye contact, $\rho(15) = .92$, amount of time speaking, $\rho(15) = .79$, and latency to respond, $\rho(15) = .79$, but a lower correlation for nervous laughter, $\rho(14) = .55$. Overall, these findings suggest that coding of most of the behaviors had excellent reliability with the exception of nervous laughter, which fell in the fair to good range (Bland & Altman, 1986).

Correlations among dependent measures. Nervous laughter was the only safety behavior found to positively correlate with participant ratings of their state social anxiety. Further, no significant correlations were found among the four safety behaviors, with the exception of a significant negative correlation between length of time speaking and latency to respond to questions. As expected, state social anxiety was positively correlated with trait social anxiety (both the SIAS and SPS). See Table 3 for a summary of these correlations.

Effect of beverage condition on state social anxiety. In order to investigate whether the social interaction induced state social anxiety in participants, a 2 x 2 (beverage condition x time) repeated measures analysis of variance (ANOVA) was

conducted comparing the Post-Drinking state social anxiety measure (measured after consuming the assigned beverage⁶ but before being informed about the upcoming social interaction) to the Social Interaction state social anxiety measure (reflecting on how they felt *during* the social interaction) across the two beverage conditions. A main effect of time was found such that participants reported higher ratings of state social anxiety during the social interaction ($M = 23.54, SD = 31.23$) compared to before learning about the social interaction ($M = 7.38, SD = 12.21$), $F(1, 86) = 33.07, p < .001$. This main effect was qualified, however, by a significant beverage condition x time interaction, $F(1, 86) = 5.84, p < .05$. In order to probe the interaction, difference scores were calculated looking at the change in state social anxiety from post-drinking baseline to the social interaction. A one-way (beverage condition) ANOVA on the post-drinking baseline scores revealed no significant differences in state social anxiety at post-drinking baseline ($F(1, 86) = 2.18, p = .14$) indicating no control of baseline scores was necessary in the analysis of state anxiety reactivity scores. Then a one-way ANOVA was conducted on the difference scores which revealed that those in the alcohol condition had less of an increase in state social anxiety from post-drinking baseline to the social interaction ($M = 9.47, SD = 14.69$) than those in the no alcohol condition ($M = 23.16, SD = 34.97$), $F(1, 86) = 5.82, p < .05, d = .51$. See Figure 1 for a summary of these findings.

⁶ The Post-Drinking measure of state social anxiety was used rather than the Pre-Drinking Baseline measure in order to account for the potential effects of alcohol consumption alone on participants' social anxiety (e.g., increased heart rate caused by the alcohol in the resting state [e.g., Stewart, Peterson, Collins, Eisnor, & Ellery, 2006] may lead to higher ratings of somatic distress). This allowed for a more accurate investigation of changes in state social anxiety that were induced by the social interaction alone and not the combination of consuming alcohol and engaging in the social interaction (see Sayette, 1993, for a further discussion).

Effect of beverage condition on safety behaviors. A Multivariate Analysis of Variance (MANOVA) was conducted examining the effect of beverage condition (alcohol versus no alcohol) on the set of four safety behaviors (eye contact, length of time speaking, nervous laughter, and latency to respond).⁷ An overall multivariate effect of beverage condition was found, $F(4, 83) = 2.49, p < .05$. When examining the univariate effects, a significant beverage condition effect was found only for length of time speaking, $F(1, 86) = 9.70, p < 0.01, d = .67$, with participants in the alcohol condition spending a greater amount of time speaking during the social interaction than participants in the no alcohol condition. Findings revealed no significant effects of beverage condition on participant eye contact, $F(1, 86) = .002, p = .87$, nervous laughter, $F(1, 86) = .21, p = .65$, or latency to respond, $F(1, 86) = 1.92, p = .17$. See Table 4 for a summary.

4.3.5 Confederates

Inter-rater reliability. Inter-rater reliability was calculated to ensure that raters were coding confederates in a consistent manner. Excellent inter-rater reliability was achieved for confederates' eye contact, $\rho(15) = .95$. Inter-rater reliability for the four adjectives fell within the fair to good range for ratings of confederates' friendliness, $\rho(15) = .62$, likeability, $\rho(15) = .49$, anxiousness, $\rho(15) = .48$, and coldness, $\rho(15) = .59$.

Comparison across beverage conditions. Confederate behavior toward the participants across beverage conditions were compared to see if confederates were acting similarly towards participants in both conditions.⁷ Even though confederates were trained

⁷ Since inter-rater reliability ranged from fair to good for each of the confederate behaviors, ratings from the first coder (who rated all videos) were used in all analyses.

to criterion to behave in a neutral manner across participants and even though confederates were blind to participant beverage condition, a MANOVA revealed a significant multivariate main effect of beverage condition on confederate behaviors, $F(5, 82) = 2.60, p < .05$. When examining univariate effects, confederates interacting with participants in the alcohol condition engaged in significantly more eye contact than those interacting with participants in the no alcohol condition, $F(1, 86) = 10.69, p < .01, d = .70$. Further, confederates interacting with socially anxious participants in the alcohol condition were rated as more friendly, $F(1, 86) = 7.52, p < .01, d = .58$, more likeable, $F(1, 86) = 5.46, p < .01, d = .50$, and less anxious, $F(1, 86) = 5.02, p < .05, d = .47$, than confederates interacting with socially anxious participants in the no alcohol condition. No significant beverage condition effect was observed in ratings of confederates' coldness, $F(1, 86) = 2.04, p = .16$. See Table 5 for a summary of the means.

4.3.6 Correlations between Participant and Confederate Behaviors

Bivariate correlations were computed to determine if there was a relationship between confederate and participant behaviors during the social interaction. It was found that confederate eye contact was significantly positively correlated with participant eye contact, $r(86) = .23, p < .05$, and with amount of time participants spent speaking, $r(86) = .29, p < .01$. Further, ratings of how anxious confederates appeared during the interaction were significantly positively correlated with participants' nervous laughter, $r(86) = .23, p < .05$.

Given the beverage condition differences in confederate behaviors, and the relations of confederate behaviors to the study outcome measures (i.e., participant safety behaviors), all analyses comparing participant behavior/subjective reactions in the

alcohol and no alcohol condition were re-run including confederate eye contact, friendliness, likeability, and anxiousness as covariates. The pattern of significant findings did not differ from those reported earlier in the main analyses suggesting that the beverage condition differences in confederate behaviors were reactions to, rather than causes of, beverage condition differences in socially anxious participants' behavior.

4.4 DISCUSSION

It was hypothesized that alcohol would reduce the use of safety behaviors among socially anxious participants when engaged in a social interaction. Four behaviors were examined, including the amount of time participants made eye contact with the confederate, the amount of time participants engaged in nervous laughter, the amount of time participants spent speaking in response to questions, and participants' latency to respond to questions posed by the confederate during the social interaction. Coding of all four of the safety behaviors was adequately to highly reliable. As hypothesized, participants who consumed alcohol spent a greater amount of time speaking during the social interaction than participants who did not consume alcohol.

The finding that alcohol lead to a greater amount of time speaking is consistent with the limited research to date that has examined the effect of alcohol on various behavioral indicators of anxiety (e.g., Kushner et al., 1997). There are a number of possibilities for interpreting these findings. It could be that this effect is specific to safety behaviors or it could be that this effect extends more broadly to a variety of behavioral indices of social anxiety whether or not they serve a safety behavior function (see Appendix B for a discussion of the physiological effects alcohol has on behavior). Future research examining both possibilities in a single study is needed to examine this further.

It is interesting that no differences were found regarding the other safety behaviors measured. One possible explanation for this is that these safety behaviors were not applicable to the current population of socially anxious students. As mentioned previously, McManus et al. (2008) have demonstrated that socially anxious individuals report using a large number of diverse safety behaviors in a broad range of social situations. Perhaps the current sample was too heterogeneous with respect to the types of safety behaviors they typically use and the current study was not able to capture those most relevant. Indeed, in treatment, an idiographic approach is typically used where clients identify the safety behaviors that are most relevant to them and then try to reduce using these behaviors during exposures (Wells et al., 1995). Such an approach may also be useful in future studies whereby participants could identify which safety behaviors they typically use and then these specific behaviors could be observed to determine if alcohol has an effect on them.

There are a number of other possibilities for why alcohol was not found to affect the other three safety behaviors measured in the current study. It is possible that our sample size was too small and power too limited to detect small behavioral changes. Alternatively, only one moderately intoxicating dose of alcohol (mean BAC = 0.06%) was used, which leaves open the possibility that higher or lower doses of alcohol could affect participant's eye contact, nervous laughter, and/or latency to respond. Moreover, the social interaction used in the current study was not highly anxiety-provoking for participants (e.g., although ratings of state social anxiety increased during the social interaction, they were still at relatively low levels). This may have been due to the structured nature of the task where participants were given specific questions to answer

rather than having to come up with conversation topics on their own. It is possible that a more anxiety provoking social interaction task would elicit more safety behaviors in sober participants, which would allow for a greater opportunity for alcohol to dampen the use of these behaviors.

Overall, findings from the current study are consistent with predictions derived from the tension reduction hypothesis (Conger, 1951), which postulates that alcohol reduces anxiety. Moreover, these findings are consistent with previous studies, which have found alcohol to have a dampening effect on state social anxiety in individuals who are high in social anxiety (e.g., Abrams et al., 2001). Finally, the current study is unique in that it used a social interaction task to induce state social anxiety in participants. Previous research has often used a performance task (e.g., giving a speech) to induce anxiety, which although effective, may not be representative of the types of situations in which socially anxious individuals are likely to consume alcohol when experiencing state social anxiety (Thomas et al., 1999).

Another intriguing finding that emerged in the current study was that although confederates were trained to criterion to act in a similarly neutral manner with all participants, confederates were found to behave differently toward participants across beverage conditions. Specifically, confederates interacting with socially anxious participants in the alcohol condition engaged in greater eye contact and were rated as more friendly and likeable and less anxious in their interactions than confederates interacting with socially anxious participants in the control condition. This is particularly interesting given that confederates were also blind to participant condition. This finding suggests the possibility that there was a reciprocal relationship between how confederates

and socially anxious participants behaved, which was moderated by alcohol.

There have been numerous studies demonstrating that socially anxious individuals do in fact elicit more negative responses from others compared to those low in social anxiety (e.g., Heerey & Kring, 2007). Moreover, a recent investigation by Taylor and Alden (2011) examined the reciprocal relationship between how socially anxious individuals behaved and how others reacted to them during a social interaction. They found that when instructed to reduce their use of safety behaviors, participants had more positive beliefs about the interaction and were actually judged as more likeable by their interaction partners as compared to a control condition. It is possible that in the current study, participants who consumed alcohol and reduced their use of safety behaviors lead the confederates to act more positively towards them. Although this is speculative, it certainly provides directions for future research in this area. While additional analyses in the present study did not support the possibility that beverage condition differences in confederate behavior were the sole cause of the observed beverage condition differences in participant behaviors or anxiety, all ratings and observations were taken at a single point in time. Future studies could code participant and confederate behavior and emotional states at various time points over the course of an interaction to test the possibility that reciprocal relations may exist between socially anxious participants' state anxiety and observable behavior and the emotional states and observable social behaviors of their social interaction partners.

Findings from the current study should be interpreted in light of the following limitations. The current sample consisted of university students who were selected to be high on a trait measure of social anxiety. This limits the generalizability of findings in

that it is unknown if similar results would be found in individuals lower in social anxiety and/or in individuals with a clinical diagnosis of social anxiety disorder. Also, a placebo condition (i.e., participants who believe they are receiving alcohol when in fact they are not) was not used in the current study. Hence, further research with the inclusion of a placebo condition is needed in order to investigate if the alcohol effects observed in the present study are due to alcohol expectancy or pharmacological effects of alcohol. Nonetheless, as the first study on the effects of alcohol on safety behaviors in socially anxious individuals, comparing an alcohol to a no alcohol control condition represented an appropriate design to begin to examine this question.

Finally, as noted earlier, participants were given details about the social interaction after they had consumed alcohol. However, for ethical reasons, the consent form that participants read at the beginning of the study did mention that they would be taking part in a social interaction. It is possible that participants processed this information at the beginning of the study (i.e., prior to consuming alcohol), which according to Sayette's (1993) appraisal disruption model, would result in alcohol *not* having a dampening effect on state social anxiety. The current study was not able to decipher when participants made their initial appraisal of the social interaction threat. However, because alcohol dampening effects were found, it can be speculated that participants most likely made their appraisals *after* consuming their assigned beverages. Future research would benefit from either informing participants about an upcoming stressor at only one time point, or including a measure to determine when participants made their appraisal of the stressor.

In sum, the current study found that alcohol dampened increases in state social

anxiety and lead socially anxious individuals to talk more during an interaction. Moreover, their interaction partners engaged in more eye contact and behaved in a more friendly and likeable and less anxious manner, when participants had consumed alcohol. Taken together, these findings suggest that alcohol may be reinforcing for socially anxious individuals not only because it reduces state social anxiety, but also because it reduces their perceived need to use certain safety behaviors to conceal their anxiety from others, allowing them to engage more fully in conversations. This greater engagement may in turn elicit more positive reactions from their interaction partners, which could provide additional social reinforcement of their drinking. These reinforcing effects of alcohol may contribute to socially anxious individuals' further alcohol use and subsequent development of alcohol problems, helping explain the high rates of alcohol use disorder among those with high social anxiety (e.g., Schneier et al., 2010).

Table 4.1

Summary of Demographics and Baseline Measures across Conditions

	Alcohol Condition (<i>n</i> = 45)		No Alcohol Condition (<i>n</i> = 43)		Total (<i>N</i> = 88)		<i>p</i> -value
Gender	47% Male		51% Male		52% Male		.841
Ethnicity	87% White		86% White		86% White		.608
Relationship Status	53% Single		56% Single		55% Single		.895
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Age (in years)	20.91	1.65	21.53	2.35	21.22	2.04	.156
SIAS	34.49	11.19	30.67	11.37	32.63	11.38	.116
SPS	18.60	11.11	17.37	10.39	18.00	10.72	.593
VAS Baseline	11.09	18.10	9.60	17.61	10.36	17.77	.696
DDQ-Drinks/week	10.34	7.94	11.00	10.83	10.66	9.41	.705
RAPI	11.87	8.43	10.49	8.01	11.19	8.21	.426

Note. SIAS = Social Interaction Anxiety Scale (Mattick & Clarke, 1998); SPS = Social Phobia Scale (Mattick & Clarke, 1998); VAS = Visual Analogue Scales of state social anxiety at pre-drinking baseline (Abrams et al., 2001); DDQ = Daily Drinking Questionnaire (Collins, Parks, & Marlatt, 1985); RAPI = Rutger's Alcohol Problem Index (White & Labouvie, 1989).

Table 4.2

Correlations among Baseline Variables

	SIAS	SPS	VAS	DDQ	RAPI
SIAS	-	.60**	.33**	-.27*	.05
SPS		-	.23*	-.12	.15
VAS			-	.01	.03
DDQ				-	.44**
RAPI					-

Note. * = $p < .05$. ** = $p < .001$. SIAS = Social Interaction Anxiety Scale (Mattick & Clarke, 1998); SPS = Social Phobia Scale (Mattick & Clarke, 1998); VAS = Visual Analogue Scales of state social anxiety at pre-drinking baseline (Abrams et al., 2001); DDQ = Daily Drinking Questionnaire assessing drinks per week (Collins, Parks, & Marlatt, 1985); RAPI = Rutgers Alcohol Problem Index (White & Labouvie, 1989).

Table 4.3

Correlations among Dependent Variables and Trait Measures of Social Anxiety

	VAS	Eye Contact	Speaking Time	Latency to Respond	Nervous Laughter	SIAS	SPS
VAS	-	.13	-.09	.05	.32**	.33**	.23*
Eye Contact		-	.07	-.05	-.02	-.06	-.04
Speaking Time			-	-.40**	.06	-.08	-.13
Latency to Respond				-	.08	.05	-.02
Nervous Laughter					-	-.01	.03
SIAS						-	.60**
SPS							-

Note. ** $p < .01$; VAS = Visual Analogue Scale of state social anxiety (Abrams et al., 2001) measured after the social interaction (reporting on state social anxiety experienced during the social interaction).

Table 4.4

Comparison of Participant Behaviors across Conditions

	Alcohol Condition (<i>n</i> = 45)		No Alcohol Condition (<i>n</i> = 43)		<i>p</i> -value	Effect size Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Speaking Time	237.54	76.88	191.61	59.97	.003	.67
Nervous Laughter	5.87	6.94	6.63	8.30	.645	.10
Eye Contact	262.13	138.63	263.34	121.93	.966	.01
Latency	77.79	35.86	88.66	37.71	.170	.30

Note. Mean values are in seconds. For Cohen's *d* an effect size of 0.2 is considered a "small" effect, 0.5 a "medium" effect and 0.8 a "large" effect (Cohen, 1992).

Table 4.5

Comparison of Confederate Behaviors across Conditions

	Alcohol Condition (<i>n</i> = 45)		No Alcohol Condition (<i>n</i> = 43)		<i>p</i> -value	Effect size Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Eye Contact (in seconds)	195.23**	138.23	114.28**	87.05	.002	.70
Friendly Rating	4.89**	0.63	4.47**	0.80	.007	.58
Likeable Rating	4.78*	0.56	4.51*	0.51	.022	.50
Anxiety Rating	2.82*	1.03	3.26*	0.76	.028	.49
Cold Rating	2.64	0.88	2.94	1.04	.157	.31

Note. Adjectives were rated on a scale ranging from 1(not at all) to 8(extremely). For Cohen's *d* an effect size of 0.2 is considered a "small" effect, 0.5 a "medium" effect and 0.8 a "large" effect (Cohen, 1992).



Figure 4.1. The effect of beverage condition on state social anxiety across time: Post-Drinking baseline to Social Interaction.

CHAPTER 5: PROLOGUE TO STUDY 2

The findings described in Study 1, (Chapter 4) indicate that alcohol may have effects on multiple indices of social anxiety. In addition to adding to the current research showing alcohol to have a dampening effect on self-reported social anxiety (e.g., Abrams et al., 2001), Study 1 found that socially anxious students who consumed alcohol talked more during a social interaction compared to those who did not consume alcohol. These findings suggest that alcohol may actually alter the social behavior of socially anxious individuals. This could provide reinforcement for socially anxious individuals by leading others to act more positively towards them in return. In fact, the unexpected finding that confederates who interacted with participants in the alcohol condition were rated as friendlier, more likeable, less anxious, and as displaying more eye contact than confederates interacting with participants in the control condition point towards this possibility. However, it is unknown whether the reinforcing effects of alcohol, which take place during the social event (and while participants are still intoxicated), persist afterwards when participants are sober and reflect back on the social event.

In order to provide a more comprehensive examination of the effects of alcohol on social anxiety, the next study (Study 2) measured how alcohol affected a cognitive variable-- post-event processing -- which is particularly relevant to the experience of social anxiety. Post-event processing describes dwelling on events after they happen and has been found to be more common in those who experience social anxiety (e.g., Kocovski & Rector, 2007). In Study 2, the same participants who took part in Study 1 completed a measure of post-event processing three days after the social interaction to

determine how alcohol affected how much they thought about or dwelled on the social interaction.

CHAPTER 6: STUDY 2- DRINKING AND THINKING: ALCOHOL EFFECTS ON POST-EVENT PROCESSING IN SOCIALLY ANXIOUS INDIVIDUALS⁸

Abstract

The current study examined the effects of drinking alcohol at the time of a social event on later post-event processing of that social event among socially anxious individuals. A sample of 84 (43 males, $M_{age} = 21.36$ years, $SD_{age} = 2.06$) undergraduates were randomly assigned to an alcohol ($n = 44$; mean blood alcohol concentration = 0.057%), or a no alcohol ($n = 40$) condition. Following beverage consumption and absorption, they participated in a social interaction with an opposite-gendered confederate. A few days later, participants completed a measure of post-event processing of this interaction. A significant beverage condition by gender interaction was observed on levels of post-event processing: Post-event processing levels were lower in the alcohol versus the no alcohol condition for females, whereas they were higher in the alcohol versus the no alcohol condition for males. This pattern of alcohol reinforcement might help explain observed gender differences in the odds of co-morbid alcohol use disorders in social anxiety disorder.

⁸ Adapted from Battista, S.R., Pencer, A.H., & Stewart, S.H. (2014). Drinking and thinking: alcohol effects on post-event processing in socially anxious individuals. *Cognitive Therapy and Research*, 38, 38-42. Copyright (2014) with permission from Springer Publishers. As first author of this paper, I designed the study, organized participant recruitment, collected data by running participants through the study protocol, entered all data into the database, conducted the data analyses, wrote the manuscript and revised the manuscript while incorporating feedback from my co-authors, the peer reviewers and the journal editor.

6.1 INTRODUCTION

A positive association between social anxiety and alcohol use disorders has been well-established in clinical populations (e.g., Grant et al. 2005; Schneier et al., 2010). For example, in a large sample of adults, the lifetime prevalence of co-occurring social anxiety disorder and an alcohol use disorder was 2.4% (Schneier et al., 2010). Further, in 79.7% of those cases, social anxiety disorder preceded the onset of the alcohol use disorder (Schneier et al., 2010). Recently, an investigation by Xu and colleagues (2012) examined gender differences in the course of social anxiety disorder. They found that, as in the general population, men were more likely than women to meet criteria for alcohol abuse overall, regardless of whether or not they had social anxiety disorder. However, women with social anxiety disorder were especially likely to develop comorbid alcohol abuse compared to women without social anxiety disorder (17.5% versus 11.2%, respectively). The respective rates of alcohol abuse in men with and without social anxiety disorder were 25.9% and 24.6%, respectively. Similar gender differences have been found using a prospective research design where the presence of social anxiety disorder at baseline predicted the development of an alcohol use disorder approximately three years later in women, but not in men (Buckner & Turner, 2009).

Given these findings, it may be that women share a common vulnerability (e.g., neuroticism, anxiety sensitivity) for both social anxiety and alcohol problems. However, based on findings indicating that social anxiety disorder typically precedes alcohol use disorder (Buckner & Turner, 2009; Schneier et al., 2010), it is also possible that alcohol use is negatively reinforced in individuals with social anxiety by reducing their levels of state social anxiety and that this effect may be stronger in females. For example, a study

by Norberg, Norton, Olivier, and Zvolensky (2010) found that using alcohol as a means of coping with negative emotions mediated the relationship between social anxiety and alcohol problems in women, but not in men.

Indeed, many experimental studies have found alcohol to have a dampening effect on state social anxiety (see Chapter 2 for a comprehensive review). Although numerous studies have been conducted in this research area, most have examined the effect of alcohol on measures of state social anxiety using either self-reports or physiological indices (e.g., heart rate). However, few have focused on how alcohol may affect other factors known to be related to social anxiety. It is possible that alcohol may also be reinforcing because of its impact on cognitive variables that contribute to social anxiety. One potential cognitive variable that may be affected is post-event processing.

In cognitive-behavioural models of social anxiety, post-event processing is described as a “postmortem” of a past event where an individual dwells on his/her performance during the event (Clark & Wells, 1995; Hofmann, 2007). Post-event processing is similar to “rumination” which has been described as a maladaptive response style that involves dwelling on symptoms of distress and the meaning, causes, or consequences of those symptoms (Nolen-Hoeksema, 1994). Although post-event processing and rumination have been discussed as distinct constructs (relating to social anxiety and depression, respectively), others have suggested that they may in fact be one construct that is transdiagnostic for both depression and anxiety (e.g., McLaughlin & Nolen-Hoeksema, 2011). Given the conceptual similarities between these constructs, I reviewed literature relevant to both constructs here. However, for clarity, I maintain the

distinction in the terms and refer to dwelling on one's performance in a past situation as "post-event processing" and dwelling on symptoms of distress as "rumination."

A number of studies have demonstrated that individuals high in social anxiety engage in more post-event processing of previous social situations than individuals low in social anxiety (e.g., Kocovski & Rector, 2007; Lundh & Sperling, 2002; Rachman & Gruter-Andrew, & Shafran, 2000), and that their thoughts and appraisals of social situations are biased towards negative information (Abbott & Rapee, 2004; Field & Morgan, 2004; Kocovski, Endler, Rector, & Flett, 2005). It has been suggested that post-event processing of previous social events maintains social anxiety by perpetuating maladaptive thoughts, leading to increased social apprehension and the expectation that future social interactions will go poorly (Clark & Wells, 1995; Hofmann, 2007). Further, despite these negative effects of post-event processing, those high in social anxiety are more likely to believe that engaging in post-event processing is helpful than those low in social anxiety (Wong & Moulds, 2010).

Despite the accumulation of evidence suggesting that post-event processing is particularly relevant for those with social anxiety (see Brozovich & Heimberg, 2008, for a review) and that social anxiety and alcohol problems tend to co-occur (see Morris et al., 2005, for a review), there is a paucity of research that has examined the connection between alcohol and post-event processing. The literature on rumination, however, suggests that the process of dwelling on prior negative events may be an important factor in alcohol and substance abuse. For example, in a recent study, Harwell, Cellucci, and Iwata (2011) found that the process of ruminating over anxious symptoms (a construct similar to post-event processing, but focused on dwelling over general feelings of anxiety

rather than a specific social event) mediated the relationship between anxiety sensitivity (i.e., fear of anxiety sensations) and negative reinforcement drinking (i.e., drinking to alleviate undesirable emotions) in a sample of male and female students.

Two other studies with mixed gender samples have shown that rumination independently predicted alcohol use after accounting for levels of depression in both community-recruited social drinkers (Caselli, Bortolai, Leoni, Rovetto, & Spada, 2008) and individuals receiving treatment for alcohol abuse (Caselli et al., 2010). Some research suggests that this relation may be specific to women, however. For example, in a study by Nolen-Hoeksema and Harrell (2002), although rumination was cross-sectionally associated with greater alcohol use problems in both adult men and women, it only predicted alcohol problems longitudinally in women. Similarly, Nolen-Hoeksema, Stice, Wade, and Bohon (2007) found that rumination predicted substance abuse (including alcohol abuse) symptoms over a four-year period in community-recruited, female adolescents.

In sum, based on the aforementioned findings, researchers have suggested that drinking may be used as a maladaptive coping strategy in an attempt to escape or distract from rumination in the short term (e.g., Caselli et al., 2008; Nolen-Hoeksema et al., 2007). A similar process might be at play with respect to alcohol use and the related construct of post-event processing. For example, socially anxious individuals may use drinking as a maladaptive coping strategy during social situations to avoid later post-event processing or afterwards, to escape or distract from post-event processing of a previous social event. The current study examined the effects of a moderate dose of alcohol administered at the time of a social event on later post-event processing

(measured a few days later) of a standardized social event, in a sample of individuals with high scores on a measure of trait anxiety.

Given that this is a relatively new area of research, there were a number of possible outcomes that could be expected based on theories related to alcohol effects. There are several theories that lead to the prediction that alcohol would result in *decreased* post-event processing in socially anxious individuals. For example, the *self-awareness model of alcohol use* (Hull, 1981) provides a potential mechanism by which alcohol may lead to decreased post-event processing. This model postulates that alcohol interferes with the encoding of self-relevant information, which then decreases negative self-evaluations. A study by Abrams and colleagues (2002b) found that individuals with social anxiety disorder who consumed alcohol before giving a speech had fewer negative thoughts about their speech performance compared to when they had not consumed alcohol. It is possible that alcohol leads to decreases in negative evaluations/thoughts, which then results in decreased post-event processing.

It is also possible that alcohol may interfere with the appraisal of the social situation as threatening (Sayette, 1993) or with laying down a memory trace of the event (Mintzer, 2007), any of which could then result in less post-event processing after the event. Thus, in the current study, it was possible that those who consumed alcohol during the event would engage in decreased post-event processing of the event a few days later compared to those who did not consume alcohol.

On the other hand, it is also possible that alcohol could lead to *increased* post-event processing. Given that alcohol intoxication at the time of an event can lead to impaired memory of the event (Mintzer, 2007), it is possible that those who are socially

anxious may assume the worst about their social performance in the absence of a clear memory of what actually occurred at the social event. Indeed, as Hofmann's (2007) model points out, post-event processing is especially likely to occur after unsuccessful or ambiguous social encounters. Hence, a drinking-induced blurred memory of the social event could lead a socially anxious individual to engage in greater post-event processing. There is also the possibility that alcohol's disinhibiting effects (see Giancola, Josephs, Parrott, & Duke, 2010, for a review) actually do lead socially anxious individuals to behave in ways that may be viewed as socially inappropriate and/or embarrassing. Hence, an accurate memory of alcohol-induced social blunders could also lead a socially anxious individual to engage in greater post-event processing.

In sum, theories are mixed with regard to the impact of alcohol on post-event processing, with some suggesting an increase, while others suggest a decrease in post-event processing following alcohol consumption. Based on gender differences in rumination (e.g., Nolen-Hoeksema & Harrell, 2002) and gender differences in the comorbidity of social anxiety disorder and alcohol use disorders (e.g., Xu et al., 2012), the current study examined gender as a potential moderator of the effects of alcohol on post-event processing. Prior research suggests that females tend to engage in rumination more often than males (Nolen-Hoeksema, 1994) and that rumination predicts alcohol problems longitudinally in women, but not in men (Nolen-Hoeksema & Harrell, 2002). Therefore, it may be that drinking alcohol at the time of a social event is particularly rewarding for socially anxious women as it may allow them to subsequently avoid or decrease persistent negative thoughts about the social event (i.e., post-event processing). Hence, it was hypothesized that women who consumed alcohol would experience a

decrease in their levels of post-event processing as compared to women who did not consume alcohol. On the other hand, it was hypothesized that men who consumed alcohol would not show a decrease in their levels of post-event processing as compared to men who did not consume alcohol.

6.2 METHOD ⁹

6.2.1 Participants

The sample consisted of 84 university students (43 males, 41 females) who ranged in age from 19 to 28 years ($M = 21.37$, $SD = 2.06$). The majority identified as White (83.3%). Through randomization, a similar proportion of males and females were assigned to each beverage condition (i.e., in the alcohol condition, 52% were male versus 50% males in the no alcohol condition), $X^2(2, N = 84) = .043$, $p > .05$. Participants were recruited using posters that were displayed in various locations around the Halifax Regional Municipality and were compensated \$10/hour for taking part in the study. All participants completed a screening interview over the phone to ensure that they were eligible to participate in the study. In order to be eligible, participants had to score high on a measure of trait social anxiety (i.e., the Social Interaction Anxiety Scale, see below for details). They also had to have some experience with alcohol use (consumed a minimum of two alcoholic drinks at least twice within the month prior to screening). However, they could not have any significant problems associated with alcohol use due to ethical concerns regarding serving alcohol to individuals with a likely alcohol use

⁹ All study procedures were the same as those reported in Study 1, (Chapter 4) as data was collected for both studies at the same time. The results presented in Study 1 examined how alcohol affected participant behaviors during the social interaction whereas the current study focused on data that was collected four days after the social interaction (i.e., post-event processing).

disorder (this was assessed using the Brief Michigan Alcoholism Screening Test [Pokorny et al., 1972] where individuals with a score of greater than 5 were excluded). Further, they could not have any medical conditions that prohibited alcohol use or be taking any medications that could interact negatively with alcohol. Finally, female participants could not be pregnant, nursing, or planning to become pregnant.

6.2.2 Measures

Demographic Questionnaire (DQ). The DQ is an author-compiled questionnaire that asked participants to report their age, gender, and ethnicity. This measure was included in order to describe the sample and ensure equivalence across beverage conditions and gender groups in demographic characteristics.

Daily Drinking Questionnaire (DDQ; Collins et al., 1985). The DDQ has participants indicate how many alcoholic drinks they consumed on each day of a typical drinking week during the past 30 days. This measure has been widely administered among university students (e.g., Marlatt et al., 1998) and was included in order to describe the sample and ensure equivalence across beverage conditions and gender groups in drinking characteristics.

Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989). The RAPI is a 23-item self-report measure designed to assess the negative consequences of alcohol use in adolescents and young adults (e.g., “Neglected your responsibilities; “Noticed a change in your personality”). Participants indicate how often they have experienced a variety of consequences related to alcohol in the past three years, using a 5-point scale ranging from 0 (never) to 5 (greater than ten times). This scale has demonstrated strong internal consistency and convergent validity in a number of studies (Ginzler, Garrett,

Baer, & Peterson, 2007; White & Labouvie, 1989). This measure was included in order to describe the sample and ensure equivalence across beverage conditions and gender groups in levels of alcohol problems.

Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998). The SIAS is a 20-item, self-report measure that assesses anxiety in social situations (e.g., "I am tense mixing in a group"). Items are rated on a five-point scale ranging from 0 (not at all characteristic or true of you) to 4 (extremely characteristic or true of you). This measure has demonstrated good internal consistency ($\alpha = .88-.94$) and test-retest reliability ($r's = .92$, after both one and three months) (Mattick & Clarke, 1998). This measure was used to select participants for the present study since our procedure used an interaction specific anxiety-inducing social task and I wanted to ensure that participants would experience an increase in their state social anxiety. A score of 29 and greater was required for women and a score of 30 and greater was required for men. These values represent one standard deviation above the mean scores reported by Mattick and Clarke (1998) using an unselected student sample.

Social Phobia Scale (SPS; Mattick & Clarke, 1998). The SPS is the companion scale to the SIAS that measures anxiety in situations involving observation by others (e.g., "I can get tense when I speak in front of other people"). It consists of 20 items rated on a 5-point scale, ranging from 0 (not at all characteristic or true of you) to 4 (extremely characteristic or true of you). Similar to the SIAS, this scale has also demonstrated good internal consistency ($\alpha = .89-.94$) and test-retest reliability ($r's = .91$ and $.93$ at one and three months, respectively) (Mattick & Clarke, 1998). This measure was included in

order to further describe the sample in terms of social anxiety levels and to ensure equivalence across beverage conditions and gender groups in trait social anxiety.

Blood Alcohol Concentration Readings (BAC). Participants' BAC levels were measured throughout the experiment using a FC20 Lifeloc Breathalyzer, and measurements were in grams of alcohol per 100 ml of blood, expressed as a percentage. The readings analyzed in the current study occurred at baseline to ensure that participants had not consumed alcohol prior to beginning the study, 20 minutes after the beverage consumption phase (referred to as Post-Drinking time point), and immediately after the social interaction (referred to as the Social Interaction time point).

Subjective Intoxication Rating Form (Kushner, Mackenzie, Fiszdon, Valentin, & Foa, 1996). Participants rated how intoxicated they felt at each time their BAC was measured. Ratings were made by putting a mark along a line ranging from 0 (I feel completely sober) to 10 (I feel more drunk than I have ever felt before).

Visual Analogue Scale-Interaction Anxiety (VAS-Interaction Anxiety; Abrams et al., 2001). Participants rated their state social anxiety using three VAS scales (mental distress, somatic distress, and fear of negative evaluation). They were asked to make a mark along three separate 100 mm horizontal lines ranging from 0 (not at all) to 100 (severely) on each of the three scales. Previous research investigating the effect of alcohol on social anxiety (e.g., Abrams et al., 2001) has used this self-report measure of state anxiety. For the current study, the three subscales were summed to create one total score (possible range of 0 to 300). This measure was administered at the following time points: Baseline-- to ensure that beverage conditions/gender groups were equivalent before consuming alcohol; Post-Drinking-- after consuming alcohol; and Social

Interaction-- after completing the social interaction, but indicating how they felt *during* the social interaction.

Post-Event Processing Questionnaire (PEP; Rachman et al., 2000). The PEP was designed to measure the extent to which the respondent dwelled on a specific event/situation. In the current study, the target event was the social interaction that participants took part in during the first phase of the study. The PEP contains 13 items that are rated on a visual analogue scale ranging from 0 to 100. Sample items include: “Did you try to resist thinking about the event?”; “Did you ever wish that you could turn the clock back and re-do it -- do it again, but do it better?”; “Did thoughts about the event ever interfere with your concentration?” This scale has been shown to have good internal consistency and has been shown to positively correlate with social anxiety (Rachman et al., 2000). *A priori*, it was decided that one item (“If you thought about the event, did you see it from your point of view, or how other people would view it?”) would be dropped from the calculation of the scale total as the interpretation of this item can be ambiguous (see Battista & Kocovski, 2010). Therefore, a 12-item version of the PEP was used in all subsequent data analyses. This 12-item version was found to have acceptable internal consistency ($\alpha = .71$).¹⁰

6.2.3 Procedure

Please see Study 1 (Chapter 4) for a more detailed description of the study procedures. In brief, participants first completed their Baseline subjective intoxication and state social anxiety measures and provided a baseline BAC sample. They were then

¹⁰ The full, 13-item version of the PEP had a lower internal consistency ($\alpha = .66$) than the modified 12-item version, and the alpha of the full 13-item version was below the commonly accepted cutoff of $\alpha = 0.70$, further justifying the exclusion of this item from the total score calculation.

randomly assigned to either an alcohol or no alcohol beverage condition and were made fully aware of the beverage condition to which they had been assigned. The experimenter left the room in order to prepare the beverages using a standard formula, which accounts for age, gender, and weight, and targeted a peak BAC of 0.07% (MacDonald, Baker, Stewart, & Skinner, 2000). Participants completed the DQ, RAPI (White & Labouvie, 1989), SIAS (Mattick & Clarke, 1998), and SPS (Mattick & Clarke, 1998) in counterbalanced order while the experimenter prepared the beverages.

Participants were then given 20 minutes to consume their beverages, followed by a 20-minute absorption period. Then they completed the Post-Drinking subjective intoxication and state social anxiety measures, and provided a Post-Drinking BAC sample. Participants were then told that they would be engaging in a 15-minute, video-taped interaction with another participant (who was actually a trained confederate). Confederates were undergraduate psychology students who were trained to behave in a neutral manner and to provide scripted responses during the interaction. After the social interaction was complete, the confederate left the room, and participants completed the Social-Interaction subjective rating of intoxication and state social anxiety measure (asking them to report on how they felt *during* the interaction), and provided the Social-Interaction BAC sample.

Participants were then required to stay in the lab until their BAC reached 0.04% or lower. Those in the no alcohol condition were also required to stay in the lab for a similar period in order to ensure that the two conditions were as similar as possible. The entire lab-based portion of the study took at least 4 hours to complete (with some

participants staying slightly longer if their BAC was not at 0.04% at the end of the four hour period).

Three days¹¹ after participants completed the in-lab portion of the study, they were sent an e-mail instructing them to follow a link that contained an electronic version of the PEP. If they did not complete the PEP that day, then they were sent subsequent reminders until it was completed. If participants did not fill out the measure within ten days following completion of the in-lab portion of the study, then they were considered non-completers ($n = 13$) of the study. A comparison of completers and non-completers revealed no differences on any demographic or baseline measures. Data for all non-completers were dropped from the final analyses.

6.3 RESULTS

6.3.1 Statistical Analyses

In order to explore whether beverage condition and/or gender had an effect on post-event processing, I first ensured that all groups were comparable on demographic and baseline measures. I then examined whether our alcohol manipulation was successful (i.e., that those in the alcohol condition had greater BAC and subjective intoxication ratings than those in the no alcohol condition) and consistent across males and females. Further, I ensured that our social interaction had the desired effect of inducing social anxiety in our participants and whether alcohol dampened this effect in both men and women. Finally, the central goal of the current study was explored by comparing levels of

¹¹ On average, participants completed the PEP approximately four days ($M = 3.74$, $SD = 1.49$; range = 3 to 10 days) after completing the lab-based portion of the study. A 2x2 ANOVA revealed no significant main or interactive effects of beverage condition or gender on the time elapsed between completing the study and completing the PEP measure.

post-event processing of the social event among men and women assigned to the alcohol or no-alcohol beverage conditions at the time of the social event. All of these were investigated using a series of 2 x 2 [(beverage condition: alcohol versus no alcohol) x (gender: male vs. female)] between-subjects analyses of variance (ANOVAs).¹²

6.3.2 Comparison of Demographic and Baseline Measures across Conditions and Gender

In order to ensure that participants were comparable across beverage conditions and gender, a number of 2x2 between-subjects analysis of variance (ANOVA) tests were conducted comparing the males and females in the alcohol and no alcohol condition on all demographic and baseline variables. For typical alcohol consumption self-reports, it was found that males typically consumed more than females, $F(1, 80) = 6.63, p = .01$. There was a marginal effect of gender for alcohol problems with men tending to score higher than women, $F(1, 80) = 4.08, p = .05$. Please see Table 1 for a summary. Further, for a summary of the correlations between variables, please see Study 1 (Chapter 4).

6.3.3 BAC and Subjective Intoxication Ratings across Condition and Gender

BAC and subjective intoxication ratings before and following the social interaction (but following beverage consumption) were compared across the alcohol and no alcohol condition and across genders using a set of between-subjects, 2x2 analyses of variance (ANOVAs). Results revealed significant main effects of beverage condition

¹² Given that men had significantly greater levels of typical drinking (measured with the DDQ) at baseline and there were two other gender differences that approached significance (i.e., scores on the RAPI and BAC levels after the social interaction), I re-ran our main analysis using an analysis of covariance (ANCOVA), controlling for scores on the DDQ, RAPI, and Social Interaction BAC. Since results did not change, I have reported only the original ANOVA in the main text for the sake of simplicity and parsimony.

such that, as expected, those in the alcohol condition had significantly higher BACs ($M = .056$, $SD = .018$), $F(1, 80) = 392.01$, $p < .001$, and subjective intoxication ratings ($M = 2.80$, $SD = 1.77$), $F(1, 80) = 90.54$, $p < .001$, than those in the no alcohol condition ($M = 0.0$, $SD = 0.0$ for BAC and subjective intoxication ratings) before completing the social interaction. Similarly, they also had higher BACs ($M = .059$, $SD = .20$), $F(1, 80) = 374.93$, $p < 0.001$, and subjective intoxication ratings ($M = 2.36$, $SD = 1.73$), $F(1, 80) = 66.52$, $p < 0.001$, after completing the social interaction than the no alcohol condition ($M = 0.0$, $SD = 0.0$ for BAC and subjective intoxication ratings). No significant main effects were found for gender and no interactive effects between beverage condition and gender were found. However, there was a marginal effect of gender with men tending to achieve higher BAC levels ($M = .065$, $SD = .017$) than women ($M = .053$, $SD = .021$) after the social interaction, $F(1, 80) = 3.79$, $p = .06$.

6.3.4 Manipulation Check: Effects of Alcohol and Gender on State Social Anxiety Reactivity

A 2x2 (beverage condition x gender) ANOVA was conducted examining change scores in self-reported, state social anxiety from the Post-Drinking measure (at the end of the drinking phase, but before learning of the social interaction) to the Social Interaction measure (taken after the social interaction, but reporting on *during* the social interaction) across the alcohol and no alcohol condition and between genders. Findings revealed a significant main effect of beverage condition, $F(1, 80) = 4.58$, $p < .05$, such that those in the alcohol condition had less of an increase in state social anxiety from Post-Drinking to the Social Interaction ($M = 10.14$, $SD = 16.09$) compared to those in the no alcohol condition ($M = 22.04$, $SD = 32.55$). No main or interactive effects of gender were found.

6.3.5 Effects of Alcohol and Gender on Post-event Processing

A 2x2 between-subjects ANOVA was conducted to examine the effect of beverage condition (alcohol versus no alcohol) and gender (male versus female) on post-event processing. As expected, a significant interaction between beverage condition and gender was found, $F(1, 80) = 10.49, p < .01$. An examination of simple main effects of condition within each gender separately showed that among the females, as hypothesized, those in the alcohol condition had significantly lower levels of post-event processing compared to those in the no alcohol condition, $F(1, 39) = 5.81, p < .05$. Unexpectedly, among the males, the opposite was the case with those in the alcohol condition reporting significantly higher levels of post-event processing than those in the no alcohol condition, $F(1, 41) = 4.71, p < .05$. I also probed the interaction by examining the simple effects of gender within each beverage condition separately. In the no alcohol condition, females showed significantly higher levels of post-event processing than males, $F(1, 38) = 7.32, p = .01$. In the alcohol condition, there was no significant simple main effect of gender, $F(1, 42) = 2.88, p > .05$. Please see Figure 1 for a visual depiction of these findings.

6.4 DISCUSSION

The current study examined the effect of a moderate dose of alcohol on levels of post-event processing in male and female undergraduates high in social anxiety. As hypothesized, findings revealed a significant moderating effect of gender on the effects of consuming alcohol at the time of a social event on later post-event processing of this earlier social event. Specifically, as had been expected, socially anxious females who consumed alcohol at the time of the social interaction engaged in *less* post-event processing a few days afterward than socially anxious females who had not consumed

alcohol at the time of the social interaction. In contrast, socially anxious males who consumed alcohol at the time of the social interaction unexpectedly engaged in *more* post-event processing a few days afterward than socially anxious males who did not consume alcohol at the time of the social interaction.

Our finding that alcohol consumption at the time of a social event decreased subsequent post-event processing of the event among socially anxious women provides novel evidence of a way in which alcohol use may be reinforcing for socially anxious women. Specifically, socially anxious women may learn to drink alcohol during social events because it helps them avoid or decrease aversive post-event processing afterwards. In turn, this avoidant drinking pattern could place women with social anxiety at greater risk for the development of alcohol use disorders as has been shown in recent epidemiologic and longitudinal studies (Buckner & Turner, 2009; Xu et al., 2012). Although speculative, this explanation is consistent with findings that post-event processing and the related cognitive process of rumination are associated with alcohol use problems (e.g., Caselli et al., 2008, 2010; Harwell et al., 2011; Nolen-Hoeksema et al., 2007), particularly in women (Nolen-Hoeksema & Harrell, 2002).

The unexpected finding that socially anxious men experienced an increase in post-event processing after consuming alcohol is partially consistent with Battista and Kocovski's (2010) finding where, after controlling for gender, self-reported drinking at an event was associated with greater post-event processing in a mixed gender sample of undergraduates unselected for social anxiety. The current study expanded on these findings by using a more controlled experimental methodology to examine the link between administration of a specific dose of alcohol at the time of a standardized social

interaction and later post-event processing of that standardized social interaction separately for men and women high in social anxiety. One potential explanation for the failure to observe a dampening effect of alcohol on post-event processing among men (socially anxious and non-socially anxious) in the present study and in the Battista and Kocovski study is that levels of post-event processing may not typically be elevated enough among men in general for them to experience the reinforcing effects of drinking in reducing post-event processing. Previous studies have consistently found women to engage in more rumination than men (e.g., Nolen-Hoeksema, 1994); however, gender differences in post-event processing have not been examined to date. In the current study, it was certainly the case that women had significantly higher levels of later post-event processing than men when not consuming alcohol at the time of the event. Future research could examine whether alcohol may affect lower levels of post-event processing differently than higher levels, and whether this might help explain the observed gender differences.

Not only did alcohol fail to dampen subsequent post-event processing in men, it led to an unexpected increase in post-event processing in socially anxious men. One potential explanation for these increases may be due to differences in the type of concerns men and women have with regards to their anxiety. For example, Stewart and colleagues (1997) found that men reported more anxiety-related social concerns (e.g., looking foolish in front of others) compared to anxiety-related physical concerns. As mentioned previously, acute alcohol use may lead to memory impairments (Mintzer, 2007), which may lead socially anxious individuals to assume that they behaved inappropriately in the social situation. Alternatively, acute alcohol use may lead to disinhibition (Giancola et

al., 2010), which could result in actual inappropriate behavior during the social situation. Both these scenarios could exacerbate men's worries related to looking foolish in front of others which could then lead to an increase in their post-event processing after drinking at a social event. Moreover, the aversive effect of increased post-event processing could result in decreased drinking in future situations (as a means of avoiding the after-effect of increased post-event processing) possibly explaining why men with social anxiety disorder are not at an increased risk of developing alcohol use disorder compared to men without social anxiety disorder (Xu et al., 2012). This possibility is merely speculative, but warrants further research.

The current findings should be interpreted in light of the following limitations. The current sample was relatively homogenous with regards to age and ethnicity so it remains unknown if these findings would replicate across different age ranges and ethnicities. The current sample was also selected to be high on a measure of trait social anxiety so it would be important to examine the effect of alcohol on individuals low in trait social anxiety and/or individuals diagnosed with social anxiety disorder. Moreover, given that this research is intended to help explain the high co-morbidity between social anxiety disorder and alcohol use disorders, it is important that future researchers consider including those with alcohol problems. One should also consider that the dose of alcohol administered in the current study may not be representative of the amount of alcohol that socially-anxious individuals typically consume during social interactions, and that different doses may well have different effects on post-event processing. Employing a lab-based, dose-response study design may be beneficial in determining how different amounts of alcohol may affect post-event processing across genders. Finally, the current

study did not include a placebo beverage condition, so it is unknown if findings were due to a pharmacological and/or expectancy alcohol effect.

In sum, the current study provides evidence consistent with hypothesis, that socially anxious women experienced a reduction in later post-event processing of an earlier social interaction when drinking at the time of the social interaction. The mechanism by which this occurs warrants further exploration. One possibility is that socially anxious women are particularly susceptible to the state anxiety reducing effects of alcohol, which then results in less subsequent post-event processing. However, this did not seem to be the case in the current study. Consistent with many experimental studies (e.g., Abrams et al., 2001), both socially anxious males and females experienced a dampening of their state social anxiety reactivity when they had consumed alcohol. However, it was only socially anxious women who went on to experience a decrease in their later levels of post-event processing. This suggests that another mechanism may be responsible for reductions in women's post-event processing, independent of reductions in state social anxiety at the time of the social event.

It is possible that, for socially anxious women, consuming alcohol at the time of a social interaction interferes with the appraisal of the social situation as threatening (Sayette, 1993), with self-awareness during the interaction (Hull, 1981), and/or with laying down a memory trace of the interaction (Mintzer, 2007). Any of these possibilities could then result in less post-event processing after the event among women. Future research is needed to tease apart these potential mechanisms.

Conversely, for socially anxious men, consuming alcohol at the time of a social interaction may lead to memory impairments or a disinhibitory effect that leads to

increased social concerns about what occurred during the social interaction and therefore, greater post-event processing. Certainly, the current study provides numerous directions for future research that could further explore the mechanisms by which alcohol may lead to decreased or increased post-event processing which may help explain the observed gender difference.

Table 6.1

Summary of Demographics and Baseline Measures across Conditions and Gender

	Alcohol Condition						No Alcohol Condition						Full Sample					
	Males		Females		Total		Males		Females		Total		Males		Females		Total	
	<i>(n = 23)</i>		<i>(n = 21)</i>		<i>(n = 44)</i>		<i>(n = 20)</i>		<i>(n = 20)</i>		<i>(n = 40)</i>		<i>(n = 43)</i>		<i>(n = 41)</i>		<i>(n = 84)</i>	
Ethnicity	83% White		81% White		82% White		85% White		85% White		85% White		84% White		83% White		83% White	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age (years)	20.96	1.58	21.19	1.99	21.07	1.77	22.40	2.72	21.00	1.59	21.70	2.31	21.63	2.28	21.10	1.79	21.37	1.79
SIAS	38.26	10.52	32.19	9.43	35.36	10.36	31.60	10.93	34.20	11.88	32.90	11.35	35.16	11.10	33.17	10.61	34.19	10.85
SPS	18.71	11.93	20.86	11.17	19.73	11.49	16.85	8.39	20.05	12.94	18.45	10.89	17.84	10.36	20.46	11.92	19.12	11.16
VAS-Baseline	8.96	15.74	9.67	19.70	9.30	17.53	10.25	18.58	10.60	18.86	10.43	18.48	9.56	16.93	10.12	19.06	9.83	17.89
DDQ	12.54	8.08	6.67	6.36	9.74	7.81	11.23	7.80	8.80	7.07	10.01	7.45	11.93 **	7.89	7.71	6.72 **	9.87	7.60
RAPI	14.59	8.27	8.38	7.74	11.63	8.53	10.06	9.71	11.36	8.25	10.71	8.92	12.48	9.15	9.83	8.03	11.19	8.67

Note. SIAS = Social Interaction Anxiety Scale (Mattick & Clarke, 1998); SPS = Social Phobia Scale (Mattick & Clarke, 1998); VAS = Visual Analogue Scales of state anxiety at baseline (Abrams et al., 2001); DDQ = Daily Drinking Questionnaire (Collins, et al., 1985) measuring drinks/week at study outset; RAPI = Rutgers's Alcohol Problem Index (White & Labouvie, 1989); ** $p < .01$

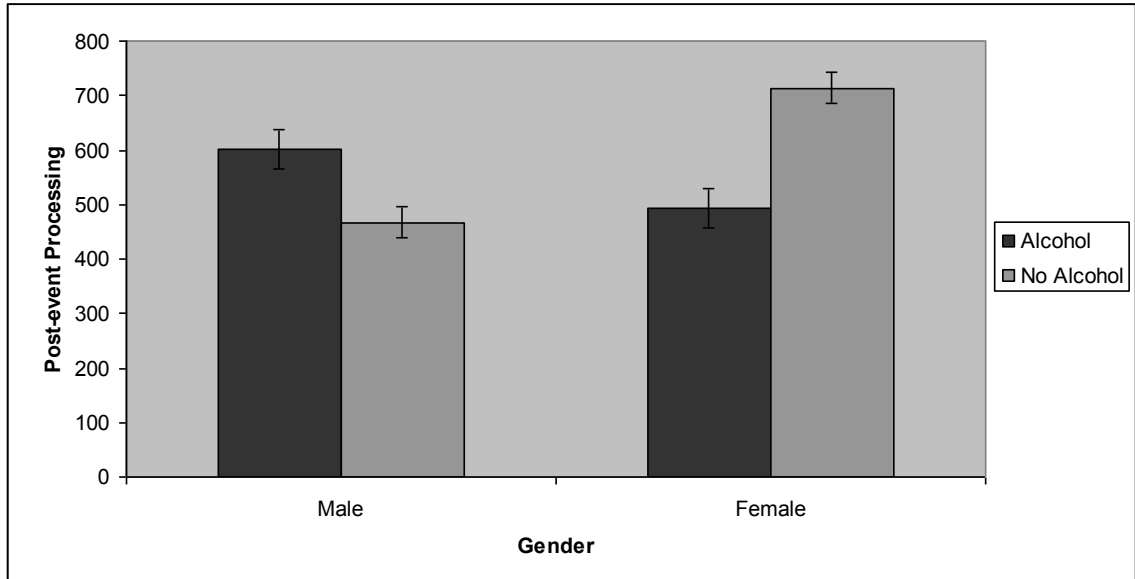


Figure 6.1. The effect of beverage condition and gender on post-event processing (PEP scores). Error bars represent one standard error above and below the mean.

CHAPTER 7: PROLOGUE TO STUDY 3

As discussed in Chapter 6, there may be sex differences in the connection between social anxiety and alcohol. When considering epidemiological findings, women with social anxiety disorder appear to be at a greater risk of developing a comorbid alcohol use disorder compared to women without social anxiety disorder. On the other hand, men may be at a similar risk of developing an alcohol use disorder with or without social anxiety disorder (e.g., Xu et al., 2012). This highlights the need for researchers to consider gender in studies that are exploring alcohol effects on social anxiety.

Interestingly, in Study 2, it was found that women who consumed alcohol before engaging in a standardized social interaction had less post-event processing than women who did not consume alcohol. However, in men, the opposite was found- those who consumed alcohol had more post-event processing than those who did not.

The findings described in Chapter 4 and 6 add to our understanding of how alcohol affects social anxiety by demonstrating that there are a number of factors that affect the experience of social anxiety. Alcohol can lead to widespread effects that influence how one behaves and how one thinks about his/her experience after it has occurred. These studies, however, were conducted in a lab-based setting using well-controlled, experimental protocols. Although efforts were made to increase the external validity of these experiments (e.g., using an interaction-based task in a casual environment), they can only approximate how drinking takes place in the real world. In order to more fully understand how alcohol affects social anxiety, it was necessary to conduct a final study (Study 3) where the use of experience sampling methods allowed

me to examine the effect of alcohol on state social anxiety in real time, in the drinker's own environment.

CHAPTER 8: STUDY 3- DOES DRINKING REDUCE SOCIAL ANXIETY IN DAILY LIFE? A 22-DAY EXPERIENCE SAMPLING STUDY¹³

Abstract

To explain the co-occurrence of social anxiety and alcohol use problems, researchers have used experimental methods to test whether alcohol reduces state social anxiety in the lab. The present study used experience sampling methods to test if these experimental findings extend to real world settings. Students ($N = 132$; 100 women; 32 men; aged 17 to 32 years) completed measures of their state social anxiety and alcohol intake from 4:00 p.m to 4:00 a.m each day for 22 consecutive days. Multilevel modeling suggested for each alcoholic drink consumed, state social anxiety decreased by 4.0% two hours later. Those with greater levels of trait social anxiety experienced higher state social anxiety than those with lower levels of trait social anxiety. Findings support predictions made by tension reduction theory—that alcohol reduces state social anxiety in daily life. These results extend many lab-based findings to the real world and provide further evidence that alcohol may provide negative reinforcement for those who are experiencing social anxiety.

¹³ Adapted from Battista, S.R., Mackinnon, S.P., Sherry, S.B., Barrett, S.P., & Stewart, S.H. (in preparation). Does alcohol reduce social anxiety in daily life? A 22-day experience sampling study. As first author of this paper, I helped design the study, organized participant recruitment, collected data by running participants through the study protocol, entered all data into the database, conducted the data analyses with the assistance of the second author, wrote the manuscript and revised the manuscript while incorporating feedback from my co-authors, the peer reviewers, and the journal editor.

8.1 INTRODUCTION

Heavy alcohol use and problems associated with alcohol use are relatively common among undergraduate students (Turrisi, Mallett, Mastroleo, & Larimer, 2006). For example, one study found over a third of undergraduates met diagnostic criteria for an alcohol use disorder in the past year (Knight et al., 2002). Research indicates that in clinical samples, those with social anxiety are at increased odds of also having an alcohol use disorder compared to those without social anxiety, and it is typically social anxiety that precedes problematic alcohol use (Buckner et al., 2008; Schneier et al., 2010). This is consistent with alcohol being used to cope with social anxiety among socially anxious individuals (Buckner & Heimberg, 2010). Unfortunately, drinking to cope with anxiety may be particularly problematic in terms of unique associations with negative consequence drinking (Grant, Stewart, O'Connor, Blackwell, & Conrod, 2007).

Various theories purport to explain the relationship between anxiety and problem drinking. For example, according to tension reduction theory (Conger, 1951), alcohol consumption reduces state anxiety, thereby providing negative reinforcement and leading to further alcohol use in situations that provoke anxiety. Although this theory was originally developed to explain the effects of alcohol on more general tension/anxiety in animal models, it has also been applied specifically to *social* anxiety in humans. Although there is overlap between the two, social anxiety may be reliably distinguished from more general anxiety using self-report measures (e.g., Brown et al., 1997). Further, evidence suggests that of the anxiety disorders, social phobia is one of the most likely to co-occur with alcohol use disorders (even more so than generalized anxiety disorder; Boschloo et al., 2011). Finally, given that a large amount of drinking takes place in a

social context, researchers have applied the tension reduction hypothesis to consider alcohol's effect on the anxiety that is experienced anticipating and/or participating in social situations (see Chapter 2).

Two predictions are made by the tension reduction theory when applied to the social anxiety-alcohol problem relationship. First, individuals are expected to experience a decrease in their state social anxiety when consuming alcohol and second, they are expected to learn to consume alcohol in anxiety-provoking situations. Although research in this area is prolific, findings are often inconsistent and difficult to integrate. Further, most of this research is experimental and does not always capture how drinking occurs in the real world. The goal of the present study was to extend experimental findings and focus on the first tenet of tension reduction theory by using an experience sampling methodology to explore the effect of alcohol on individuals' levels of state social anxiety in their everyday lives.

To investigate alcohol's theorized dampening effects on state social anxiety, researchers typically use experiments with a between-subjects design (e.g., moderate dose of alcohol vs. placebo), and measure state social anxiety using self-reports or physiological measures (e.g., heart rate) while participants undergo a social anxiety-induction task (see Chapter 2). In undergraduate samples, evidence suggests alcohol dampens increases in state social anxiety during a social stressor (Balodis, Wynne-Edwards, & Olmstead, 2011). Similar results are found when considering individuals diagnosed with social phobia (Abrams, Kushner, Medina, & Voight, 2001). However, several lab-based studies have not found alcohol to reduce state social anxiety (e.g., Ham, Casner, Bacon, & Shaver, 2011). In order to further explore these disparate findings,

researchers have investigated how individual difference variables may affect the relationship between alcohol intake and social anxiety.

In fact, another theory in this area -- the stress response dampening model (Sher & Levenson, 1982) -- focuses on such individual difference variables that may predispose some people to experience greater anxiety reductions than others when consuming alcohol. Trait social anxiety, defined as one's relatively stable level of social anxiety across time and situations (Spielberger, 1985), may be of particular interest as one such individual difference variable since studies consistently find individuals with higher levels of trait social anxiety have more alcohol problems than those with lower levels of trait social anxiety (Buckner, Heimberg, Ecker, & Vinci, 2013; Stewart, Morris, Mellings, & Komar, 2006). This suggests that people with high levels of trait social anxiety may be particularly sensitive to the state social anxiety-reducing effects of alcohol and that this may lead them to consume more alcohol than others when anticipating social anxiety provoking situations (Buckner et al., 2013).

Consistent with this latter possibility, experiments indicate that individuals anticipating an anxiety-provoking task consumed more alcohol compared to when they were anticipating a neutral task and that this effect was greater in participants who scored high on a measure of trait social anxiety (Kidorf & Lang, 1999). However, there has been very limited research examining the effect of alcohol on state social anxiety while also considering trait social anxiety. Naftolowitz and colleagues (1994) compared a sample of participants diagnosed with social phobia ($n = 9$) to a control sample ($n = 9$) and did not find alcohol to lead to state social anxiety reduction in either group. However, this study had small sample sizes and did not include a no alcohol control condition. Given

suggestions that trait socially anxious individuals may experience greater tension-reduction from alcohol (Buckner et al., 2013), the present study examined trait social anxiety as a potential moderator of the within-person relationship between alcohol intake and state social anxiety reduction.

There are limitations in the methodology of lab-based experimental studies of social anxiety and alcohol use that may account for inconsistent findings (see Chapter 2). Lab-based studies can only approximate how drinking naturally takes place in the drinker's daily environment. For example, for reasons of experimental control, a standard dose and type of alcohol is administered to all participants, rather than having participants choose how much or what they would like to drink. Further, the drinking context in lab-based studies is often artificial in that the drinking takes place in a standard sterile lab space (although some are set up to resemble a bar), while the participant is alone. In a review of lab-based alcohol administration studies, McKay and Schare (1999) found greater effect sizes for anxiety reduction in response to alcohol intake in studies where the lab was set up to resemble a casual drinking environment compared to a typical sterile lab environment. All of these factors may influence how alcohol affects state social anxiety and point to the need to examine participants in their own real world environment where drinking takes place naturally.

Experimental methods often involve between-subject designs examining relations among variables, across groups of people. In contrast, a within-subject approach examines relations among variables within a single individual over time and/or across situations (Bolger, Davis, & Rafaeli, 2003). This can be achieved using experience sampling methods, which measure a particular behaviour as it occurs in real life. This

method is increasingly recognized as a naturalistic research strategy that combines the strengths of between-subject and within-subject approaches (Tennen, Affleck, Armeli, & Carney, 2000).

Several studies have used experience sampling methods to capture the link between mood, including state *general* anxiety, and subsequent alcohol intake (Armeli, Todd, Conner, & Tennen, 2008; Grant, Stewart, & Mohr, 2009; Mohr et al., 2005). However, few studies have looked specifically at the link between state *social* anxiety and subsequent alcohol intake using experience sampling methods. One recent study by O'Grady, Cullum, Armeli, and Tennen (2011) examined whether trait social anxiety moderated the relationship between daily feelings of embarrassment and daily drinking in undergraduate students such that those high in trait social anxiety were predicted to show a stronger association between feeling embarrassed and drinking compared to those lower in trait social anxiety. However, findings indicated for those who were high in trait social anxiety, there was no link between daily embarrassment and evening alcohol use, whereas those low in social anxiety drank *less* alcohol on days when they experienced embarrassment. This study was limited, however, in that participants were only asked once per day to indicate whether they had experienced embarrassment and how much alcohol they had consumed, making it difficult to establish more nuanced within-day temporal relationships. Further, no studies to date have used experience sampling methods to look at the effect of alcohol intake on subsequent state anxiety. Thus, our study is unique and extends lab-based research examining how a specific dose of alcohol affects state [social] anxiety to a real world setting where we captured drinking as it naturally occurred over time.

The present study was designed to expand on the scarce research examining relations between state social anxiety and alcohol use using daily process methods. We were interested in testing the first tenet of tension reduction theory, which predicts consuming alcohol leads to subsequent reductions in state social anxiety. We used experience sampling, employing palm pilots to capture multiple assessments of alcohol intake and state social anxiety levels each day. The use of palm pilots has benefits including reduced reliance on retrospective memory, and studies suggest palm pilots can be used to reliably record both alcohol consumption (Collins et al., 1998) and mood states (Marco, Neale, Schwartz, Shiffman, & Stone, 1999).

The present study was designed to test the within-person link between alcohol intake and state social anxiety in real world settings by having participants report on these variables using palm pilots up to six times per day, over a 22-day period. Specifically, we tested whether level of alcohol intake predicted a participant's subsequent state social anxiety approximately two hours later. This time frame was chosen to capture alcohol's sedative/anxiolytic effects based on the timing of the blood alcohol concentration (BAC) curve (Earleywine & Martine, 1993). Given that a number of lab-based experimental studies in this area found support for alcohol leading to state social anxiety reductions within a similar time frame (e.g., Balodis et al., 2011), we expected a similar effect would be found in naturalistic settings using experience sampling. Therefore, it was hypothesized that within individuals, increased alcohol consumption would be related to decreased self-reported social anxiety two hours later. Another goal of the present study was to test whether trait social anxiety moderated the within-person relationship between alcohol intake and state social anxiety. It was hypothesized that people with higher levels

of trait social anxiety would exhibit a stronger within-person relationship between increased alcohol intake and decreased state social anxiety compared to those lower in trait social anxiety.

8.2 METHOD

8.2.1 Participants

Individuals were eligible to participate in our study if they reported consuming alcohol at least four times in the past month. This criterion is used in a number of daily diary studies examining drinking (e.g., Grant et al., 2009) as it increases the probability of capturing alcohol consumption during the experience sampling period. All participants had to be university or college students. A total of 135 participants completed baseline measures (100 women; 35 men), but three did not complete any of the experience sampling measures. Therefore, the final sample consisted of 132 participants (100 women; 32 men), who ranged in age from 17 to 32 years ($M = 20.76$, $SD = 2.65$) and the majority of whom were White (85.5%). Further, 21 participants (15.9%) in our sample would be considered in the clinical range of social anxiety based on Heimberg, Mueller, Holt, Hope, and Liebowitz's (1992) cutoff score of 34 on the SIAS.

8.2.2 Baseline Measures

Screening questionnaire. A measure was created to unobtrusively ask participants about their typical drinking patterns to see if they met study inclusion criteria. This questionnaire contained items asking about various behaviors (e.g., exercise, internet use), but the only item used for the present study asked participants how many times they had consumed alcohol in the past 30 days. The response options ranged from 0 (*not applicable*) to 4 (*six or more times*).

Drinking questionnaire. Two questions were added to our demographic questionnaire to assess drinking patterns in our sample. Participants were asked to indicate their typical number of drinking occasions per week in the past six months (drinking frequency). They were also asked to provide the number of drinks they typically consumed per occasion in the past six months (drinking quantity). These questions were embedded within the demographics measure to reduce their salience and increase response accuracy (Sobell & Sobell, 1990).

Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989). This scale assesses alcohol-related problems in young people. The RAPI contains 23 items where participants indicate how often they have experienced negative consequences related to their alcohol use (e.g., “neglected your responsibilities”) in the past six months, with response options ranging from 0 (*never*) to 5 (*10 or more times*). This scale was scored by summing the number of items participants endorsed (Martens, Neighbors, O’Conner, Lee, & Larimer, 2007). When scored this way, Martens et al. (2007) found good internal consistency (alphas from .72 to .80) and convergent validity with frequency of alcohol use in undergraduates. In our study, internal consistency alpha was .89.

Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998). The SIAS is a 20-item, self-report scale assessing participants’ trait level of anxiety in social situations (e.g., “When mixing socially, I feel uncomfortable”). Each item is rated on a five-point Likert scale from 0 (*not at all characteristic or true of you*) to 4 (*extremely characteristic or true of you*). This scale has good internal consistency ($\alpha = .88-.94$) and test-retest reliability ($r_s = .92$) after one and three months (Mattick & Clarke, 1998). In our study, internal consistency was .85.

8.2.3 Experience Sampling Measures

State social anxiety. Participants were asked to report their levels of state social anxiety using an 8-item scale (e.g., “I feel self-conscious”) at each of the six time frames each day. This scale was taken from Kashdan and Steiger (2006) and adapted to have participants respond based on how they were feeling “at this moment” to measure *state* social anxiety. The wording of a few items was changed (e.g., “When I was talking to someone, I was worried about what they were thinking of me” was changed to “I am finding it hard to interact with people” to simplify and put the item in present tense) and one additional item was added (“I am worried about looking foolish”). Each of the eight items was rated on a 5-point Likert scale from 0 (*not at all*) to 4 (*extremely*). In our analyses, all eight items were summed to give a total state social anxiety value at each time frame. Internal consistency of this adapted measure was calculated using two methods. First, the overall alpha was calculated by averaging across all 22 days and all six time frames and found to be .98. Second, alphas were calculated for each time frame separately by averaging across the 22 days for a given timeframe. The values were as follows: Timeframe 1 = .94; timeframe 2 = .93; timeframe 3 = .93; timeframe 4 = .92; timeframe 5 = .91; timeframe 6 = .91.

Alcohol consumption. At each of the six time frames, starting at 4:00 p.m and ending at 4:00 a.m, participants indicated how many total standard drinks they had consumed since 4:00 p.m that day. This interval was chosen as research suggests most undergraduate drinking occurs between 4:00 p.m and 4:00 a.m (Orcutt & Harvey, 1991). A standard drink conversion chart was also displayed with this question so participants could determine what constituted one standard drink (one alcoholic beverage = one bottle

of beer, one wine or other cooler, one small [4-ounce] glass of wine, or one shot/mixed drink containing one ounce of hard liquor). Participants reported the number of drinks as a running total (i.e., if they had two drinks at timeframe 1, and three drinks at timeframe 2, they would report five drinks as their running total at timeframe 2). They were asked to provide a running total as it was reasoned that this would be easier for participants than having to remember how many new alcoholic drinks they had consumed since their last report. Before analysis, these running totals were transformed into number of drinks per 2-hour timeframe.

8.2.4 Procedure

Participants were recruited using the university's psychology student research participant pool and via ads posted around the Canadian city where this study took place. For participants in the psychology student participant pool, the screening measure was completed online to ensure the eligibility criterion was met. Of those who completed screening through the university research pool, 774 of 1497 (51.7%) students met eligibility criteria (consumed alcohol four or more times in the past 30 days). For participants recruited through posted advertisements, the same screening was conducted over the phone. Of those who were screened over the phone, 89 of 256 (34.8%) met eligibility criteria.

Eligible participants were booked to come into the lab for an introductory session. During this session, they completed informed consent and baseline questionnaires. Participants were then given their palm pilots and a research assistant provided instructions and a 15-minute demonstration on how to use the palm pilots over the 22-day period. This included detailed instruction on how to provide the cumulative alcohol

intake reports each day. For completing the introductory session, participants received either course credit (1 credit point) toward their grade in a psychology class or \$10.

Palmtop computers (Dell Axim X51) were programmed with customized software designed by Fusient Corp. (Toronto, Canada). Each day, six alarms were programmed to go off at a random time during specified, 2-hour timeframes (i.e., 4:00-6:00 p.m; 6:00-8:00 p.m, 8:00-10:00 p.m; 10:00 p.m-12:00 a.m, 12:00-2:00 a.m, and 2:00-4:00 a.m). Although participants were encouraged to complete the questionnaire as close as possible to being signaled, they were permitted to complete the questionnaires at any time during the specified 2-hour timeframe (e.g., if an alarm went off at 6:17 p.m, then they had until 8:00 p.m to complete that questionnaire) to maximize data collected at each timeframe. Each questionnaire contained the state social anxiety and alcohol consumption measures described above.

During the 22-day period, participants were prompted six times each day to complete their questionnaires. They were informed they were not required to wake up to complete questionnaires during times they were asleep. They were also sent weekly reminder e-mails that included a check-in to ensure they were not experiencing problems with palm pilots. At the end of the 22-day period, participants came in to the lab for debriefing. They returned their palm pilots, were fully informed about the purpose of the study, and received course credit (3 credit points) or \$30 for taking part in the experience sampling portion of the study. As an incentive, participants who completed 85% of their daily questionnaires received a bonus of \$50 (see Grant et al., 2009). Participants were informed of this bonus at the beginning of the study. All participants were also given a

list of resources that they could pursue if they had any concerns about their drinking and/or anxiety.

8.2.5 Data Analytic Strategy

Our study design had three nested levels of data. Level 1 (time) included variables measured once per timeframe (alcohol intake and state social anxiety across the six timeframes). Level 2 (day) included day of study (from 1 to 22), the day of the week on which reports were completed (e.g., Monday), and number of total drinks and average state social anxiety per day (see below where it was determined that this second level was not needed in our final model). Finally, level 3 (participants) contained between-subject variables measured at baseline (age, sex, trait social anxiety, and alcohol problems) and the total number of drinks consumed across the 22 days per participant.

First, descriptive statistics and bivariate correlations were calculated for all variables of interest. Because the multilevel structure does not permit correlations between variables at different levels, all level 1 variables were aggregated into level 3 variables by taking the average across all 22 days before calculating descriptive statistics and bivariate correlations.

Before conducting multilevel analyses, intraclass coefficients were calculated to determine if each level of the model was necessary to include in the final analysis. All analyses were done using multilevel modeling with HLM Software (Version 7.01; Raudenbush, Bryk, Congdon, & du Toit, 2011). Multilevel modeling is advantageous with this type of design because it allows for missing level 1 observations by giving a weighted regression coefficient in the final regression to account for the number of level 1 observations (i.e., those with fewer observations have less of an influence on the final

results than those with more observations, and participants with low completion rates are still included in analyses; Raudenbush & Bryk, 2002). To examine change over time (from one timeframe to the next), lagged variables (lagged by one timeframe) were created at level 1 for alcoholic beverages and state social anxiety. At level 3, relevant covariates and trait social anxiety were entered as main effects and as cross-level moderators.

The outcome variable (state social anxiety) contained a large number of zeros with an over-dispersed Poisson distribution. To correct for this, an over-dispersed Poisson sampling model was employed (see Grant et al., 2009). The final model interpreted was the unit-specific model with robust standard errors. Further, when using a Poisson model within multilevel modeling, a log-link function is automatically applied to coefficients to account for non-normal distributions. These coefficients can then be exponentiated to yield odds ratios, which provide a measure of effect size (Raudenbush et al., 2011). Hence, for significant findings reported below, odds ratios with 95% confidence intervals (CIs) were calculated to aid in interpretation. All variables were grand mean centered to reduce collinearity and our final model specified random intercepts and fixed slopes.

8.3 RESULTS

8.3.1 Participant Completion Rates

In the final sample ($N = 132$), 7,330 reports were completed out of a total 17,424 possible reports (132 participants x 22 days x 6 timeframes). This represents an overall completion rate of 42.1%. It is important to note participants were not expected to complete reports during times when they were sleeping; many of the missed reports were

during the last two timeframes, which were between 12:00 a.m and 4:00 a.m each day. Specifically, the completion rates for each timeframe were 52.5% for timeframe 1, 52.4% for timeframe 2, 52.5% for timeframe 3, 52.7% for timeframe 4, 34.3% for timeframe 5, and 11.8% for timeframe 6. Missing data increased in a linear fashion from day 1 (43.5% missing) to day 22 (84.2% missing). Completion rates were not significantly associated with any other study measures. Missing data were handled via a maximum likelihood approach, which produces relatively unbiased parameter estimates even for high rates of missing data when data are missing at random (Collins, Schafer, & Kam, 2001; Graham, 2009). To meet the missing at random assumption, the timeframe and day of study variables were entered in as covariates at level 1 and 2, respectively, as both variables significantly predict missingness and can be used to adjust parameters and standard errors to account for the missing data ¹⁴.

8.3.2 Descriptive Statistics

Demographic and baseline variables appear in Table 1. Participants reported consuming alcohol a couple of times per week, which is somewhat more often than similarly selected student samples ($d = 0.38$; Grant et al., 2009). However, when considering drinking quantity, our sample reported consuming somewhat fewer drinks per occasion than similarly selected student samples ($d = 0.25$; Grant et al., 2009).

Participants' scores on the RAPI were higher than those reported in a study using

¹⁴ Although some researchers choose to remove participants with low response rates, we opted to retain all of our participants regardless of how many daily questionnaires they completed. Removal of participants based on a cutoff response rate is similar to listwise deletion of data, which significantly reduces statistical power and is more biased than the maximum likelihood approach that we used (Graham, 2009). Removing participants also reduces the representativeness of the sample, as it treats non-compliant participants as non-existent, rather than modeling all of the data provided.

undergraduates that did not pre-select participants who were regular drinkers (Martens et al., 2007; $d = 1.09$). Regarding social anxiety, participants had levels consistent with what would be expected in an undergraduate sample (Mattick & Clarke, 1998).

Participants reported consuming alcohol between 4:00 p.m and 4:00 a.m on 853 days (39.9%) of a possible 2,140 days when reports were completed (reports were missing for 764 days). On days when alcohol was consumed, participants drank an average of 4.40 alcoholic beverages ($SD = 3.90$) per day. Across all reporting days (not just drinking days), participants consumed an average of 0.55 drinks per day ($SD = 1.13$).

8.3.3 Bivariate Correlations

Baseline measures. Age was significantly negatively correlated with typical drinking quantity, but was not related to drinking frequency or alcohol problems (see Table 2). Alcohol problems were significantly and positively correlated with both drinking frequency and drinking quantity. Drinking frequency and drinking quantity were not significantly correlated. Trait social anxiety was not significantly correlated with either drinking quantity or drinking frequency, but was significantly and positively correlated with alcohol problems.

Baseline and daily measures. To examine correlations between the experience sampling variables (experience sampling alcoholic beverages and state social anxiety) and baseline variables (age, trait social anxiety, alcohol problems, typical drinking frequency and drinking quantity), averages were calculated for each participant across a maximum of 22 days for each experience sampling variable. Averaged experience sampling alcoholic beverages were positively related to baseline drinking frequency, but

not to baseline drinking quantity or alcohol problems. Averaged state social anxiety was positively correlated with both trait social anxiety and alcohol problems (see Table 2)¹⁵

8.3.4 Intraclass Correlations

Before testing hypotheses, we first calculated intraclass correlation coefficients (ICC). The ICC1 provides the amount of total variance available to be explained at each level. The ICC2 represents the reliability of the group means. An ICC2 score should be .70 or higher to justify aggregating a level 1 variable into a higher level variable (e.g., averaging across all 22 days¹⁶ to create a level 3 variable; Bliese, 2000). When considering the variability in state social anxiety at each level (ICC1), 42.7% of the variance was at level 1, 14.2% at level 2, and 43.1% at level 3. The ICC2 value for state social anxiety was .25 at level 2 and .88 at level 3. When considering the variability in alcohol intake at each level, 32.4% of the variance was at level 1, 40.2% at level 2, and 27.4% at level 3. The ICC2 value for alcohol intake was .57 at level 2 and .78 at level 3. Taken together, these values indicated (a) there is considerable variance in social anxiety at both level 1 and level 3 and variance in alcohol intake at all three levels; and (b) level 2 social anxiety and alcohol intake are virtually isometric with level 3 social anxiety and

¹⁵ Although the correlation found between state and trait social anxiety is lower than some previous studies, it is possible that our measure was more specific to state social anxiety given that the wording of the items was “how do you feel *at this moment*” and that it was administered so frequently each day (see Mushquash, Sherry, MacKinnon, & Mushquash, [in press] for a discussion of the overlap between trait and state measures).

¹⁶ Similar studies have used a 21-day time frame (e.g., Armeil, Todd, & Mohr, 2005). However, since our analysis was intended to examine level 2 variables that were lagged by a day, which would have resulted in the loss of one day of data, we opted to have participants complete measures on 22 days in order to have 21 full days of data. Although we ended up not including level 2 aggregated variables in our final model, we still decided to retain all 22 days of data.

alcohol intake. Thus, only an aggregated level 3 alcohol variable (i.e., average number of drinks over 22 days) was created and entered into analyses. Put differently, no aggregated level 2 predictors for lagged alcohol and social anxiety were entered at level 2 as the ICC values suggested that the level 2 and level 3 variables derived from the level 1 variables were very highly correlated with each other, so adding them both into the model would result in multicollinearity.

8.3.5 Multilevel Model Hypotheses Testing

We hypothesized increased alcohol consumption at one time frame would be associated with subsequent decreased state social anxiety at the next time frame. We also hypothesized this relationship would be moderated by trait social anxiety such that those with higher levels of trait social anxiety would show a stronger alcohol intake-state social anxiety relationship than those lower in trait social anxiety. Finally, though not of primary interest, timeframe and day of study were entered as level 1 and level 2 covariates to meet the missing at random assumption. To test these hypotheses statistically, a multilevel model was run using the following equation:

$$\begin{aligned} \text{STATE SOCIAL ANXIETY} = & \gamma_{000} + \gamma_{001} * (\text{AGE}) + \gamma_{002} * (\text{SEX}) + \\ & \gamma_{003} * (\text{DRINKS}_{\text{mean}}) + \gamma_{004} * (\text{TRAIT ANXIETY}) + \gamma_{005} * (\text{ALCOHOL} \\ & \text{PROBLEMS}) + \gamma_{010} * (\text{DAYOFSTUDY}) + \gamma_{100} * (\text{DRINKS}_{t-1}) + \\ & \gamma_{101} * (\text{DRINKS}_{t-1}) * (\text{AGE}) + \gamma_{102} * (\text{DRINKS}_{t-1}) * (\text{SEX}) + \\ & \gamma_{103} * (\text{DRINKS}_{t1}) * (\text{DRINKS}_{\text{mean}}) + \gamma_{104} * (\text{DRINKS}_{t-1}) * (\text{TRAIT ANXIETY}) + \\ & \gamma_{105} * (\text{DRINKS}_{t-1}) * (\text{ALCOHOL PROBLEMS}) + \\ & \gamma_{200} * (\text{STATE SOCIAL ANXIETY}_{t-1}) + \gamma_{300} * (\text{TIMEFRAME}) + r_0 + u_{00} + e. \end{aligned}$$

The subscript “mean” refers to level 3 variables derived from level 1 data, and the subscript “t-1” refers to variables lagged by one timeframe. Measures were included from all days of the study, including when no alcohol was consumed where drinks were coded as “0.” All of the continuous level 3 variables were grand-mean centered and sex was contrast coded as +1 for men and -1 for women. The intercept (γ_{000}) should be interpreted as how much state social anxiety a participant is predicted to experience at a given timeframe at the sample mean value for every predictor variable. The parameter γ_{100} represents the main effect of interest (i.e., does alcohol intake at a previous timeframe reduce state social anxiety at a later timeframe?). The parameter γ_{104} represents the predicted cross-level interaction of interest (i.e., does alcohol intake have a stronger anxiety-dampening effect for people high in trait social anxiety?). Results of this analysis appear in Table 3.

As expected, there was a significant association between alcohol intake and subsequent state social anxiety, when controlling for previous levels of state social anxiety, as well as all of the level 3 variables. Specifically, for each alcoholic drink consumed, state social anxiety at a subsequent timeframe decreased by approximately 4.0%. This may be observed in the negative slope in Figure 1 where it may be seen that as alcohol intake increases, subsequent state social anxiety levels decrease. Further, state social anxiety at a previous timeframe significantly predicted the subsequent timeframe’s state social anxiety, supporting test-retest reliability.

A main effect was also found for trait social anxiety which indicates trait social anxiety is positively associated with average levels of state social anxiety across 22 days while controlling for age, sex, alcohol problems, and average experience sampling drinks.

This effect may be observed in Figure 1 by the higher levels of state social anxiety among high vs. low trait socially anxious participants at the intercept (i.e., 0 drinks).

Unexpectedly, there was also a main effect of alcohol problems, indicating that alcohol-related problems were associated with higher average levels of state social anxiety across 22 days, while controlling for all other variables.

Contrary to hypotheses, trait social anxiety did not moderate the within-person association between alcohol intake and state social anxiety. In fact, no significant cross-level interactions were found for any level 3 variables, suggesting alcohol intake predicted a reduction in state social anxiety similarly across both sexes, all ages, and all levels of alcohol consumption, alcohol problems, and trait social anxiety. The lack of expected moderation by trait social anxiety level is seen in Figure 1, where increased alcohol intake was associated with a similar decrease in levels of subsequent state social anxiety for those high compared to those low in trait social anxiety (see roughly parallel slopes in Figure 1)¹⁷. If our moderation hypothesis was supported, then the parameter γ_{104} would be positive and significant; and the negative slope between alcohol intake and subsequent state social anxiety would be steeper for those high in trait social anxiety.

8.4 DISCUSSION

We used experience sampling methods to test how alcohol intake affected participants' self-reported state social anxiety across a 22-day period. As hypothesized, a dampening effect of alcohol was found such that as a participant drank more, his/her subsequent state social anxiety decreased. This finding is consistent with predictions

¹⁷ A model to test for possible quadratic trends was run (i.e., adding in lagged drinks squared as a predictor of state social anxiety). However, the quadratic term was non-significant, suggesting that the relationship is best modeled as linear in our sample.

outlined in tension reduction theory (Conger, 1951) as well as results from lab-based studies where alcohol has been shown to reduce state social anxiety (e.g., Abrams et al., 2001). However, the current study extends such prior findings into a real world setting by demonstrating individuals experience relief from state social anxiety after consuming alcohol across a variety of situations and times throughout the evening.

The present study also examined individual difference variables to test whether certain participants were more sensitive to alcohol's social anxiety-reducing effects. Contrary to our hypothesis and predictions made on the basis of the stress response dampening model (Sher & Levenson, 1982), trait social anxiety did not moderate the within-person relationship between alcohol intake and state social anxiety. Given findings regarding the co-occurrence of trait social anxiety and alcohol problems (Stewart et al., 2006), it was expected those higher in trait social anxiety would be more sensitive to alcohol's anxiety reducing effects than those low in social anxiety. However, few researchers have directly compared those who scored high vs. low on measures of trait social anxiety in a single study. Rather, most use an unselected undergraduate student sample or select only participants who are high in social anxiety (i.e., a clinical or analogue clinical sample). Although the present study opted to use an unselected student sample, baseline scores on a measure of trait social anxiety were collected and included in the analysis as a potential moderator.

Our findings suggest that, although high and low trait socially anxious individuals experience similar magnitude state social anxiety reductions from alcohol intake, those who are high in trait social anxiety start out with greater levels of state social anxiety than those low in trait social anxiety (see Figure 1). Anxiety reductions experienced by those

high in trait social anxiety may be more reinforcing because these individuals are more often at an elevated level of state social anxiety, and thus the state social anxiety-reduction offered by alcohol may be more valued by them. It is also possible that we failed to find a moderating effect of trait social anxiety because of range restriction in our trait social anxiety measure. Specifically, few participants in our sample would be considered “high” in social anxiety using standard cutpoints (Heimberg et al., 1992). Future researchers might consider recruiting participants based on their elevated scores on a measure of trait social anxiety or compare a clinical sample to controls to determine if alcohol affects those who are clinically socially anxious differently than those who are not in the real world.

An interesting finding that emerged was that scores on a measure of alcohol-related problems taken at baseline were associated with greater levels of both baseline trait social anxiety and measures of state social anxiety taken during the daily portion of our study. The positive relationship between trait social anxiety and alcohol problems is consistent with previous research (Lewis et al., 2008). However, the finding that baseline alcohol problems were associated with greater state social anxiety is novel and warrants further study. There may be reciprocal relations between social anxiety and alcohol problems; individuals with higher trait social anxiety may use alcohol to reduce their state social anxiety, but then experience more alcohol problems, which may then exacerbate their state social anxiety (Stewart & Conrod, 2008). This explanation is speculative, but provides directions for future research.

The current study also has limitations. The use of a homogenous student sample leaves open the possibility that findings may differ in clinical and/or community samples.

Completion rates were relatively low in the current study. This was potentially due to the relatively high number of prompts participants received each day in combination with the 22-day timeframe. Future studies using experience sampling may benefit by limiting the burden placed on participants (e.g., reducing the number of times that participants are prompted to complete measures each day), using event-contingent measures (i.e., participants only complete measures when they are drinking alcohol), increasing incentives to complete measures, and/or including a practice period to familiarize participants with the study procedure. It was also found that completion rates were particularly low for the later timeframes each day and it is unknown whether this was due to non-compliance or because participants were sleeping during these later timeframes. However, it should be noted that because timeframe was found to predict missingness in our dataset, we were able to enter it as a covariate in our model so that our parameters could be adjusted accordingly (Collins et al., 2001).

It is also important to consider that our study design did not allow us to test if the observed alcohol-induced reductions in state social anxiety were physiological and/or expectancy based. There are a number of mechanisms by which alcohol may reduce state social anxiety (e.g., it may lead to decreases in self-awareness, see Hull, 1981) and future research is necessary to study *how* alcohol leads to state social anxiety dampening. Also, although prior work does suggest that social anxiety measures are distinct from generalized anxiety measures (Brown et al., 1997), it is unknown if the decreases in state social anxiety that we found were specific to *social* anxiety or represent a more global state anxiety reduction that occurs with alcohol intake. To make this distinction, future research needs to include measures of both types of state anxiety to determine if this

effect is specific to state social anxiety. Finally, although a linear relationship was found in the current study, future research may consider whether there are dose-response effects of alcohol such that social anxiety reduction may not occur equally at all levels of alcohol consumption. It would also be interesting to explore the effect of other drugs (e.g., marijuana) on state social anxiety. Future researchers would need to specifically select samples of participants with a history of drug use in order to capture this using daily experience sampling.

In sum, our study used experience sampling to examine how alcohol affected state social anxiety in everyday life. The main finding that greater levels of alcohol intake led to subsequent decreases in state social anxiety has a number of clinical implications. This suggests individuals may use alcohol to reduce their state social anxiety in their everyday lives and this strategy may be effective in the short-term. This finding may be even more relevant for those with high levels of trait social anxiety given that, although they experience these reductions similarly to those lower in trait social anxiety, the reductions may be more meaningful since they start off with higher levels of state social anxiety. However, it is important to consider the long-term consequences of relying on alcohol to reduce state social anxiety. It may result in greater alcohol-related problems (e.g., missing work or relationship difficulties) and may interfere with the development of more adaptive ways of coping with state social anxiety, thus maintaining social anxiety in the longer-term (Stewart & Conrod, 2008). Clinically, it is important to help individuals develop alternative ways of coping with their state social anxiety as a way to prevent, or help treat, alcohol problems.

Table 8.1

Summary of Demographic, Baseline, and Daily Variables

	Full sample ($N = 132$)	
	<i>M</i>	<i>SD</i>
Baseline variables		
Age	20.76	2.65
Drinking frequency	2.10	1.53
Drinking quantity	5.32	2.95
Alcohol problems	8.70	5.54
Trait social anxiety	20.88	13.27
Experience sampling variables		
Drinks	0.55	1.13
State social anxiety	3.52	5.12

Note. Drinking frequency was measured as the number of drinking occasions per week.

Drinking quantity was measured as the number of drinks consumed per occasion.

Alcohol problems were measured using the Rutgers Alcohol Problem Index (White &

Labouvie, 1989) and trait social anxiety was measured using the Social Interaction

Anxiety Scale (Mattick & Clarke, 1998). Experience Sampling drinks is the average

number of drinks per day, averaged across a maximum of 22 days and across all

participants. Experience Sampling state social anxiety represents the average state social

anxiety across a maximum of 22 days and across all participants.

* $p < .05$.

Table 8.2

Between-subjects Bivariate Correlations Between Demographic, Baseline, and Experience Sampling Measures

	1	2	3	4	5	6	7
1. Age	-	-.08	-.20*	-.06	-.06	.04	-.07
2. Drinking frequency		-	.05	.26**	-.01	.23**	.07
3. Drinking quantity			-	.34**	-.05	.04	-.03
4. Alcohol problems				-	.22*	.16	.22*
5. Trait social anxiety					-	.03	.35**
6. Experience sampling drinks						-	.01
7. Experience sampling state social anxiety							-

Note. $N = 132$. Drinking frequency was measured as the number of drinking occasions per week. Drinking quantity was measured as the number of drinks consumed per occasion. Alcohol problems were measured using the Rutgers Alcohol Problem Index (White & Labouvie, 1998) and trait social anxiety was measured using the Social Interaction Anxiety Scale (Mattick & Clarke, 1998). Experience Sampling drinks is the total number of drinks consumed across a maximum of 22 days for each participant. Experience Sampling state social anxiety represents the average daily state social anxiety across a maximum of 22 days for each participant.

* $p < .05$. ** $p < .01$.

Table 8.3

The Relationship between Alcohol Intake and State Social Anxiety as Predicted by Sex, Age, Alcohol Problems, Averaged Experience Sampling Drinks, and Trait Social Anxiety

Predictor	Coefficient	SE	t-ratio (df)	p	Odds Ratio (95% CI)
γ_{000} Intercept	.28	.12	2.38 (116)	.02	1.32 (1.05-1.67)
Level 1 main effects					
γ_{100} Drinks _{t-1}	-.04	.02	-2.14 (2323)	.03	0.96 (0.92-0.997)
γ_{200} State Social Anxiety _{t-1}	.01	.01	2.06 (2323)	.04	1.01 (1.001-1.03)
γ_{300} Timeframe	-.04	.02	-2.30 (2323)	.02	0.96 (0.93, 0.99)
Level 2 main effects					
γ_{010} Day of Study	.00	.01	0.13 (1396)	.90	1.00 (0.98-1.02)
Level 3 main effects					
γ_{001} Age	-.08	.05	-1.82 (116)	.07	0.92 (0.84-1.01)
γ_{002} Sex	-.04	.14	-0.31 (116)	.76	0.96 (0.73-1.26)
γ_{003} Drinks _{mean}	.00	.00	0.56 (116)	.58	1.00 (1.00-1.01)
γ_{004} Trait Social Anxiety	.04	.01	4.81 (116)	< .001	1.04 (1.02-1.06)
γ_{005} Alcohol Problems	.04	.02	2.09 (116)	.04	1.04 (1.02-1.06)
Cross-level interactions					
γ_{101} Age	.00	.01	0.20 (116)	.84	1.00 (0.99-1.02)
γ_{102} Sex	-.00	.01	-0.15 (2323)	.88	1.00 (0.97-1.03)
γ_{103} Drinks _{mean}	.00	.00	0.36 (2323)	.72	1.00 (1.00-1.00)
γ_{104} Trait Social Anxiety	-.00	.00	-0.42 (2323)	.67	1.00 (1.00-1.00)
γ_{105} Alcohol Problems	-.00	.00	0.06 (2323)	.95	1.00 (0.99-1.01)

Note. The outcome variable is state social anxiety. The subscript “mean” refers to level 3 variables derived from level 1 data, and the subscript “t-1” refers to variables lagged by one timeframe. This represents a unit-specific model with robust standard errors. Coefficients are unstandardized and significant coefficients are in bold. Sex was coded as -1 for women and +1 for men. Alcohol problems were measured using the Rutgers Alcohol Problem Index (White & Labouvie, 1989) and trait social anxiety was measured using the Social Interaction Anxiety Scale (Mattick & Clarke, 1998).

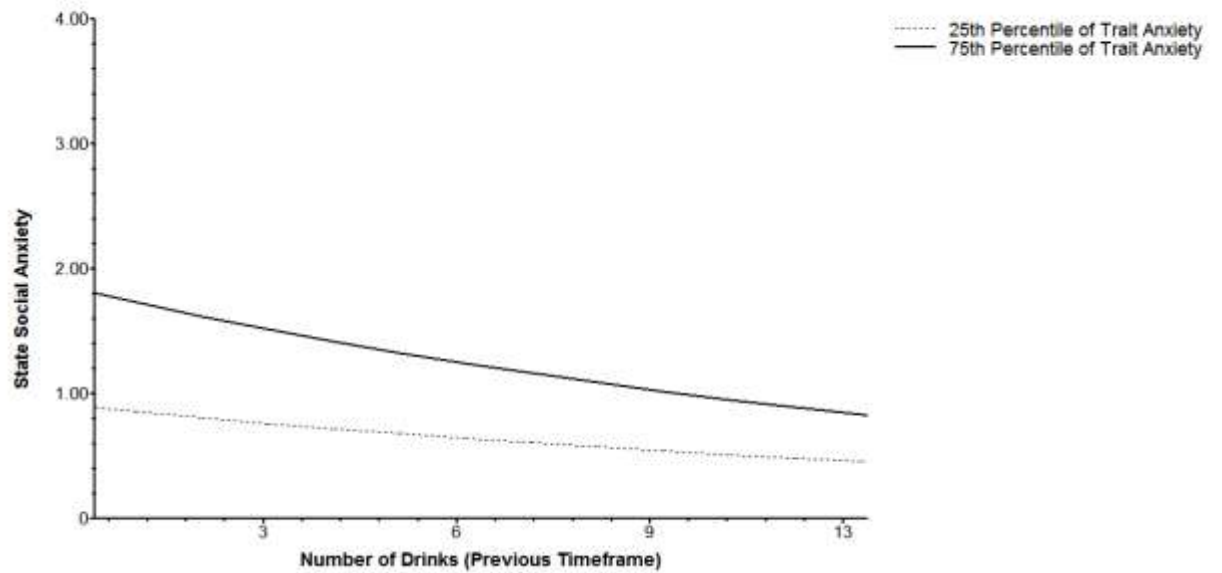


Figure 8.1. The effect of alcohol intake on state social anxiety for those high and low in trait social anxiety. For illustrative purposes, high trait social anxiety was defined as scoring in the 75th percentile or higher (a score of ≥ 29) on the SIAS and low social anxiety was defined as scoring in the 25th percentile or lower (a score of ≤ 11) on the SIAS.

CHAPTER 9: GENERAL DISCUSSION

The current thesis provided a number of contributions to the understanding of the complex link between social anxiety and alcohol use. A full exploration of the prominent theories in this area was discussed in Chapter 2, with a summary of experimental studies that have been conducted to examine the hypotheses derived from each theory. It is apparent from this review and others (e.g., Morris et al., 2005) that although research in this area is prolific, there are still a myriad of questions that remain unanswered. Of particular relevance to this thesis, is the tendency for researchers to focus on self-reported symptoms of social anxiety. However, as was outlined in Chapter 1, social anxiety is usually conceptualized using cognitive-behavioral models (e.g., Hofmann, 2007) that describe a number of variables that maintain social anxiety. The two potential maintaining variables that were explored in the current dissertation were safety behaviors and the cognitive variable of post-event processing.

In Study 1, (Chapter 4), it was found that socially anxious students who consumed alcohol had less of an increase in their self-reported social anxiety and spoke more during a standardized social interaction than those who consumed control beverages. This provides evidence that alcohol can lead to observable behavioural changes in individuals within a lab-based setting. Regarding post-event processing (Study 2, Chapter 6), it was found that socially anxious women who consumed alcohol at the time of a social interaction engaged in less post-event processing of the prior interaction than socially anxious women who did not consume alcohol. However, for socially anxious men, the opposite was found: those who consumed alcohol engaged in more post-event processing than those men who did not consume alcohol.

In the final study (Study 3, Chapter 8), some of our experimental findings (i.e., the findings in Study 1&2 that alcohol dampened self-reported social anxiety) were replicated using ecological momentary assessments to explore drinking and social anxiety in a real world setting. Here, it was found that as participants drank more, their state social anxiety decreased, and this was similar for men and women and at all levels of trait social anxiety. However, those with high levels of trait social anxiety tended to have higher levels of state social anxiety to begin with compared to those lower in trait social anxiety. Thus, those with higher trait social anxiety may experience more alcohol reinforcement from the reductions in state social anxiety they experience.

In sum, the findings from the three empirical studies presented in this thesis demonstrate that drinking alcohol provides negative reinforcement to individuals by alleviating symptoms of social anxiety. This was consistent across an experimental and real world setting when considering self-reported levels of state social anxiety. Taken together, this provides converging evidence to support one of the main tenets of Tension Reduction Theory (Conger, 1951), which simply put, states that alcohol reduces tension/anxiety. It should be noted that the current thesis did not focus on the second tenet of Tension Reduction Theory, which predicts that individuals will choose to consume alcohol when they experience anxiety. Although this was not a main goal of the current thesis, it certainly requires further exploration and provides directions for future researchers. For example, it is possible that when individuals experience significantly high levels of social anxiety, they avoid social situations all together, which may result in less drinking, not more.

In order to further understand and consolidate findings from these three studies, a number of overriding themes are discussed below.

9.1 SEX DIFFERENCES

Based on my findings, it is clear that considering a participant's sex is extremely important in this research area. Recent epidemiological studies demonstrated that women with social anxiety in particular were at risk of developing problems with alcohol (e.g., Xu et al., 2010). A great deal of research in this area has focused on studying how alcohol affected state social anxiety during an anxiety-provoking task (see Chapter 2 for a comprehensive review). When considering the findings using this research paradigm, a few early sex differences were found (e.g., Abrams & Wilson, 1977); however, most recent investigations have not found differences in how alcohol affects state social anxiety in men and women (e.g., Abrams et al., 2001).

As described in Study 2, Chapter 6, I investigated not only how alcohol affected state social anxiety *in the moment*, but also afterwards by examining levels of post-event processing. Although alcohol lead to a dampening of state social anxiety in both men and women, a significant sex difference was found such that alcohol *decreased* post-event processing in women, but *increased* it in men. This novel finding suggests that although alcohol may decrease state social anxiety in the moment for both men and women, there may be longer-term effects that differentially affect men and women. This provides a number of directions for future researchers.

First, further work may consider using alternative measures of post-event processing. Although I opted to use the Post-event Processing Questionnaire (Rachman et al., 2000), there are a number of other tools used to capture this construct. For example,

Fehm, Hoyer, Schneider, Lindemann, and Klusmann (2008) developed a modified version of the Post-event Processing Questionnaire, which contained four factors- cognitive impairment, negative self, thoughts about past and future, and avoidance. It would be interesting to use this measure in future studies to test how alcohol affects each factor and whether the sex differences found in our study are consistent across all factors or specific to only some.

Further research is also needed to explore potential mechanisms underlying how alcohol affects post-event processing and whether there are sex differences in this mechanism. One promising avenue to consider is the effect of alcohol on participant self-evaluations. Past findings indicated that negative evaluations of one's performance during an anxiety provoking social task mediated the relationship between social anxiety and post-event processing (Perini, Abbott, & Rapee, 2006). Findings of this nature suggest that thoughts and perceptions experienced during an anxiety-provoking task may predict levels of post-event processing after the task. It is essential then, that future researchers expand study protocols to include measures that tap into cognitive constructs related to social anxiety. This may be achieved by designing studies that investigate both the effect of alcohol on self-evaluations during a task and then the later processing (i.e., post-event processing) of that task.

9.2 SELECTING FOR SOCIAL ANXIETY

In the lab-based studies conducted (Studies 1 & 2, Chapters 4 & 6), participants were specifically selected because they scored high on a measure of trait social anxiety. On the other hand, in our naturalistic study (Study 3, Chapter 8), I included participants with a range of trait social anxiety scores. These latter scores were then included in our

statistical analyses in order to examine whether they had an effect on the relationship between drinking and state social anxiety. It was hypothesized that those who were higher in trait social anxiety would experience greater state social anxiety reduction due to alcohol than those lower in social anxiety. However, this hypothesis was not supported. It should be noted, however, that in our naturalistic study, scores on our trait social anxiety measure were limited in that relatively few participants would be considered “high” in social anxiety. Using the cutoff scores that were implemented in our lab-based studies (a score of 29 or higher for women and 30 or higher for men on the Social Interaction Anxiety Scale), only approximately 21% of women and 16% of men (20% of the total sample) would be classified as high in social anxiety. This leaves open the possibility that I may have found differences in anxiety-reducing effects of alcohol if I had specifically recruited a sample of individuals high in trait social anxiety and compared them to a specifically recruited sample of individuals low in trait social anxiety.

Indeed, when considering past studies that looked at the effect of alcohol on state social anxiety, researchers have opted to either recruit individuals unselected for social anxiety (e.g., Wilson & Abrams, 1977) or who met criteria for social anxiety disorder (e.g., Abrams et al., 2001). When considering studies that have looked at unselected individuals, there are mixed findings where some have found alcohol to lead to a dampening of self-reported anxiety (deBoer et al., 1999), while others have not found this effect (e.g., Ham et al., 2011). In regards to studies that have specifically looked at samples of individuals diagnosed with social anxiety disorder, findings more consistently support that when participants believed that they consumed alcohol (i.e., when they

receive alcohol or placebo beverages), they experienced a dampening in their self-reported anxiety (e.g., Himle et al., 1999).

As demonstrated above and discussed in Chapter 2, consideration of trait levels of social anxiety is of paramount importance in studies examining the social anxiety--alcohol link. It is interesting that few studies have directly compared samples of individuals high and low in trait social anxiety to determine if anxiety-reduction is dependent on trait social anxiety levels. Our naturalistic study provides some evidence that, at least within the normal range of trait social anxiety, alcohol does not have differential effects on state social anxiety for those higher or lower in trait social anxiety.

However, further research is necessary to determine the nature of this relationship in those who are high in social anxiety. This can be achieved either by recruiting individuals high in social anxiety (i.e., those with social anxiety disorder or who score high on an established measure of trait social anxiety) or by including individuals with a greater range of trait social anxiety scores (i.e., ensuring that the samples includes a sufficient number of those who score in the high range).

It should also be noted that considering both sex and trait social anxiety together as moderators of the alcohol-social anxiety link may be an important avenue for further study. It may be that women with high trait social anxiety are a specific group of interest given findings demonstrating that women with social anxiety in particular are at increased risk of developing alcohol problems (e.g., Xu et al., 2012). Although I was not able to directly look at the interactive moderating effect of sex with trait social anxiety on the within person association of alcohol and state social anxiety due to inadequate sample size, findings from Study 2 suggest that women with social anxiety may

experience additional reinforcing effects from alcohol use (i.e., reductions in post-event processing). Further, in Study 3, it was found that those with higher levels of trait social anxiety typically had greater levels of state social anxiety as well, but that trait social anxiety did not moderate the relationship between drinking and state social anxiety. Future researchers may consider recruiting large enough sample sizes to explore all combinations of sex and trait social anxiety.

9.3 NON-LINEAR RELATIONSHIPS

The studies discussed in the current thesis (and many in this area of research) are based on the assumption that the relationship between drinking and social anxiety and vice versa is linear- as alcohol consumption increases, social anxiety decreases or as social anxiety increases, alcohol consumption increases in a linear pattern. There are, however, some findings demonstrating that these relationships may be non-linear (Crum & Pratt, 2001). For example, in a cross-sectional study, Strahan, Panayiotou, Clements, and Scott (2011) found a quadratic relationship between social anxiety and drinking in male students; men highest in social anxiety drank the least alcohol whereas those moderate in social anxiety drank the most.

When considering the effect of alcohol on anxiety, there is also some evidence that the relationship may not be linear. Stewart and colleagues (1992) found that relatively high doses of alcohol (greater than 0.075%) lead to dampening of anxiety as measured by heart rate in a sample of men, while lower doses did not. However, this study used a physical stressor (electric shock) to induce anxiety, so it is necessary to explore if similar results would be found when employing a social stressor.

It is more difficult to examine non-linear relationships in experimental studies as it requires recruitment of more participants in order to directly test different doses of alcohol on social anxiety. One alternative is to use BACs or subjective intoxication measures that were taken during the study and employ regression analyses to examine if there is a non-linear relationship between levels of intoxication and social anxiety. It is, important for future research to consider how different levels of intoxication may affect social anxiety. It is certainly possible that at extreme levels of intoxication, alcohol's disinhibiting effects (e.g., Giancola et al., 2010) may lead one to behave in ways that are inappropriate and/or embarrassing. This could lead to increased anticipatory social anxiety (i.e., due to fears of losing control and behaving inappropriately) and/or increased post-event processing (due to embarrassment over how one behaved while intoxicated).

9.4 CLINICAL IMPLICATIONS

The studies presented in this thesis did not recruit clinical samples of participants, but rather opted to use student samples in order to gain a better understanding of problematic student drinking. However, the clinical applications of our findings could certainly extend beyond students and be helpful in considering treatment programs for clinical samples as well. When considering intervention strategies, it is worth considering that programs are typically aimed reducing symptoms of social anxiety or reducing problem drinking, not necessarily both in tandem. Therefore, specific interventions for social anxiety and then for alcohol will be outlined separately, followed by a discussion of how further interventions may consider incorporating both into one intervention program.

9.4.1 Social Anxiety Interventions

Social anxiety is often treated using a cognitive-behavioral approach (e.g., Radomsky & Otto, 2001). This involves targeting the components outlined in cognitive behavioral models of social anxiety (e.g., Hoffman, 2007), which were described in greater detail in Chapter 1. Simply stated, exercises are aimed at challenging maladaptive thinking patterns and beliefs (e.g., “Everyone has to like me”), and reducing avoidance by exposing individuals to feared situations (e.g., starting a conversation with a stranger). This type of treatment is often done within a group to allow for exposures to take place directly within the group setting (Heimberg, et al., 1990). A number of studies examining the efficacy of such treatments have reported positive results such as reductions in social anxiety symptoms (see Baez, 2005). It is important to note, however, that in most of these studies, participants are excluded if they have co-occurring substance use problems, including alcohol problems. This makes it difficult to determine if the established treatment for social anxiety is also helpful for those who have social anxiety and alcohol problems.

9.4.2 Drinking Interventions

At the individual level, many programs have been developed to reduce problematic drinking. Some of the most common programs involve brief motivational interventions combined with personalized and/or normative feedback (Marlatt et al., 1998) and Cognitive-Behavioral programs that may include expectancy challenge interventions (Darkes & Goldman, 1993). Brief motivational interventions aim to increase an individual’s motivation and commitment to change his/her drinking behaviours. This is often achieved by providing general education about alcohol and teaching specific coping and harm-reduction strategies. It also often involves providing

personalized information about the client's drinking patterns and related consequences, his/her alcohol motives and expectancies. A final component includes giving normative feedback where the client compares his/her drinking patterns to a specific reference group (e.g., same-aged peers).

Expectancy challenge interventions focus on increasing students' awareness of their beliefs about how alcohol will affect them. This is achieved by having them consume alcohol or placebo beverages and engage in social interactions in a bar-like setting. They are then asked to guess who actually received alcohol and who did not. This provides the opportunity to discuss and challenge students' expectations regarding how alcohol affects behavior.

Cronce and Larimer (2011) recently conducted a metaanalysis comparing the efficacy of a number of individual focused interventions aimed at reducing drinking and its associated problems to control conditions. They found that brief motivational interventions with personalized and normative feedback consistently lead to reductions in alcohol use and negative consequences in students. Further, the use of personalized and normative feedback on its own was also found to be efficacious.

In another recent metaanalysis, Scott-Sheldon, Terry, Carey, Garey, and Carey (2012) found that alcohol expectancy challenge interventions were also successful at reducing positive alcohol expectancies, drinking quantity and frequency of heavy drinking in students. In sum, there is evidence that a number of interventions strategies can lead to positive drinking outcomes when delivered to students. However, these effects may not transfer to individuals who experience high levels of trait social anxiety. For example, Terlecki, Buckner, Larimer and Copeland (2011) compared groups of high

and low socially anxious students who completed a brief motivational alcohol intervention. It was found that although the intervention lead to similar reductions in alcohol-related problems, it was less effective at reducing drinking quantity per occasion in the high social anxiety group as compared to the low social anxiety group. The finding that socially anxious individuals may not respond to the same degree as non-socially anxious individuals to alcohol interventions suggests that further strategies need to be developed or incorporated into treatment in order to specifically help those who drink as a means of reducing social anxiety.

9.4.3 Social Anxiety and Drinking Interventions

As mentioned above, there are established treatments for social anxiety and alcohol problems when each occurs on its own. However, given the high overlap of these disorders (e.g., Schneier et al., 2010), efforts have been made to develop integrated treatments specifically for those with co-occurring social anxiety and alcohol problems (e.g., Baillie et al., 2013; Tran, 2008). These treatment protocols are partly based on Kushner, Abrams, and Borchardt's (2000) explanation that although alcohol may result in short-term anxiety reduction, it also leads to long-term anxiety induction in part due to alcohol withdrawal symptoms. The combination of these anxiety reductions and inductions then creates a vicious cycle that worsens both anxiety symptoms and alcohol problems (Stewart & Conrod, 2008). Therefore, treatment requires targeting both difficulties simultaneously.

Although there are mixed findings regarding the efficacy of combined programs in adult, clinical populations (e.g., see Baker, Thornton, Hiles, Hides, & Lubman, 2012 for a review), there is emerging evidence that integrated treatment programs may be

helpful for students with social anxiety and alcohol use problems. For example, Tran (2008) found that a brief intervention for socially anxious student drinkers lead to better outcomes (e.g., greater reductions in alcohol use and problems) compared to a psychoeducation program that focused only on drinking.

Findings from the current thesis underscore the importance of continuing to develop and test these interventions. Specifically, findings from Study 1 suggest that alcohol may result in more social behaviour (i.e., talking more to peers) in those who are socially anxious. This represents another way that alcohol may be reinforcing. It is important, however, to investigate how this may serve to maintain social anxiety in the long run. For example, if socially anxious individuals attribute changes in social behaviour to alcohol rather than their own abilities, then this would prevent the habituation of social anxiety and could worsen the anxiety experienced when anticipating future social situations. Hence, it would be important to expose individuals to social situations without using alcohol to allow them to experience anxiety reduction without relying on alcohol and improve their social self-efficacy.

Moreover, Study 2 suggests that women and men may experience differing cognitive effects from drinking. When using an integrated approach, it would therefore be important to consider sex differences and further explore ways that individuals may be using alcohol to cope with anxiety beyond the relief of symptoms in the moment. For example, in treatment for women, it would be imperative to discuss how alcohol may be reinforcing through its effect on post-event processing experienced after the social situation. Hence, alternative strategies should be explored for reducing post-event processing such as mindfulness or cognitive restructuring. In men, it would also be

important to point out the effect alcohol has on their post-event processing, but here, the goal would be to highlight that it is actually leading to more aversive post-event processing and this may be used as motivation to decrease alcohol use.

9.5 LIMITATIONS

Although limitations for each study are discussed in their respective chapters, there are several considerations that apply to all of the studies presented in this thesis. First, all of the studies used student samples, which may limit the generalizability of the findings. These student samples represent a relatively homogenous population with regards to age, ethnicity and socio-economic status. Hence, it is important to determine if our findings can be replicated in more diverse populations.

Another important consideration across studies is that we were unable to determine if our findings were due to pharmacological or expectancy alcohol effects. In my lab-based studies (Studies 1 and 2, Chapters 4 and 6), a placebo condition (i.e., where participants are told they are receiving alcohol when in fact, they are not) was not employed. Therefore, a pertinent next step in this research is to conduct similar lab-based studies with the inclusion of a placebo condition. Regarding naturalistic studies, it is difficult to tease apart whether an effect is pharmacologically or expectancy-based. One method to help differentiate between the two is to have participants complete a measure of alcohol expectancies to determine if those who hold greater tension-reduction alcohol expectancies go on to experience greater anxiety reduction than those who do not hold such expectations.

It is also important to consider the blood alcohol curve when designing alcohol administration studies. Although the methods used in my lab-based study were intended

to capture participants while they were at peak levels of intoxication, it is possible that some participants were still experiencing ascending limb effects (see Appendix B). Therefore, it would be useful in future studies to include a measure that asks participants to report on what effects they are experiencing at various time points in the study. This would help determine whether changes in behaviour (e.g., increased talking) were due to stimulating effects, which typically occur during the ascending limb and/or sedative/anxiolytic effects which typically occur on the descending limb.

Finally, researchers need to keep in mind that many individuals do not use alcohol in isolation; often drinking alcohol is combined with using other illicit substances (e.g., Chiauzzi, DasMahapatra, & Black, 2013). This presents a significant challenge in studies that are designed to examine the specific effect of alcohol on social anxiety. Although lab-based studies are able to isolate the effect of alcohol alone on social anxiety, it is unknown whether these findings will extend to real world settings where various combinations of alcohol and other substances may be used. On the other hand, in naturalistic studies, it is difficult to explore all of the potential combinations of alcohol and other substances, especially within a single study. However, it is feasible for future studies in this area to include a measure inquiring about other substances to at least determine if there are differences when considering the use of alcohol alone versus with other substances. This might provide a first step in determining which specific combinations would be important to explore further. Moreover, a number of recent studies have identified social anxiety as a risk factor for cannabis use (e.g., Buckner et al., 2012) so studies investigating the use of alcohol in combination with cannabis may be a logical place to start.

9.6 FINAL SUMMARY

A number of interesting and important findings were discussed in the current thesis, but at the crux of these findings is confirmation that alcohol can affect multiple symptoms of social anxiety. This provides further support for cognitive-behavioral models of social anxiety (e.g., Hoffman, 1997) in viewing social anxiety as being influenced by a number of factors and points to the need to consider how alcohol may affect these various factors associated with social anxiety. It is also important to bridge empirical findings with clinical directions and use the knowledge gained in the current studies (and others) to develop effective interventions for those who use alcohol as a means of coping with anxiety. Given the high co-occurrence of social anxiety and alcohol problems in undergraduate student populations (e.g., see Schry & White, 2013 for a recent review), it is imperative to also consider how interventions can be directed at students and implemented within an undergraduate student setting.

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Susan Battista
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APPENDIX B: BLOOD ALCOHOL CURVE

The timing employed in the lab-based alcohol administration study described in Chapters 4 and 6 was intended to capture the anxiolytic/sedative effects of alcohol and to avoid the stimulating effects of alcohol. Specifically, the social interaction was timed to begin at 30 minutes post completion of beverage consumption so that the beverages would be fully absorbed during the interaction (i.e., between 30 and 45 minutes post-beverage consumption is when beverage absorption should be complete and participants should have reached peak BAC; King, Houle, deWit, Holdstock, & Schuster, 2002).

Examination of the average BACs achieved at various points during the study (see Figure B.1, page 241) does verify that the BAC plateau had been reached by the time the average participant was engaging in the social interaction. However, beverage absorption rates are known to be highly variable (e.g., O'Neill, Williams & Dubowski, 1983) and examination of Figure B.1 does indicate substantial variability in BACs across participants. This suggests that for at least some of the study participants, BAC was likely still increasing during the social interaction.

Since alcohol's stimulant effects typically occur during the ascending limb of the blood alcohol curve (see Martin, Earleywine, Musty, Perrine, & Swift, 1993), this suggests that some participants were experiencing the stimulating effects of alcohol while they took part in the social interaction. One of the stimulating effects that may occur on the ascending limb is increased talkativeness (Martin et al., 1993). Given that Study 1 found those in the alcohol condition to speak more during the social interaction, it is possible that this effect was driven by alcohol's stimulating effects, rather than, or in addition to, its anxiolytic effects. In support of this possibility is the finding that state

social anxiety was not significantly correlated with speaking time during the social interaction in Study 1 (see Table 4.3). But contrary to this possibility, alcohol-induced reductions in subjective anxiety reactivity to the social interaction stressor were found, which is inconsistent with participants being on the ascending limb of the BAC at the time of the social interaction.

Additionally, sedative/anxiolytic effects typically occur during the descending limb of the blood alcohol curve (see Martin et al., 1993). Again, upon examination of the average blood alcohol concentration (BAC) reached at various time points throughout the study (see Figure B.1), it appears that the average participant was at the plateau phase rather than on the descending limb of the BAC where anxiolytic/sedative effects would be most likely. But again, there was great variability, as can be seen in the Figure, suggesting that some participants would have been on the descending limb at the time of the social interaction, and thus likely to have been experiencing the sedative/anxiolytic effects of alcohol. However, a measure of the stimulating and sedating subjective effects of alcohol (e.g., Martin et al., 1993) was not administered in this study, making it difficult to determine whether participants spoke more due to alcohol's stimulating and/or sedating/anxiolytic effects.

An important area for future research is to explore how the stimulating properties of alcohol affect those with social anxiety. Previous research has found individual variations in the experience of stimulant versus sedative/anxiolytic effects of alcohol on the ascending and descending limbs of the blood alcohol curve based on a number of factors (e.g., family history of alcohol problems, level of typical alcohol consumption;

see Quinn & Fromme, 2011). The current dissertation provided evidence that social reinforcement of an increase in social behavior (i.e., talking) may be another reason that socially anxious individuals are motivated to consume alcohol in social situations. It is possible that those with social anxiety experience positive effects during both the ascending and descending limbs of the blood alcohol curve, leaving them susceptible to developing alcohol use problems. This certainly warrants follow-up investigation.

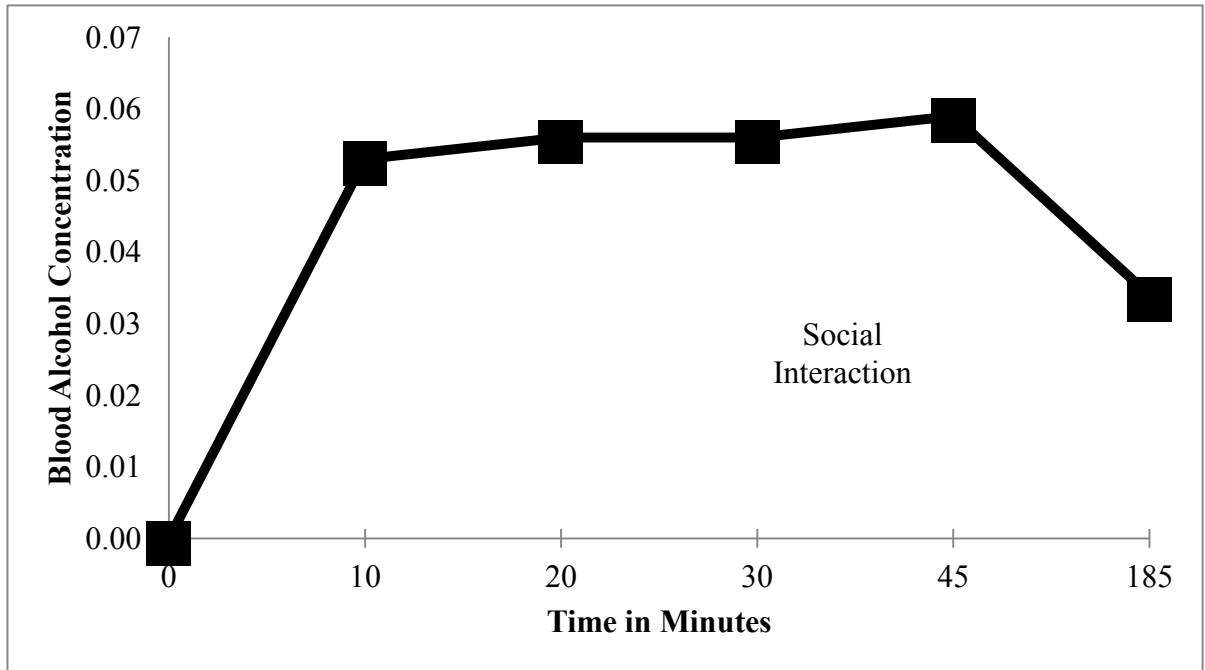


Figure B.1. Mean blood alcohol concentrations (BACs) at various time points throughout the study. Time “0” represents baseline measurement taken at the beginning of the study, while all other time points represent the amount of time in minutes since alcohol was consumed.