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# Examining the Interface between Alcohol Expectancies, Psychophysiological Reactivity to Alcohol Picture Cues, and Risk for Substance Use Disorders

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# Examining the Interface between Alcohol Expectancies, Psychophysiological Reactivity to Alcohol Picture Cues, and Risk for Substance Use Disorders

by

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ABSTRACT

The study examined the overlap between cognitive and affective measures of alcohol expectancies as they related to risk for developing alcohol use disorders. It was hypothesized that cognitive-based, paper-and-pencil measures and appetitive psychophysiological reactivity to alcohol cues would correlate and independently correlate to drinking behavior in a sample of college drinkers. It was also hypothesized that genetic risk would impact the relationship between upstream and downstream expectancy measures, given that children of alcoholics displayed blunted reactivity to appetitive cues.

A sample of 137 college drinkers (67 males; mean age = 20.23 ± 1.61) reporting a range of drinking behavior (mean quantity/occasion = 4.03 ± 2.34; mean frequency/month = 6.24 ± 4.31) and genetic risk for alcohol use disorders (47 children of alcoholics) participated in this study. The cue reactivity paradigm included the measurement of skin conductance, cardiac response, and acoustic startle eyeblink response to a randomized sequence of alcohol and neutral pictures. Questionnaires and interviews assessed alcohol expectancies, family history, drinking behavior, and risk.

Findings revealed that cognitive and affective measures shared modest overlap in the overall sample, such that sedating and negative alcohol expectancies were positively correlated with less appetitive early acoustic startle response. However, alcohol expectancies were not significantly correlated with any of the remaining psychophysiological measures. Further, affective measures were not related to drinking behavior, indicating failure to detect drinking variance in a sample of college drinkers.

Findings also indicated that genetic risk impacted the relationship between cognitive and affective measures of expectancy. Specifically, children of alcoholics (COAs) displayed stronger relationships between both positive and negative expectancies and early startle response than their peers. Further, COA Status moderated the relationship between early startle response and Social/Physical Pleasure and Positive/Arousing alcohol expectancies.

This dissertation provided evidence that cognitive and affective measures of alcohol expectancies shared modest overlap, indicating that expectancy subscales and early acoustic startle response tapped into the same expectancy construct. Further, genetic risk moderated the strength of relationships between upstream and downstream expectancy measures, which were stronger in children of alcoholics. Overall, affective measures of expectancy were more sensitive to expectancy variation in high-risk college drinkers.

# INTRODUCTION

The addiction field has long focused on identifying biopsychosocial risk factors that contribute to problematic drinking behaviors and the development of alcohol use disorders. Alcohol expectancies, or individual outcome expectations of the use of alcohol, were identified as one such risk factor that contributes to the reinforcement of drinking behavior. Alcohol expectancies represented both cognitive and affective associations with drinking behavior, and they were thought to be automatically elicited in the presence of alcohol-related cues in the environment (Goldman, Darkes, Reich, & Brandon, 2006). A limitation of expectancy research, however, was the focus on the explicit, cognitive component of alcohol expectancies, measured via paper-and-pencil questionnaires, while the automatic and affective properties of alcohol expectancies have not been as thoroughly measured.

The cue reactivity paradigm utilized psychophysiological measures as a set of indices for the automatic, affective appraisals of provocative environmental cues (e.g. Lang, Bradley, & Cuthbert, 1990; Lang, Greenwald, Bradley, & Hamm, 1993). Addiction researchers have extended the cue reactivity paradigm to substance-related cues, especially among individuals currently addicted to (or at heightened risk for) substance use disorders, and strong relationships between substance cue reactivity and substance use behavior were found (Miranda, Meyerson, Buchanon, & Lovallo, 2002a; Miranda, Meyerson, Buchanon, & Lovallo, 2002b). The relationship between cue reactivity and drinking behavior suggested that cue reactivity may represent a more automatic, affective form of alcohol expectancy, preparing the body to approach or avoid drinking behavior.

Since expectancy theory posited that drinking behavior results from a combination of affective and cognitive appraisals of alcohol cues in the environment, psychophysiological reactivity to alcohol cues and explicit, paper-and-pencil expectancy scales, respectively, are possibly indexing different components of the same construct. Up until recently, however, alcohol expectancy research has remained separate from cue reactivity research. The manner by which explicit alcohol expectancy scales and psychophysiological reactivity to alcohol cues either independently or concurrently predict drinking behavior remains to be examined. Studying both methods in tandem would not only converge two lines of research, but it would also combine the affective and cognitive components of the alcohol expectancy construct into one body of research.

Two such preliminary studies (Drobes, Carter, & Goldman, 2009; Carter, 2006) revealed modest relationships between explicit alcohol expectancies and psychophysiological reactivity to salient cues among young adult drinkers. In particular, reactivity to simple alcohol cues (e.g. pictures of beer in the absence of any social context) had the strongest relationship with positive and arousing alcohol expectancies. Both studies also hinted that individuals at greater risk for future alcohol use disorders displayed blunted cue reactivity to both affective and alcohol-related stimuli, which was consistent with previous cue reactivity studies that examined children of alcoholics (Miranda et al., 2002b). Neither study, however, had a large enough sample to thoroughly examine the concurrence (or divergence) of alcohol expectancies and cue reactivity in the prediction of drinking behavior. In addition, neither study had a large enough sample of high-risk individuals to test the impact of risk upon the relationship between cue reactivity and alcohol expectancies.

The primary goal of the current study was to continue the examination of the convergence of cognitive and affective components of alcohol expectancies and the interface between expectancy theory, cue reactivity, and risk. This study examined how multiple measures of alcohol expectancies (i.e. explicit paper-and-pencil measures; subjective ratings; psychophysiological cue reactivity) were related to each other and how each type of expectancy measurement either independently or concurrently predicted drinking behavior. This study also addressed the manner in which genetic risk influenced the relationship between psychophysiological reactivity to alcohol cues and explicit alcohol expectancies.

**Alcohol Use Disorders**

It has been estimated that more than seventeen million American adults suffer from an alcohol use disorder each year, making alcohol abuse and alcohol dependence two of the most prevalent disorders in the United States (Grant, Dawson, Stinson, Chou, Dufour, et al., 2004). Data from the 2001-2001 National Epidemiological Survey on Alcohol and Related Conditions (NESARC) and the 1991-1992 National Longitudinal Alcohol Epidemiologic Survey (NLAES) indicated that alcohol abuse had increased from 3.03 percent to 4.65 percent, and alcohol dependence had declined slightly from 4.38 percent to 3.81 percent (Grant et al., 2004). Young adults have been revealed as the highest risk for alcohol use disorders, such that the prevalence of heavy drinking and binge drinking peaks between the ages of 18 and 24 (Naimi, Brewer, Mokdad, Denny, Serdula, et al., 2003). Risky behaviors and socio-economic problems associated with heavy drinking and alcohol use also peak in young adulthood, including motor vehicle crashes and unintentional injuries (Hingson, Heeren, Zakocs, Kopstein, & Wechsler, 2002), drinking and driving (CDC, 2000), unprotected or unsafe sex, and sexual assault or date rape (KFF, 2002).

Alcohol research has focused on examining the biopsychosocial factors that motivate drinkers to consume alcohol, despite negative consequences. Alcohol expectancies have been identified as one such factor that contributes to risky drinking behaviors, especially in high-risk, young adult drinkers (Goldman, Greenbaum, & Darkes, 1997). Individuals endorsing positive and arousing alcohol expectancies reported drinking more frequently and at higher dosages than those individuals with negative alcohol expectancies (Goldman, 1994; Goldman & Rather, 1993), rendering them at risk for the development of an alcohol use disorder. Research geared toward the interaction of alcohol expectancies and drinking behavior has contributed to greater understanding of the development of alcohol use disorders.

**Expectancy Theory**

Formal expectancy theory was first developed to describe the cognitive processes by which the environment impacts animal behavior (Tolman, 1932). Tolman suggested that organisms are goal-oriented in nature and purposefully combine cognitions about the environment and past experience to reach “determinable ends.” Expectancy theory was formulized into an equation that includes an organism’s response to a stimulus (S-R) and the expected outcome of the response to a stimulus (S-R-S; MacCorquodale & Meehl, 1953). The strength of reinforcement (S* or degree of preference for possible outcomes given a stimulus), the expected outcome of a stimulus (S-S* or learned expectancies) and the expected outcome of a response to that stimulus (R-S* or prior expectancies) were later included in the expectancy equation (Rotter, 1954; Bolles, 1972). This model of formal expectancy theory proposed that an organism's learned cognition and innate motivations combine to predict the likelihood that an animal will respond to an environmental cue in a specific, determined way.

Expectations about the environment involved both explicit, cognitive assessments of a stimulus, and also automatic, affective associations with a stimulus (Goldman et al., 2006). In that regard, modern expectancy theory employed both automatic, affective (this stimulus makes me *feel* good/bad) and explicit, cognitive (I *know* the causes and effects of my behavior) appraisals of environmental stimuli. From an evolutionary point of view, an organism that could quickly assess whether salient stimuli was particularly threatening (i.e. a snake which bite can lead to death) or advantageous (i.e. a social gathering of one's peers, which can lead to reproduction and gene proliferation) was more genetically fit than their peers.

Expectancy theory as applied to alcohol research described individual motivations and cognitions driving drinking behavior. Alcohol expectancies referred to an individual's reasons to drink (approach) or not to drink (avoid), as developed through personal experience and observation of alcohol use in one's environment. Generally, it was believed that alcohol expectancies developed by the gathering of information about alcohol from the environment and the forming an automatic, subconscious system of associations with behavior that operates below the surface of awareness (Goldman, Del Boca, & Darkes, 1999). In other words, an individual's drinking behavior on a given occasion was driven by past experience and memory associations about the effects of alcohol, both positive and negative, which were automatically evoked in the presence of an alcohol stimulus.

**Alcohol Expectancies**

Alcohol expectancies have proven one of the strongest predictors of drinking behavior, holding other variables constant such as race, gender and socioeconomic status (Goldman, 1994; Goldman & Rather, 1993). Characteristics of alcohol expectations, including valence and arousal dimensions of drinking associations, best predicted drinker type, such as heavy and light drinker status (Goldman et al., 1999). Positive alcohol expectancies were those that reflected the more emotionally positive, arousing and reinforcing properties of alcohol consumption, such as feeling happy, social or horny. Alternatively, negative alcohol expectancies typically included more emotionally negative and sedating effects of alcohol, such as feeling sick, sad or sleepy. Heavier drinkers have been shown to endorse more positive, arousing effects of alcohol consumption, while lighter drinkers endorsed more negative and sedating effects of drinking (Goldman et al., 1999).

Expectancies and drinking behavior were thought to maintain a reciprocal relationship, with one influencing the other, thus strengthening the relationship between alcohol expectancies and subsequent alcohol use (Smith, Goldman, Greenbaum, & Christiansen, 1995; Aas, Leigh, Anderssen, & Jakobsen, 1998). Heavy drinkers possessed strong associations between positive and arousing outcomes for drinking, while light drinkers displayed a looser association network between drinking and positive outcomes (Rather & Goldman, 1994). Although heavy drinkers at times associated drinking with negative consequences, such as sickness or danger, these associations were much weaker than positive associations to alcohol.

Alcohol expectancies have also been shown to mediate the relationship between antecedents of risk for alcohol use problems, such as family history, gender, race, age, and sensation seeking (Goldman et al., 1999). Among young adults at highest risk, social patterns (such as drinking at bars and parties) and social alcohol expectancies best predicted quantity and frequency of alcohol consumption that place individuals at risk for developing alcohol use disorders (Moulton, Moulton, Whittington, & Cosio, 2000). Strong associations between positive outcomes and drinking alcohol served to encourage risky drinking behavior and strengthen the risk for developing alcohol use disorders.

Thus far, the measurement of alcohol expectancies has been primarily explicit and cognitive in nature (paper-and-pencil questionnaires) and has not accounted for the more automatic, emotional motivations rewards driving drinking behavior. The cognitive components to alcohol expectancy theory have long since been validated: drinkers' self report of alcohol expectancies predicted drinking behavior; when positive expectancies were activated, drinking behavior was produced; and free-associations to alcohol primes ere correlated with drinking behavior (e.g. Goldman & Darkes, 2004; Reich & Goldman, 2005). More effective measurement of the automatic, affective processing of alcohol cues in one's environment was necessary to further understand the affective component of alcohol expectancy theory. The cue reactivity paradigm was identified as one such methodology useful in indexing automatic and affective processing of alcohol cues.

## Cue Reactivity

The term cue reactivity referred to the psychophysiological responding to an environmental stimulus. These psychophysiological responses included autonomic responses, such as changes in heart rate and sweating, which were elicited very fast and prior to explicit, cognitive evaluations of the presented cue. Often, these reactions were so subtle that they never reached cognitive awareness. Cue reactivity studies have often included cardiac response, skin conductance response, and the startle eyeblink reflex as indices for the affective, arousing, and attentional properties of salient picture stimuli (e.g. Lang et al., 1990; Lang et al., 1993).

**Cardiac response.** Cardiac activity reflected changes in both arousal and valence while processing and attending to stimuli (Cacciopo, Klein, Berntson, & Hatfield, 1993). The typical cardiac wave pattern during cue exposure included an initial deceleration, followed by acceleration, and a final deceleration back to baseline. In cue reactivity research, the heart rate waveform was often indexed by four key variables: baseline, initial deceleration, acceleration, and secondary deceleration.

The initial deceleration in cardiac response was first linked with outward directed attention, or "stimulus intake," and the acceleration phase was linked to the affective processing of the stimulus (Lacey & Lacey, 1970). For survival purposes, it was beneficial that an organism first orient to potential threat, then allow for emotional processing of the stimulus. This initial cardiac deceleration was therefore most often linked to attentional resources given to particularly threatening and aversive stimuli. During unpleasant stimuli, the initial deceleration was often potentiated in the presence of unpleasant cues, compared to neutral and pleasant cues (Polomba, Angrilli, & Mini, 1997). However, during aversive cues, particularly among phobic individuals, the heart wave pattern skipped the initial orienting deceleration phase and immediately accelerated, reflecting a strong affective response to the cue (Lumley & Melamed, 1992).

The acceleratory phase of the cardiac waveform reflected the shift from the attentional processing to the emotional processing of an external cue. Heart rate acceleration was modulated by the individual's intensity of the emotion, such that heart rate increased more in the presence of more arousing cues (Witvliet & Vrana, 1995). Valence did not moderate the acceleration phase of heart rate, indicating that the acceleration phase of the cardiac wave pattern was sensitive to arousal and not valence.

Conceptualizing both the initial deceleration and acceleration period of the cardiac wave pattern, cardiac response patterns signaled both the arousing and valence (particularly aversive) properties of environmental stimuli. Cardiac activity has been thought to reflect a combination of two competitive systems, the autonomic and cognitive processing of stimuli, and the heart rate wave form can be useful in determining both the affective and cognitive properties of cues (Lang, Bradley, & Cuthbert, 1997). Because initial deceleration was not moderated by the appetitive nature of cues, the cardiac response pattern was best suited for measuring the arousing (and not valence) properties of pleasant cues.

**Skin conductance response.** Skin conductance responses reflected changes in arousal while processing and attending to environmental stimuli. Changes in skin conductance were dependent on the function of the amygdala, a brain structure key to the processing of emotional and arousing stimuli (Glascher & Adolphs, 2003). Skin conductance shared a strong correlation (0.81) with subjective reports of arousal when viewing picture cues (Lang et al., 1993). Skin conductance levels increased during arousing tasks and decreased during relaxation task performance (Nagai, Critchley, Featherstone, Trimble, & Dolan, 2004). Highly arousing unpleasant and pleasant cues elicited comparable levels of skin conductance activity, rendering this measure primarily sensitive to arousal and not valence-based processing.

**Startle eyeblink reflex.** The acoustic startle eyeblink reflex has been used to measure appetitive and aversive properties of stimuli. A brief blast of noise, presented during the exposure of an emotionally evocative cue, elicited an eyeblink magnitude response dependent on the valence of the stimuli (Lang et al., 1990). The startle eyeblink reflex was thought to serve as a defensive response, which was potentiated when threatened and attenuated when safe.

The latency between the startling stimulus and the eyeblink reflex response was very short (average of 20 msec in humans), indicating a simple neural pathway (Davis, Walker, & Lee, 1999; Davis, 1997). The primary acoustic startle reflex pathway involved direct synapses on three main structures in the brainstem and spinal cord: cochlear root neurons in the auditory nerve; the nucleus reticularis pontis caudalis (PnC) at the base of the brain; and motorneurons in the facial motor nucleus (eyeblink reflex). Lesions to any of these structures led to an absence in the acoustic startle response (Lee, Lopez, Meloni, & Davis, 1996). The basic pathway ensured an evolutionarily-adaptive, quick physical response in the presence of a sudden environmental stimulus.

A secondary neural pathway that was sensitive to stimulus valence modulated the magnitude of acoustic startle reflex. Visual information from a stimulus converged onto nuclei in the central amygdala, which then projected onto the PnC, the meeting point on the primary acoustic startle pathway (Davis, 1997; Koch & Schnitzler, 1997). The amygdala was involved in the regulation and perception of emotions such as fear. In both animal and human studies, the amplitude of the startle reflex has been shown to differentiate between pleasant, neutral and unpleasant stimuli (Bradley, Lang, & Cuthbert, 1993b; Schmid, Koch, & Schnitzler, 1995; Cook, Hawk, Davis, & Stevenson, 1991), and this effect was eliminated in the absence of a functioning amygdala, via receptor antagonists or lesions (Schauz & Koch, 2000). Specifically, startle response magnitudes were often inhibited in the presence of pleasing, appetitive cues and potentiated in the presence of unpleasant, aversive stimuli (Bradley, Moulder, & Lang, 2005). These effects were typically seen when the startling sound occurs several seconds into cue presentation (3-6 sec; Bradley et al., 1993b), allowing time for the affective processing of the visual stimulus and the environmental context in which the stimuli was presented.

Startle-eliciting stimuli presented “early” in the picture viewing sequence, or very closely following picture onset (250-350 ms), were thought to index the attentional properties of a picture stimulus. An early startle response pattern was distinguishable from a “late” startle response (as described above), such that a startling stimulus presented early elicited reduced eyeblink magnitudes when compared to startle response magnitudes elicited by stimuli presented later in the picture viewing sequence (Bradley, Cuthbert, & Lang, 1993a). The reduction in early startle eyeblink magnitude was referred to as the prepulse inhibition (PPI) effect, in which greater attentional resources were allotted to the salient picture cue, rendering fewer resources available for the startle eyeblink response. Highly salient, provocative, and arousing pictures, both aversive and appetitive, elicited the greatest PPI effect or the most reduced startle eyeblink magnitudes (Bradley et al, 1993a). From a survival perspective, it was more advantageous to attend to particularly threatening (aversive) or pleasing (appetitive) cues than a subsequent startle stimulus (Ohman & Mineka, 2001). Because of the PPI effect, the startle eyeblink response was a particularly powerful psychophysiological measure, one that not only indexed the automatic, arousing and affective processing of salient stimuli, but also the attentional processing of both pleasant and unpleasant cues.

**Substance cue reactivity**

Substance cue reactivity referred to a conditioned, physiological response to a substance cue, which either resembled drug withdrawal or mimicked drug effects (Drummond, 2000). Substance cues could be exteroceptive (picture of substance), olfactory (smell of cigarette smoke), interoceptive (priming or moods), and temporal (typical time of day alcohol is consumed). Substance cue exposure has been shown to mimic the pharmacological responses to substance use, including an increase in dopaminergic transmission, which served to motivate substance use behavior (Stewart, de Wit, & Eikelboom, 1984). Cue reactivity has been thought of as preparing the body for substance approach or avoidance, below the surface of cognitive awareness at a physiological level, and this automatic, affective process has been identified as an essential component of expectancy theory.

Substance cue reactivity was often highly related to individual cognitions associated with substance use. A recent meta-analysis of cue reactivity studies on substance users (alcohol, cigarettes, cocaine, and heroin) found strong relationships between subjective ratings (craving, arousal, and affect) with physiological reactivity (heart rate, SCR, and skin temperature) to substance cues (Carter & Tiffany, 1999). The relationships between psychophysiological reactivity to alcohol cues and explicit ratings of alcohol cues were not surprising, such that each measurement type was indexing different components of the same expectancy construct. Psychophysiological reactivity to alcohol cues likely represented the upstream (or automatic) component of alcohol expectancies, while the explicit measures indexed the downstream (or cognitive) component of alcohol expectancies. As such, the relationship between explicit expectancy measures, substance cue ratings, and substance cue reactivity often varied as a function of individual substance use patterns (Carter & Tiffany, 1999).

Active users of substances displayed an appetitive startle eyeblink response pattern in the context of appetitive substance cues (Geier, Mucha, & Pauli, 2000). Social drinkers reported higher arousal, more craving and enhanced positive affect when presented with alcohol cues when compared to lighter-drinking peers (Johnson & Fromme, 1994). Pictures of alcohol consumption were not only rated as particularly craving-inducing, but they were also processed as arousing and appetitive among current alcoholics, as evidenced by changes in heart rate, increased skin conductance, and decreased startle eyeblink response (Mucha, Geier, Stuhlinger, & Mundle, 2000).

In contrast, individuals in early stages of abstinence or substance restriction processed substance cues as aversive (Saladin, Drobes, Coffey, & Libet, 2002; Drobes, Miller, Hillman, Bradley, Cuthbert et al., 2001). Although alcoholics in various stages of abstinence reported heightened urge to drink and exhibited increased salivation in the presence of alcohol cues, the startle probe was potentiated in response to alcohol cues among those early in abstinence, suggesting an aversive response (Saladin et al., 2002).

Alcohol cues presented without a chance for consumption may have elicited a state of frustrative nonreward or a threat to abstinence among early-abstinent alcoholics. These findings were consistent with studies done on social drinkers, in which availability of alcohol consumption increased subjective reports of craving and appetitive motivation, while the unavailability to consume alcohol heightened anxiety and aversive motivation (Kambouropoulos & Staiger, 2004). Similar aversive cue reactivity patterns were seen when presenting food cues to food-deprived individuals and binge eaters, in the context of nonavailability (Drobes et al., 2001).

Frustrative nonreward was just one variable that may explain heightened aversive motivation among some substance abusers, despite increased reported craving and salivation in the presence of substance cues. It was over-simplified to assume that substance users processed all salient drug/substance stimuli as appetitive and arousing. Individual variations in substance use patterns, including abstinence and binge use, have been shown to lead to variations in both substance cue reactivity and affective cue reactivity. Furthermore, individual variations in level of risk for substance use disorders, including substance expectancies may also have contributed to variations in reactivity to substance cues.

**Risk and Cue Reactivity**

Variations in cue reactivity have been linked to individual level of risk for developing a substance use disorder. Substance abusers and individuals at greater genetic risk, or those with a genetic predisposition (e.g. children of alcoholics or COAs) and positive family history positive (FH+) for a substance use disorder, often displayed a "blunted" response pattern to salient stimuli (Miranda et al, 2002b). It was believed that blunted responding reflected biological antecedents to substance use disorders, such that substance abusers and high-risk individuals processed salient information in the environment in fundamentally different ways than their lower risk peers.

The blunted pattern appeared to be robust, such that it has been shown across a wide range of research areas, including studies on brain wave patterns, autonomic reactivity, and startle eyeblink response. In research examining brain wave activity during cognitive tasks, alcoholics displayed decreased amplitude event-related potential (ERP) waveform during both response activation and response inhibition conditions on Go/No-Go tasks (Kamarajan, Porjesz, Jones, Choi, Chorlian et al., 2005). In particular, the P300, or the positive peak that occurs around 300 ms after stimulus onset and which was thought to index attentional processing and working memory, was blunted among alcoholics. Electroencephalography (EEG) and event-related oscillations (EROs) research have also shown that basic brain activity of alcoholics and non-alcoholics differed, such that alcoholics' brains indicated decreased, inefficient, or "blunted" processing capacity (Porjesz & Begleiter, 2003). Startle response activity to both pleasing and unpleasing stimuli was also blunted among alcoholics, and particularly among those alcoholics currently diagnosed with anti-social personality disorder (ASPD), indicating decreased affective processing of salient cues (Miranda et al., 2002a).

Individuals with genetic risk for alcoholism also displayed blunted reactivity patterns similar to alcoholics. Adult COAs displayed blunted activity in EEG signals, inhibited P300, and reduced delta and theta activity during cognitive tasks (Kamarajan et al., 2005), indicating deficits in conscious awareness, recognition memory, episodic retrieval, and attentional processing. In cue reactivity studies, adult COAs displayed reduced startle eyeblink response in the presence of unpleasant stimuli (Miranda et al., 2002b; Zimmerman, Spring, Wittchen, & Holsboer, 2004). These findings suggested that high-risk people, prior to the onset of a substance use disorder, processed the arousing and affective properties of their environment in a fundamentally different way than lower risk individuals.

Family history status was not the only risk factor related to psychophysiological reactivity to affective and substance cues. Other indices of risk for future substance use disorders included the endorsement of more positive and arousing substance use expectancies (Goldman, Darkes, & Del Boca, 1999) and personality variables, such as sensation seeking (Katz, Fromme, D'Amico, 2000). The relationship between psychophysiological indices of risk for alcoholism (e.g. startle response, ERP) and risk variables (e.g. alcohol expectancies, sensation seeking) has not yet been thoroughly examined in the literature.

Preliminary evidence was found that alcohol expectancies, as an index of risk, were related to alcohol cue reactivity. For instance, young adult drinkers (as a whole) rated alcohol cues as positive, arousing, and craving-inducing and exhibited attenuated startle response to alcohol cues, indicating that alcohol cues were processed as appetitive (Drobes, Carter, & Goldman, 2009). However, two patterns of cue reactivity between high-risk young adults and low risk young adults appeared. Specifically, high risk young adult drinkers, or those endorsing greater positive and arousing alcohol expectancies and having a positive family history status, exhibited a blunted (less appetitive) startle response to alcohol-related cues (Carter, 2006), which was consistent with cue reactivity research on COAs (Miranda et al, 2002b). Conversely, among low risk drinkers, or those endorsing fewer positive and arousing alcohol expectancies and having a negative family history status, the expected appetitive pattern of reactivity to alcohol cues was observed.

The findings from these studies indicated that alcohol expectancies and cue reactivity to alcohol cues were likely related processes. Also, at some point in the continuum of risk, a blunted cue reactivity pattern to salient environmental stimuli emerged. Thus far, continuous relationships between alcohol expectancies, reactivity to alcohol cues, and genetic risk have not been observed. Furthermore, conclusions about the mechanisms underlying the convergence of risk, expectancies, and cue reactivity and the contribution of each paradigm in the prediction of drinking behavior have also not been thoroughly explored.

**Specific Aims**

The primary purpose of the present study was to examine the convergence of biopsychosocial measurements thought to index both the affective and cognitive components of the alcohol expectancy construct. These measures included explicit paper-and-pencil alcohol expectancy scales, subjective ratings of alcohol cues, and psychophysiological reactivity to alcohol cues. This study examined the extent to which varying measurement constructs of alcohol expectancies overlapped or diverged in predicting drinking behavior.

Furthermore, this study examined the manner in which genetic risk affected the relationship between alcohol expectancies and cue reactivity. Drinking behavior (frequency, quantity), family history density, negative consequences from drinking, and sensation-seeking were included as indices of risk for problem drinking behavior in a sample of young adults who did not yet meet criteria for an alcohol use disorder.

Investigating the manner in which risk impacted the relationship between upstream and downstream processing of alcohol cues would further the understanding of variables that drive problematic drinking behavior.

This study recruited a sample of young adult drinkers, with a wide range of drinker types and a range of family history for alcoholism. A cue reactivity paradigm measuring psychophysiological responses to alcohol cues was employed, and subsequent measures of alcohol expectancies and risk were administered. The study design allowed for thorough correlational and regression analyses of expectancy measures, cue reactivity, genetic risk, and drinking behavior.

**Hypotheses**

Though this study allowed for numerous comparisons across expectancy measures, the hypotheses for this dissertation narrowed in on the directionality in which multiple measures of expectancy would relate to one another based on previous studies in this laboratory. In general, the hypotheses posited that explicit expectancy measures would relate to appetitive psychophysiological reactivity to alcohol cues. However, in order to present the hypotheses properly, it was necessary to identify specific alcohol expectancy subscales included in the analyses and to define “appetitive” cue reactivity with respect to each of the psychophysiological measures used in this paradigm.

The decision to include two established paper-and-pencil expectancy measures (the Alcohol Expectancy Questionnaire (AEQ) and the Alcohol Expectancy Multi-Axial Assessment (AEMax)) was based on previous studies indicating that both differentially related to various psychophysiological reactivity measures (Drobes, Carter, & Goldman, 2009; Carter, 2006). Both of these measures included multiple subscales, and decisions were made to choose higher-order subscales (when possible) and subscales shown in the literature to best correlate with drinking behavior in a sample of young adults (e.g. positive and social alcohol expectancies). The three higher-order subscales of the AEMax (Positive/Arousing, Negative, and Sedating) were included in the analyses. The AEQ did not include higher-order subscales, and instead included only positive expectancy subscales. The decision was made to use the Global Positive and Social/Physical Pleasure for analyses based on their strong relationships with alcohol consumption in the college-aged population. In total, three "positive" alcohol subscales (Positive/Arousing, Global Positive, and Social/Physical Pleasure) and two "negative" alcohol subscales (Negative and Sedating) were included in the analyses.

It was also necessary to define "appetitive" cue reactivity within the context of each psychophysiological measure. Based on the psychophysiology literature, appetitive cue reactivity was defined as the following: greater subjective Valence, Arousal and Craving ratings of alcohol cues; potentiated skin conductance level (indicating arousal); potentiated cardiac acceleration (indicating arousal); attenuated early startle eyeblink response (indicating attention and arousal); and attenuated late startle eyeblink response (indicating positive valence). Given this definition of appetitive reactivity, the following hypotheses were tested in this study:

**Hypothesis 1.** Positive alcohol expectancies (AEQ Global Positive; AEQ Social/Physical Pleasure, and AEMax Positive/Arousing) would be positively correlated with appetitive psychophysiological reactivity to alcohol cues, and negative alcohol expectancies (AEMax Negative and AEMax Sedating) would be negatively correlated to appetitive alcohol cue reactivity.

**Hypothesis 2.** Appetitive psychophysiological cue reactivity to alcohol pictures (subjective ratings; skin conductance level; cardiac acceleration; early acoustic startle response; and late acoustic startle response) would account for variance in drinking behavior above and beyond traditional alcohol expectancy subscales (AEQ Global Positive; AEQ Social/Physical Pleasure, and AEMax Positive/Arousing, AEMax Negative, and AEMax Sedating).

**Hypothesis 3.** Genetic risk would impact the relationships between alcohol expectancies and cue reactivity in a sample of college drinkers, due to the blunted psychophysiological responding seen in children of alcoholics. Specifically it was hypothesized that family history density (FHD) would be positively correlated with both positive and negative alcohol expectancies (indicative of greater drinking and greater risk) and negatively correlated to appetitive psychophysiological reactivity to alcohol cues (indicating blunting effect).

**Hypothesis 4 (Exploratory).** Though this study was not designed to examine differences between groups, it was suspected children of alcoholic (COA) status would emerge as a moderating factor in the relationship between psychophysiological reactivity to alcohol cues and alcohol expectancies. This hypothesis stemmed from the idea that an inflection point (or threshold) of genetic risk might exist at which point the relationship between alcohol expectancies and cue reactivity would change. Based on the literature on COAs, it was expected that this inflection point would be reached with one or more biological parent with an alcohol use disorder. It was hypothesized that COAs would exhibit different relationships between alcohol expectancies and reactivity to alcohol cues due to blunted cue reactivity to salient cues.

**Analyses**

In order to examine the first hypothesis, a series of bivariate correlations, using Pearson's zero-order correlation coefficient, were run to determine relationships between multiple alcohol expectancies, cue reactivity, risk, and drinking behavior. The Bonferroni correction was made within each series of analyses to control for multiple comparisons between measures. Variables included were continuous in nature: five alcohol expectancy subscales (Positive/Arousing, Global Positive, Social Physical Pleasure, Negative, and Sedating), psychophysiological cue reactivity measures (cardiac activity, SCL, early startle eyeblink magnitude, and late startle eyeblink magnitude) in the presence of alcohol cues, subjective ratings of alcohol cues (valence, arousal, and craving), sensation seeking scores, density of family history, drinking behavior (quantity and frequency), and severity of alcohol problems.

In order to test the second hypothesis, multiple linear regression was employed to determine the convergent and divergent degree to which multiple expectancy measures (alcohol expectancy subscales, subjective craving ratings, cardiac activity, SCL, and startle eyeblink magnitude) predicted drinking behavior. Communality between variables was determined by summing the squared regression weights of common factors. Hierarchical regression was used to analyze any unique variance in drinking behavior accounted for by psychophysiological reactivity to alcohol cues while controlling for explicit measures of expectancy.

In order to test the third and fourth hypotheses, the following series of analyses were conducted, restricted by Bonferroni criteria: (1) correlations between family density, non-genetic risk variables and drinking behavior; (2) correlations between continuous measures of family density, alcohol expectancy subscales, and psychophsyiolgical measures; (3) multiple regression to explore whether COA status moderated the relationship between expectancies and psychophysiological reactivity and alcohol cues, in a series of steps outlined by Baron and Kenny (1986).

# METHODS

## Participants

College students between the ages of 18 and 24 were recruited and screened from the University of South Florida Undergraduate Psychology subject pool. Current drinkers (i.e. individuals who reported drinking at least one alcoholic beverage in the past month) were included in the study, and abstainers in the month prior to screening were excluded. An equal number of light, moderate, and heavy drinker types were recruited in order to maximize drinking behavior variability. A balance in drinking patterns was achieved by monitoring drinking levels of recruited participants and adjusting inclusion criteria related to drinking behavior within the online participant pool accordingly. Heavy drinkers were considered those who meet criteria for binge drinking on four or more occasions per month. The National Institute on Alcoholism and Alcohol Abuse (NIAAA) defined binge drinking as the consumption of 5 or more standard alcohol drinks (12 oz. beer, 5 oz. wine, 1.5 oz. spirits) for men, or 4 or more standard alcohol drinks for women over a 2-hour time period (NIH, 2004). Lighter drinkers were considered those who consumed less than 12 drinks per month and no more than 3 drinks per occasion. Moderate drinkers were defined as those whose drinking patterns fell between light drinking and heavy drinking criteria.

Since males consistently reported consuming alcohol at higher quantities than females (e.g. Mumenthaler, O'Hara, Taylor, & Yesavage, 1999), efforts were made to ensure equivalent gender ratios across drinking types during recruitment. This strategy required the oversampling of light-drinking males and heavy-drinking females. While some previous studies showed gender differences within alcohol expectancies, other studies suggested minimal gender differences (e.g. Des Rosiers, Noll, & Goldman, 2002; Weinberger, Darkes, Del Boca, & Goldman, 2003.). Evidence existed that males and females endorsed alcohol expectancies similarly, but the semantic meaning behind expectancy words may differ between genders. Two previous studies conducted in our laboratory showed little to no gender effects on reactivity to alcohol-related cues and moderate differences in typical drinking quantity and subjective ratings to alcohol-related cues (Drobes et al., in prep; Carter, 2006). Since the literature was unclear, this study continued to monitor gender differences regarding alcohol expectancies and cue reactivity.

Because family history for alcoholism was suspected to impact cue reactivity to alcohol-related pictures (i.e. Miranda et al., 2002b, Carter, 2006), efforts also were made to sample individuals with a range of family history density. This required oversampling family history positive (FH+) participants during the recruitment phase of this study. A yes/no item addressing family history status in the USF Psychology Pool screener was added so that FH+ individuals were more easily identified to the researcher. Efforts were made to ensure balance across drinker types and gender among FH+ and FH- individuals by tracking these variables as participants were recruited and adjusting recruitment criteria accordingly.

The final inclusion criterion required participants to have normal or corrected-to-normal hearing and vision (based on self-report at screening), such that they could see picture cues and hear acoustic startle appropriately.

**Power Analyses**

A power analysis for this study was based on the ability to complete a series of correlational and multiple regression comparisons between continuous measures of expectancy and cue reactivity in the prediction of drinking behavior. In two previous studies comparing these types of measures (Carter, 2006; Drobes, Carter, & Goldman, 2009), effect sizes were medium, such that a significant correlation coefficient *r* was roughly 0.30. With an expected medium effect size and using a series of multiple regression/correlation analyses with a set of 5 independent expectancy variables (alcohol expectancies, subjective craving ratings, heart rate, skin conductance level, and startle response), it was possible to achieve adequate power ($1-\beta = 0.81$) at an alpha level of 0.01 (a conservative alpha to account for the increased type 1 error rates resulting from multiple comparisons, as determined by the Bonferroni method) with a total of 126 individuals (Cohen, 1992). To that end, the proposed sample size for the current study was 126 individuals. An additional 10 participants were included to account for potential problems inherent with a cue reactivity paradigm (e.g. participants with too few scorable acoustic startles).

Although the fourth hypothesis posited moderation of the relationship between expectancies and psychophysiological reactivity to alcohol cues due to COA status, the power to detect this finding required a sample too large for the scope of this study. The moderation analysis involved one continuous variables (alcohol expectancy subscale) and one dichotomous variable (COA status). It has been estimated that the power of completing a moderation analysis with one continuous variable (alcohol expectancy) and one dichotomous variable (COA status) was low, and a sample of 200 or more participants has been suggested to test this moderation effect (Arguinis, 2004). To that end, it was decided that the power analysis would be based on the first hypothesis.

**Procedure**

Individuals interested in participating in this study were screened over the telephone to determine eligibility for a one-time, 1.5 hour laboratory session. Upon arrival to the lab setting, participants read and sign an approved Informed Consent document.

**Laboratory picture viewing.** Following Informed Consent procedure participants were asked to sit in a comfortable chair, and electrodes measuring startle eyeblink response, skin conductance, and heart rate were applied to the arms, hand, and face. Two “large” (8 mm) Beckman-type electrodes were placed between the participant’s wrist and elbows to measure cardiac activity. One grounding electrode was placed on the participant’s left arm between the previously applied electrode and the elbow. Two large electrodes were applied to the palm of the participant’s non-dominant hand, directly underneath the smallest finger, as a measure of skin conductance response. Finally, two “small” (4 mm) Beckman-type electrodes were placed just beneath the lower eyelid of the left eye to record the contraction of the orbicularis oculi muscle, in response to acoustic startle stimuli. Impedance levels were monitored and kept below 5 KOhms to ensure accurate startle measurement. Once the electrode application process was complete, andiometric headphones were placed over the participant’s ears.

Following a five-minute acclimation period, the researcher oriented the participant to the experiment by presenting two neutral, sample pictures and giving directions for making ratings. Participants were left alone in the room and watched a randomized sequence of 32 picture cues. Two picture categories were presented, consisting of 16 alcohol cues and 16 neutral cues. Efforts were made to balance complexity and color across the two cue categories.

The affective images were selected from the International Affective Picture System (IAPS) and consisted of images such as hairdryers and books (CSEA, 2002). The alcohol-related pictures were collected from various internet sources. For the purpose of consistency, only beer was shown in the alcohol-related pictures, since beer has been shown the most commonly consumed alcoholic beverage among the college-aged population (Wechsler, Kuo, Lee, & Dowdell, 2000). Alcohol cues were presented in a nonsocial context, consisting of beer images with a neutral background. This decision was made because Carter (2006) found the strongest relationship between alcohol expectancies and reactivity to nonsocial alcohol cues. Alcohol cues with a social context consisted of beer images in the foreground and social gatherings displayed in the background. A small sample of alcohol pictures with a minimal social context were chosen to reflect a similar level of sociality in selected neutral pictures and to control for any effects social context have in the appetitive nature of alcohol cues. Efforts were also made to select alcohol-related images that match in complexity, color, and size to the neutral cues.

All picture cues were presented on a large (20-inch) computer monitor placed on a table directly in front of the participant using the following sequence: (1) 2-second baseline; (2) 6-second picture viewing; (3) 20 seconds to rate valence, arousal and craving using the Self-Assessment Manikin (Lang, 1980); and (4) variable (15-second average) inter-trial intervals prior to presentation of the next picture. The startle eyeblink reflex was elicited by a binaural acoustic stimulus (50 ms white noise, 100dB, instantaneous rise time) during 12/16 cues in each cue category (alcohol and neutral) and during seven of the inter-trial intervals. The startle eyeblink was elicited "early" in the picture viewing sequence (250-350 ms) for half (6/12) of the pictures that were startled within each cue category, in order to gauge immediate attentional processing of the picture cue. For the other half of the pictures in each category, acoustic startle eyeblink was elicited "late" in the picture viewing sequence (4-5.5 seconds), in order to gauge contextual affective processing and motivational properties of the picture cue. Heart rate and skin conductance were measured continuously throughout each picture-viewing interval.

**Subjective ratings.** Participant affective and craving ratings were assessed immediately following the presentation of each individual picture cue. Valence and arousal ratings were obtained using a computerized version of the self-assessment manikin (SAM; Bradley & Lang, 1994). SAM, a cartoon of a human figure, was presented on the computer monitor, and participants were asked to manipulate SAM's figure representing each of the three affective dimensions. For the valence dimension SAM's facial expressions ranged from happy/smiling, to neutral/unaffected, to unhappy/frowning. For the arousal dimension SAM's figure ranged from excited/jumpy to relaxed/bored. During two initial practice trials the extreme end of each affective dimension were further described using several standardized adjectives. Craving ratings were assessed with the prompt “My craving to drink alcohol right now is…”, with responses placed on a continuous line ranging from “Not at all” to “Extremely.” All subjective ratings were coded on a scale from 0 to 20.

**Questionnaire and assessment portion.** Upon completion of picture viewing electrodes and headphones were removed. Participants completed several brief questionnaires and interviews, measuring demographic information, alcohol expectancies, genetic risk, and alcohol use.

**Breathalyzer**. Each participant was asked to blow a breath sample into the breathalyzer to ensure sobriety at the time of the experiment. The breathalyzer was presented at the completion of the study, so as not to prime individuals as to the experimenter’s interest in their alcohol-related experiences. No participant blew higher than a 0.0 BAC at the time of the experiment.

**Debriefing**. Upon completion of questionnaires and interviews participants were given further information regarding the purpose/goal of the study and the opportunity to ask questions. Participants were then awarded 1 extra credit point per half hour completed (3 extra credit points) toward an undergraduate psychology course.

## Measures

**Demographic form.** This form provided information regarding age, gender, ethnicity, race, date of last alcohol consumption, amount of last alcohol consumption, cigarette use, and caffeine use. Two items were also included confirming that all participants had normal (or corrected-to-normal) hearing and vision.

**Zuckerman-Kuhlman Personality Questionnaire Form III (ZKPQ III).** The full version of the ZKPQ III consists of 99 self-administered True-False items, designed to measure five dimensions of personality: impulsive-sensation seeking; neuroticism-anxiety; aggression-hostility; activity; and sociability (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993). The reliability coefficients for the subscales range from 0.72 to 0.86. This study used the 19-item impulsivity/sensation-seeking subscale of the ZKPQ III, which measured individual risk-taking behavior and need for novel and risky experiences. High levels of sensation seeking have been identified as a personality characteristic that places individuals at greater risk for alcohol use disorders. Alcohol expectancies have been shown to mediate the relationship between sensation seeking behavior and alcohol use, and individuals who scored higher on sensation seeking scales were more likely to engage in risky drinking behavior (Henderson, Goldman, Coovert, & Carnevalla, 1994; Katz et al., 2000). Sensation seeking was included in this study as one of the individual risk factors that may contribute to differential cue reactivity to alcohol-related cues.

**Alcohol Expectancy Multi-Axial Assessment (AEMax).** This measure utilized a comprehensive list of expectancy terms capturing a wide range of alcohol expectancies (Goldman & Darkes, 2004). The terms were generated in a study where college students and alcoholics completed the open-ended sentence “alcohol makes one…”, (Rather, Goldman, Roehrich, & Brannick, 1992). After item selection, a total of 132 items were selected to represent a multidimensional network of alcohol expectancies, falling in a circular pattern around arousal and valence axes. Factor analysis on these items revealed the following eight, distinct, first-order expectancy: horny; social; egotistical; attractive; sick; sleepy; woozy; and danger. The shortened version of this measure utilized in this study included 24 expectancy items, with three from each of the eight first order factors.

Participants were asked how often they believed the item best completed the sentence "alcohol makes one…", using a 7-point Likert scale ranging from 0 = never to 6 = always. The measure has been proven reliable, valid, and an effective measure of the positive-negative and arousing-sedating dimensions of alcohol expectancies. As discussed in the hypothesis section, the following subscales were included in analyses: Positive/Arousing, Negative, and Sedating.

**Alcohol Expectancy Questionnaire (AEQ).** This measure included 68 True/False statements about the various effects of alcohol, including social, physical and sedating domains (Brown, Goldman, Inn, & Anderson, 1980; Brown, Christiansen, & Goldman, 1987; Goldman et al., 1997). Expectancy items on the AEQ have correlated with alcohol consumption, alcohol abuse and behavior while drinking, with a mean reliability of 0.84. Factor analysis revealed the following six separate subscales within this measure: global positive changes; sexual enhancement; physical and social pleasure; increased social assertiveness; relaxation and tension reduction; and arousal and aggression. The relative levels on each subscale were analyzed to provide further information into the type of alcohol expectancies endorsed by each participant. As discussed in the hypothesis section, the following two AEQ subscales were included in the analyses: Global Positive and Social/Physical Pleasure.

**Rutgers Alcohol Problem Index (RAPI).** The RAPI is a 23-item self-administered screening tool for assessing problem drinking (White & Labouvie, 1989). Participants were asked how often various consequences of drinking alcohol happened over the past year, using a 4-point Likert scale ranging from 0 = "None" to 3 = "5 or more times." The RAPI, which takes less than 10 minutes to administer, has a reliability of .92 and a 3-year stability coefficient of .40 and has been validated for both clinical and nonclinical samples of adolescents and young adults.

**Family Grid.** This family history interview measured the density of first- and second-degree biological relatives having in the past or currently having significant drinking problems. The family grid listed the following as signs of a drinking problem: legal problems (drunk driving violations); health problems (cirrhosis of the liver, alcohol withdrawal); relationship problems (objections about drinking from family members); work or school problems (absenteeism, poor performance due to alcohol use); and actual treatment (detox, rehab, AA meetings). Because family history density for alcoholism (FHD) has proven a robust predictor of risk for alcoholism diagnosis, tolerance symptoms, and withdrawal symptoms among both men and women (Stoltenberg, Mudd, Blow, & Hill, 1998), FHD was main variable used to identify individual family history status in this study. FHD was calculated such that nonalcoholic relatives were scored as zero, each alcoholic parent was scored as = 0.5, and each alcoholic grandparent is scored as = 0.25. Scores were summed and ranged from 0 to 2. The second purpose of the Family Grid was to identify children of alcoholics (COAs), or those individuals having one or more parents with an alcohol use disorder.

**30-Day Timeline Follow-Back (TLFB).** This calendar-based interview measured participant alcohol use (quantity and frequency) in the month prior to assessment (Sobell & Sobell, 1992). Participants were asked to identify the amount of alcohol consumed per drinking day in the previous month, with drinks equaling standard alcoholic beverage amounts. This interview was primarily utilized in this study to measure a participant's *typical* drinking pattern, since quantity and frequency measures have been shown to be sensitive to time of year peaks and lulls in drinking, such as holidays and exam periods (Del Boca, Darkes, Greenbaum & Goldman, 2004). At the conclusion of the interview participants were asked whether the calendar represented a typical drinking month. If the month was not considered typical, participants were asked whether the prior month displayed an increase or decrease in their typical drinking pattern. Atypical calendars were flagged during analyses.

**Data Processing**

For each participant cue reactivity data was summed over trials within each picture category, in order to find an average response for each type of cue presented. Startle reflex data was stored offline, and each response was manually scored for peak amplitude (the maximum eyeblink elicited) and onset latency (the length of time from acoustic startle probe onset to response initiation) using VPM software (Cook, 1999). Within each trial startle responses were scored if peak amplitude was greater than 15 A/D units and if the onset fell between 20 msec and 80 msec after the tone was presented. Otherwise, startle data for that trial was considered either missing or zero. Participants were excluded from the analyses if more than 50% of startle magnitudes within any cue type were missing. Ultimately, raw startle magnitude data was transformed to *T* scores to minimize variability across participants.

Heart rate and skin conductance data were stored for offline editing and averaging. Of particular interest within cardiac activity were the initial deceleration magnitude (compared to baseline), peak acceleration magnitude (compared to baseline), and the difference between deceleration and acceleration variables. Peak magnitude and average magnitude of skin conductance (skin conductance level (SCL) in microsiemens) between 2-4 seconds following picture onset were scored.

# RESULTS

## Sample

One hundred and thirty-seven college-aged students (58 males; mean age = 20.23 years ±1.61) participated in the study. The sample was reflective of Tampa Bay Area demographics: 82.5 % Caucasian, 8.8% Black or African American, 6.6% Asian, 1.5% Biracial, 0.7% American Indian, and 18.2% Hispanic or Latino. Males and females did not differ significantly in age, race, or ethnicity.

Upon completion of the assessment portion of the study, one participant was excluded due to heavy levels of reported drinking (Total Drinking = 431 total drinks consumed in the previous month; mean Average Drinking = 18.74 drinks per drinking occasion), rendering him no longer eligible. The exclusion of this participant did not impact the final results or conclusions made from this study. After excluding this individual, 136 participants (57 males) remained in the following analyses.

## Descriptive Statistics

This section of the analyses examined the basic study parameters with regard to drinking behavior, alcohol expectancies, and cue reactivity. Specifically, it was necessary to determine whether the recruiting methods were successful in eliciting a sample of drinkers who endorsed a range in drinking behaviors and alcohol expectancies. It was also necessary to determine whether the alcohol picture cues were processed as more appetitive than neutral cues in this sample.

**Drinking behavior.** The following drinking variables were included in the analyses: Total Drinking (total standard alcoholic beverages consumed in the 30 days prior to assessment); Quantity (average number of standard alcoholic beverages consumed per drinking occasion in the 30 days prior to assessment); and Frequency (number of drinking days in 30 days prior to assessment; Table 1). College aged drinkers in this study reported drinking an average of 31.38 (SD = 43.21) alcoholic beverages per month and an average of 4.13 (SD = 2.65) alcoholic beverages per drinking occasion. The average frequency of drinking was 6.36 (SD = 4.53) days in the month prior to assessment. Because Total Drinking displayed a non-normal distribution, as indicated by elevated skewness and kurtosis values, the natural log transformation of Total Drinking was used in all subsequent analyses.

**Table 1**
*Descriptive Statistics for Drinking Behavior*

| | N | Min | Max | Mean | SD | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| Total Drinking | 136 | 0.00 | 143.00 | 28.65 | 26.28 | 1.44 | 2.44 |
| ln (Total +1) | 136 | 0.00 | 4.97 | 2.88 | 1.19 | -0.71 | 0.23 |
| Quantity | 136 | 0.00 | 12.50 | 4.03 | 2.34 | 0.69 | 0.93 |
| Frequency | 136 | 0.00 | 23.00 | 6.24 | 4.31 | 0.82 | 0.96 |

**Alcohol expectancies**. Descriptive statistics for the alcohol expectancy subscales are displayed in Table 2. The ranges and means were consistent with the typical college aged drinker population, such that a wide range of both positive and negative alcohol expectancies were endorsed across the sample. Also consistent was the negatively skewed AEQ Social/Physical Pleasure subscale, which reflected enhanced social motivation for drinking in college-aged drinkers. The natural log transformation to the AEQ Social/Physical Pleasure subscale did not significantly improve skewness and kurtosis, nor did it affect the results in any way.

**Table 2**
*Descriptive Statistics for Alcohol Expectancies*

| | N | Min | Max | Mean | SD | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| ***AEQ*** | | | | | | | |
| Global Positive | 136 | 0.00 | 20.00 | 8.54 | 4.98 | 0.27 | -0.75 |
| Social /Phy Pleasure | 136 | 2.00 | 9.00 | 7.49 | 1.47 | -1.16 | 1.38 |
| ***AEMax*** | | | | | | | |
| Sedating | 136 | 5.00 | 51.00 | 30.40 | 8.33 | -0.39 | 0.29 |
| Negative | 136 | 0.00 | 36.00 | 16.86 | 6.64 | -0.26 | 0.34 |
| Positive/Arousing | 136 | 8.00 | 53.00 | 33.20 | 7.81 | -0.42 | 0.54 |

*Note.* AEQ = Alcohol Expectancy Questionnaire; AEMax = Alcohol Expectancy Multi-Axial Assessment.

**Subjective ratings.** The means for Valence, Arousal, and Craving ratings across cue types are presented in Table 3. In order to test whether the sample rated alcohol expectancies as more appetitive than neutral cues, a series of paired sample t-tests revealed significant differences within ratings between cue types (alcohol and neutral). As expected, young adult drinkers rated alcohol cues as significantly more pleasing, arousing, and craving inducing compared to neutral cues (*p*'s < .01; see Figure 1).

**Table 3**
*Subjective Cue Ratings*

| | | N | Min | Max | Mean | SD |
|---|---|---|---|---|---|---|
| ***Neutral*** | | | | | | |
| | Valence | 136 | 4.88 | 14.75 | 10.03 | 1.32 |
| | Arousal | 136 | 0.06 | 11.13 | 6.06 | 2.66 |
| | Craving | 136 | 0.00 | 12.00 | 2.51 | 3.16 |
| ***Alcohol*** | | | | | | |
| | Valence | 136 | 4.44 | 19.56 | 11.84** | 2.27 |
| | Arousal | 136 | 1.06 | 19.06 | 9.85** | 3.30 |
| | Craving | 136 | 0.00 | 18.38 | 6.73** | 5.52 |

*Note*. Ratings scales ranged from 0-20. ** sig. difference compared to neutral, $p < .01$.

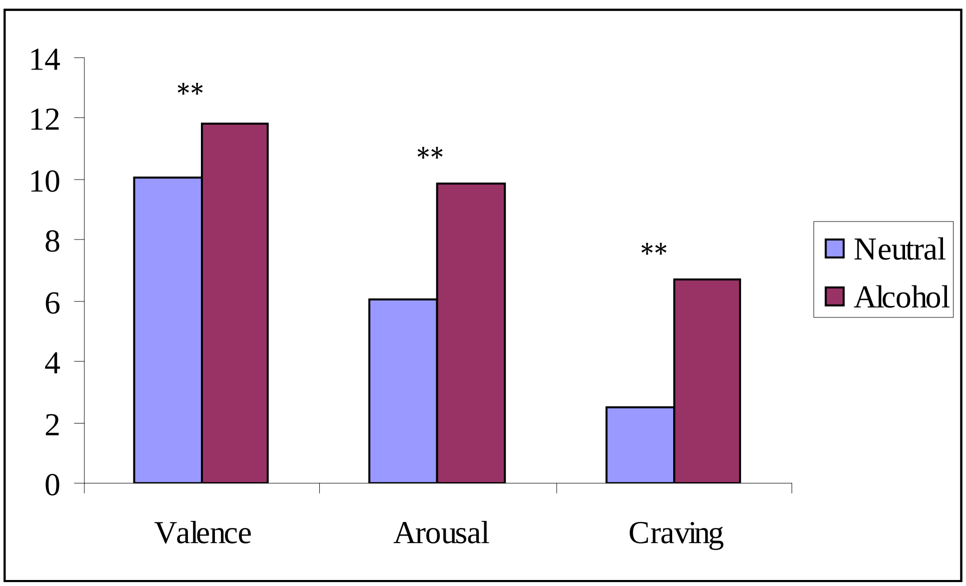


Figure 1. Subjective Ratings of Neutral and Alcohol Cues.

**Cardiac reactivity.** The average heart rate wave pattern included the following variables within the 6-second picture-viewing period for each cue type: baseline, D1 (initial deceleration phase), A1 (peak acceleration phase), and D2 (secondary deceleration phase). Table 4 presented the means for D1, A1, and D2; Figure 2 displayed the cardiac wave pattern across participants in the presence of both alcohol and neutral cues.

**Table 4**
*Cardiac Reactivity to Neutral and Alcohol Cues*

| | | ***Neutral*** | | ***Alcohol*** | |
|---|---|---|---|---|---|
| | **N** | **Mean** | **SD** | **Mean** | **SD** |
| D1 | 131 | -3.97 | 1.91 | -3.65* | 1.83 |
| A1 | 131 | 3.54 | 2.27 | 3.91** | 2.54 |
| D2 | 131 | -3.45 | 2.20 | -2.91 | 2.03 |

*Note*. D1 = initial deceleration phase; A1 = peak acceleration phase; D2 = secondary acceleration phase. Measurement was difference in beats per minute compared to baseline. * indicated sig. difference compared to neutral ($p < 0.01$).

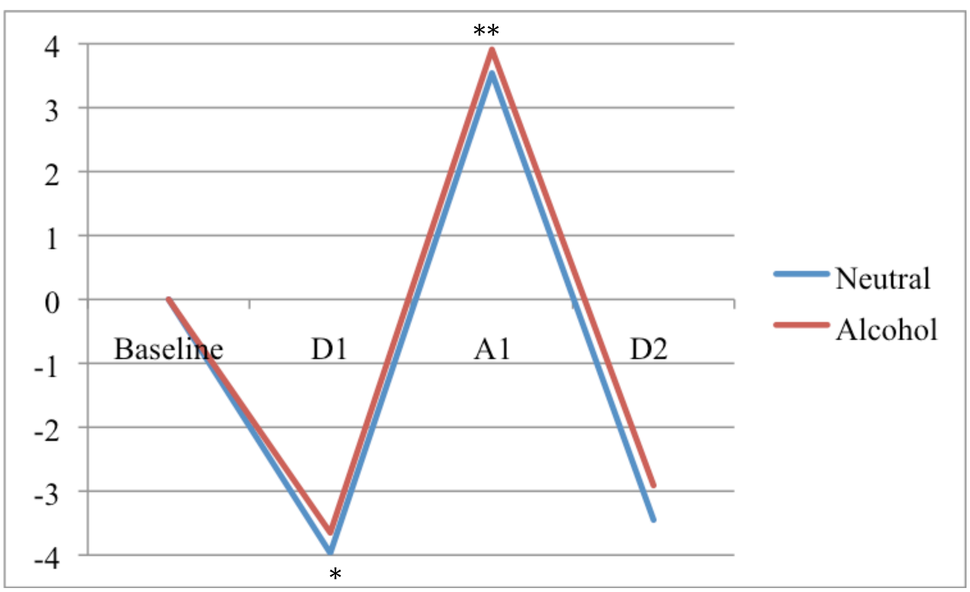


Figure 2. Cardiac wave pattern in the presence of Neutral and Alcohol Cues

Of particular interest were differences between D1 and A1 variables in the presence of alcohol cues compared to neutral cues, as these variables represented attentional and arousing properties of salient cues. In order to test if participants processed alcohol cues as more arousing than neutral cues, a series of paired sample t-tests were performed to test the significance in the differences between D1 and A1 across alcohol and neutral cues within subjects. Greater initial deceleration (or more negative D1) has been thought to represent greater threat associated with the cue, such that attentional resources were taken from cardiac activity to prepare for fight or flight. D1 was significantly blunted (less deceleration) in the presence of alcohol cues compared to neutral cues ($t(130) = -2.30$, $p < .05$), indicating that college drinkers perceived alcohol cues as less aversive than neutral cues (or more appetitive).

Peak acceleration (A1) has been associated with arousing properties of salient cues, such that potentiated A1 reflected increased arousal. A1 was significantly enhanced in the presence of alcohol cues compared to neutral cues ($t(130) = -3.07$, $p < .01$), indicating that participants processed alcohol cues as more arousing than neutral cues. Both of these findings indicated that participants processed alcohol cues as less aversive and more arousing than neutral cues.

**Skin conductance level.** Descriptive statistics for skin conductance level (SCL) variables, including average magnitude (Mean), peak magnitude (Peak), and the average difference between peak magnitude and baseline (Diff) between 2 and 4 seconds following cue presentation, are presented in Table 5. The data from two participants were excluded due to missing data on more than 50% of trials. Because variables displayed elevated skewness and kurtosis variables, each SCL variable was subjected to a linear transformation, which was then used in subsequent analyses.

**Table 5**
*Skin Conductance Variables during Neutral and Alcohol Cues*

| | | N | Mean | SD | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| ***Neutral*** | | | | | | |
| | Mean | 134 | .03 | .13 | 2.06 | 6.01 |
| | Peak | 134 | 1.07 | .20 | 2.24 | 6.13 |
| | Diff | 134 | .20* | .21 | 1.91 | 4.31 |
| ***Alcohol*** | | | | | | |
| | Mean | 134 | .03 | .11 | 1.82 | 5.22 |
| | Peak | 134 | .92 | .18 | 2.14 | 5.72 |
| | Diff | 134 | .17 | .19 | 2.03 | 5.06 |

*Note.* Unit of measurement is micro-Seimans.

In order to determine whether participants processed alcohol cues as more arousing than neutral cues, a series of paired sample t-tests were performed to test the significance in the differences between Mean, Peak and Diff variables in the presence of alcohol and neutral cues. While SCL appeared to increase in the presence of arousing cues, findings revealed no significant differences between Mean and Peak variables during alcohol cues compared to neutral cues. However, Diff SCL was significantly increased in the presence of neutral cues compared to alcohol cues ($t\ (133) = 2.40$, $p < .05$). This finding suggested that participants processed neutral cues as more arousing than alcohol cues, which was not expected. It was possible that the nature of the alcohol cues was appetitive but not particularly arousing to this particular sample of participants.

**Acoustic startle response**. The startle data for 14 participants were omitted from the analyses due to an insufficient number of scorable startle responses within each cue category. For the remaining 122 participants, the means for acoustic startle reactivity during Neutral and Alcohol cues, presented both early (250 – 350 ms) and late (4-5.5 sec) in the picture viewing sequence, are presented in Table 6. Of note, startle magnitudes are expressed in the standardized t-score metric by using the individual mean and SD from each participant across three cue types.

**Table 6**
*Acoustic Startle Response to Neutral and Alcohol Cues*

| | | **Neutral** | | **Alcohol** | |
|---|---|---|---|---|---|
| | **N** | **Mean** | **SD** | **Mean** | **SD** |
| Early | 122 | 47.75 | 3.11 | 47.60 | 3.18 |
| Late | 122 | 51.67 | 2.92 | 50.71 | 3.59 |

* sig. difference compared to neutral ($p < .05$).

Mean startle magnitudes appeared to be attenuated during alcohol cues when compared to neutral cues (Figure 3), which was consistent with appetitive reactivity. Paired samples t-tests revealed that startle response was significantly attenuated in the presence of alcohol cues compared to neutral cues, but only when pictures were presented late ($t(121) = 2.19$, $p < .05$) and not early. These results indicated that participants processed alcohol cues as more appetitive than neutral cues (as evidenced by attenuated late startle magnitudes); however, there were no significant differences in the attentional or arousing properties of alcohol cues compared to neutral cues (as evidenced by early startle reactivity). The findings regarding arousal were consistent with SCL results, such that the particular alcohol pictures in this sample did not appear to be processed as more arousing than neutral cues in this sample of college aged drinkers.

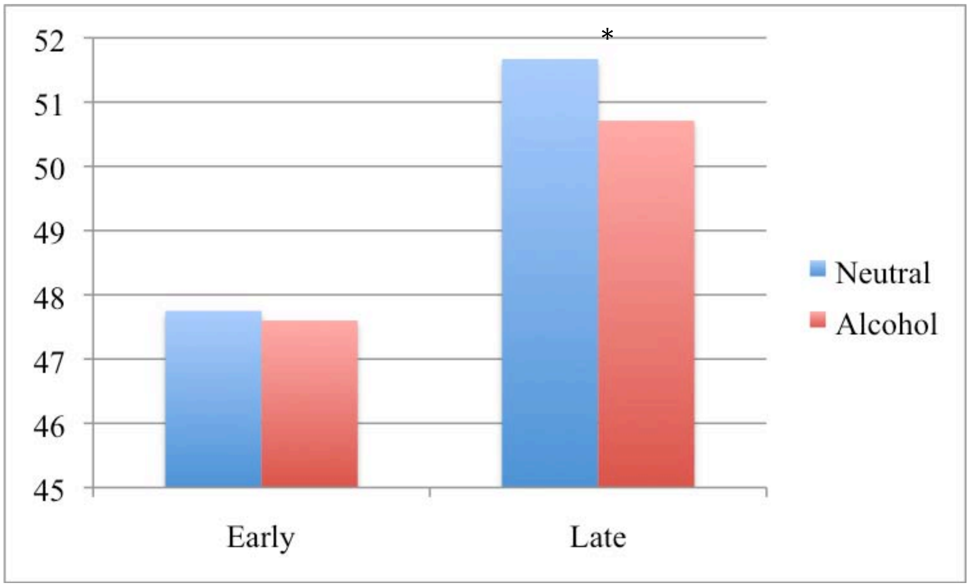


Figure 3. Acoustic Startle Response in the Presence of Neutral and Alcohol Cues.

**Summary of descriptive statistics**. The descriptive statistics confirmed that the basic study parameters were met in order to test the study hypotheses, such that a sample of college drinkers with a wide range of drinking behavior and alcohol expectancies participated in this study. Furthermore, it can be interpreted from the whole of the cue reactivity data that the alcohol cues included in this present study were processed by young adult drinkers as more appetitive than neutral cues.

Though the sample rated alcohol cues as more arousing and craving inducing than neutral cues, the psychophysiological indices did not reflect greater levels of arousal in alcohol cues compared to neutral cues. One explanation of this finding was that the psychophysiological measures were not sensitive enough to detect arousal differences across cue types, while the explicit measure of arousal was much more sensitive in measuring arousal in this sample. Another explanation for these results was that the literature on psychophysiological measures has shown that pictures displaying images of threat garner the strongest changes in reactivity, while appetitive cues were less reliably related to changes in heart rate, skin conductance level, and startle eyeblink (see Bradley et al., 2001).

**Hypothesis 1: Examining overlap between multiple measures of expectancy.**

This section of the analyses tested the hypotheses that Positive alcohol expectancies (AEQ Global Positive; AEQ Social/Physical Pleasure, and AEMax Positive/Arousing) would be positively correlated with appetitive psychophysiological reactivity to alcohol cues, and negative alcohol expectancies (AEMax Negative and AEMax Sedating) would be negatively correlated to appetitive alcohol cue reactivity. In order to correct for multiple comparisons, the Bonferroni correction was applied to the following series of analyses, such that the alpha level was set at 1/(number of correlations within series). Given that each correlational series included 5 alcohol expectancy subscales, the alpha level required for significance was 0.01667. In the interest of being conservative within a large number of correlations, it was determined that an alpha level .01 was required for significance in the following analyses.

**Alcohol expectancies and subjective ratings**. Correlations between subjective ratings and alcohol expectancy subscales are presented in Table 7. As hypothesized, positive alcohol expectancies (Global Positive and Social/Physical Pleasure) were positively and significantly correlated with greater Valence, Arousal and Craving ratings among college drinkers. These results indicated that positive subscales of paper-and-pencil measures and traditional cue reactivity subjective ratings were significantly related to each other.  Once Bonferroni corrections were made (requiring alpha level of .01), the Positive/Arousing alcohol expectancies were not significantly related to subjective ratings of alcohol cues.  The null finding indicated that this particular subscale was not as sensitive as the other two positive expectancies subscales to subjective ratings of drinking in a sample of young adult drinkers.

**Table 7**

*Correlations between Alcohol Expectancies and Subjective Ratings*

| | **Valence** | | **Arousal** | | **Craving** | |
|---|---|---|---|---|---|---|
| | **Neutral** | **Alcohol** | **Neutral** | **Alcohol** | **Neutral** | **Alcohol** |
| ***AEQ*** | | | | | | |
| Global Positive | -.07 | **.23**** | .13 | **.26**** | **.23**** | **.25**** |
| Social /Physical Pleasure | -.04 | **.34**** | .12 | **.24**** | .21* | **.29**** |
| ***AEMax*** | | | | | | |
| Sedating | .06 | -.11 | -.01 | -.11 | -.07 | -.17 |
| Negative | .02 | -.05 | -.06 | .00 | -.03 | -.07 |
| Positive/Arousing | -.12 | .19* | -.21* | .14 | .05 | .21* |

*Note.* AEQ = Alcohol Expectancy Questionnaire; AEMax = Alcohol Expectancy Multi-Axial Assessment. $*p < .05$. $**p < .01$.

The Negative and Sedating alcohol expectancy subscales were not significantly related to subjective ratings, though the correlations were in the hypothesized negative direction.  This lack of significant correlation might have reflected the nature of this sample, which consisted of all drinkers who endorsed positive associations with alcohol consumption in general.  It was possible that the negative expectancies endorsed by these young adult drinkers were not as strong as the positive, arousing, and social alcohol expectances that drive drinking behavior.

An interesting significant relationships was found between Global Positive expectancies and craving ratings of neutral cues. This relationship suggested that individuals who generally endorsed more Global Positive alcohol expectancies were more likely to report craving to drink alcohol, even in the presence of neutral cues. These findings indicated that the appetitive nature of alcohol cues continued to be activated in the presence of neutral cues among these particular drinkers.

**Alcohol expectancies and cardiac reactivity**. Correlations between cardiac reactivity in the presence of alcohol cues and alcohol expectancy subscales are presented in Table 8. Peak acceleration (A1) in the presence of alcohol cues was not correlated with alcohol expectancies, which indicated that the arousal component of cardiac reactivity was not related to paper-and pencil alcohol expectancy subscales, as hypothesized. The overall sample of college drinkers displayed increased A1 in the presence of alcohol cues compared to neutral cues (see descriptive statistics section of results); however, individual alcohol expectancy subscales were not sensitive to variations in peak acceleration. The lack of relationship between A1 and alcohol expectancy subscales indicated that all participants, regardless of expectancy ratings, processed alcohol cues as more arousing than neutral cues.

**Table 8**
Correlations between Alcohol Expectancies and Cardiac Reactivity

| | D1 | | A1 | |
|---|---|---|---|---|
| | **Neutral** | **Alcohol** | **Neutral** | **Alcohol** |
| ***AEQ*** | | | | |
| Global Positive | .09 | -.09 | .05 | -.01 |
| Social /Physical Pleasure | .19* | .08 | .02 | -.02 |
| ***AEMax*** | | | | |
| Sedating | .03 | .10 | .11 | .10 |
| Negative | -.20* | -.11 | .00 | .14 |
| Positive/Arousing | -.17 | -.16 | -.19* | -.09 |

*Note*. D1 = initial deceleration phase; A1 = peak acceleration phase; AEQ = Alcohol Expectancy Questionnaire; AEMax = Alcohol Expectancy Multi-Axial Assessment.
*$p < .05$. **$p < .01$.

In the presence of neutral cues, interesting, but non-significant, relationships emerged between D1 and A1 and alcohol expectancies. Individuals with greater Social/Physical Pleasure expectancies and fewer Negative expectancies displayed attenuated cardiac deceleration, indicating that they processed neutral cues as less aversive than their peers. Individuals with greater Positive/Arousing alcohol expectancies displayed attenuated A1, indicating that processed neutral cues as less arousing than their peers. These relationships, though not hypothesized or significant, revealed that alcohol expectancies might have been related to processing of neutral environmental stimuli.

**Alcohol expectancies and skin conductance response**. Skin conductance level (SCL) variables were not significantly correlated to any alcohol expectancy subscales, with one exception. Given that the overall sample did not process alcohol cues as particularly arousing compared to neutral (as reported in the descriptive statistics section), it was possible that skin conductance was not sensitive to expectancy changes in a sample of college-aged drinkers. Had a wider range of drinker types been included in the sample, such as abstainers and alcohol dependence individuals, it might have been possible for skin conductance levels to be sensitive to individual expectancy differences.

**Alcohol expectancies and acoustic startle eyeblink reflex**. Correlations between early and late startle reactivity to alcohol expectancy subscales are presented in Table 9. As hypothesized, Sedating alcohol expectancies were negatively correlated with appetitive early acoustic startle reflex (resulting in positive correlation). In addition, Negative alcohol expectancies were also negatively correlated to appetitive early acoustic startle response, though this finding became non-significant after Bonferroni corrections. These findings, taken together, indicated that individuals with sedating and negative alcohol expectancies displayed blunted (or less attenuated) startle reactivity to alcohol cues, suggesting that they processed alcohol cues as less arousing and less attention-grabbing than individuals with fewer sedating and negative alcohol expectancies.

**Table 9**
*Correlations between Alcohol Expectancies and Acoustic Startle*

| | Early | | Late | |
|---|---|---|---|---|
| | **Neutral** | **Alcohol** | **Neutral** | **Alcohol** |
| ***AEQ*** | | | | |
| Global Positive | -.04 | -.09 | -.01 | .02 |
| Social /Physical Pleasure | -.07 | -.14 | .02 | -.01 |
| ***AEMax*** | | | | |
| Sedating | .02 | **.28**** | -.10 | -.10 |
| Negative | -.04 | .19* | -.03 | -.12 |
| Positive/Arousing | -.08 | .05 | -.07 | -.04 |

*Note.* AEQ = Alcohol Expectancy Questionnaire. AEMax = Alcohol Expectancy Multi-axial Assessment. $*p < .05$. $**p < .01$.

The positive, arousing, and social expectancy subscales were not positively correlated to appetitive early acoustic response, as hypothesized. One possible explanation might again reflect the fact that this sample of drinkers, as a whole, provided positive explicit ratings and appetitive processing toward alcohol cues. Subtle differences in positive and appetitive processing and evaluations of cues may not have been detectable in this sample.

With regard to late startle magnitudes in the presence of alcohol cues, no significant relationships were found with alcohol expectancy subscales. These findings indicated that appetitive processing of alcohol cues (late startle) was not strongly related to individual alcohol expectancies in this sample. Again, the nature of this drinking sample may have contributed to the lack of sensitivity in cue reactivity picking up on subtle differences in paper-and-pencil measures of expectancy.

**Hypothesis 2: Predicting Drinking Behavior.**

The second hypothesis posited that appetitive psychophysiological cue reactivity to alcohol pictures (subjective ratings; skin conductance level; cardiac acceleration; early acoustic startle response; and late acoustic startle response) would account for variance in drinking behavior above and beyond traditional alcohol expectancy subscales (AEQ Global Positive; AEQ Social/Physical Pleasure, and AEMax Positive/Arousing, AEMax Negative, and AEMax Sedating). First, correlations between drinking behavior and alcohol expectancies, subjective ratings, and psychophysiological reactivity to alcohol cues were examined. If and when subjective ratings and psychophysiological reactivity to alcohol cues were significantly related to drinking behavior, then hierarchical regression analyses were employed to test the communality and unique variance demonstrated by cue reactivity measures relating to drinking behavior above and beyond alcohol expectancy subscales.

**Alcohol expectancies and drinking behavior**. Correlations between alcohol expectancies and drinking behavior variables are presented in Table 10. As expected and consistent with the expectancy literature, Global Positive and Social/Physical Pleasure subscales were positively related to drinking behavior, while Sedating and Negative subscales were negatively correlated to drinking behavior. The Positive/Arousing expectancy subscale was not significantly positively related to drinking behavior (though the relationship was positive) in this sample of college-aged drinkers. It was not understood why this study did not replicate numerous findings that Positive/Arousing alcohol expectancies were positively correlated to drinking behavior in young adults.

**Table 10**
*Correlations between Alcohol Expectancies and Drinking Behavior*

| | Total Drinking | Quantity | Frequency |
|---|---|---|---|
| ***AEQ*** | | | |
| Global Positive | **.34**** | .11 | **.30**** |
| Social /Physical Pleasure | **.50**** | **.34**** | **.38**** |
| ***AEMax*** | | | |
| Sedating | **-.36**** | **-.25**** | **-.28**** |
| Negative | **-.30**** | **-.24**** | **-.21**** |
| Positive/Arousing | .13 | .16 | .03 |

*Note.* AEQ = Alcohol Expectancy Questionnaire; AEMax = Alcohol Expectancy Multi-Axial Assessment. $^*p < .05$. $^{**}p < .01$.

**Subjective ratings and drinking behavior.** Strong relationships emerged between drinking behavior and subjective ratings of Valence, Arousal, and Craving, such that heavier drinkers rated alcohol cues as more pleasing, arousing, and craving-inducing (see Table 11). Heavier drinkers also reported greater craving to drink alcohol in the presence of neutral cues, which indicated a higher level of craving for alcohol even without the context of alcohol. These findings confirmed that individual subjective ratings of alcohol cues were significantly related to drinking behavior, as was hypothesized.

**Table 11**
*Correlations between Subjective Ratings and Drinking Behavior*

| | **Valence** | | **Arousal** | | **Craving** | |
|---|---|---|---|---|---|---|
| | **Neutral** | **Alcohol** | **Neutral** | **Alcohol** | **Neutral** | **Alcohol** |
| Total Drinking | -.12 | **.36**** | .04 | **.31**** | **.25**** | **.40**** |
| Quantity | -.11 | **.27**** | .01 | **.26**** | .14 | **.32**** |
| Frequency | -.06 | **.25**** | .02 | **.20*** | .21* | **.27**** |

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

Multiple linear regression was employed to determine the convergent and divergent degree to which subjective ratings and alcohol expectancies predicted drinking behavior. The AEQ Global Positive, AEQ Social and Physical Pleasure, AEMax Negative, and AEMax Sedating subscales were chosen for regression analyses, because they captured a range in expectancy types and were significantly related with total drinking behavior (see Table 10). Table 12 displayed the results of total drinking regressed on alcohol expectancies and subjective ratings. Tolerance and VIF indicators were within accepted ranges, which meant that multicollinearity across predictors was not problematic. These seven predictors accounted for more than one third of the variance in drinking behavior among college drinkers (Adjusted $R^2 = .36$). The Social and Physical Pleasure expectancy subscale (ß = .31, $p < .01$) was the strongest predictor, followed by Sedating expectancies (ß = -.19, $p < .05$) and craving ratings of alcohol cues (ß = .19, p < .05). These relationships made sense, such that having fewer sedating expectancies, greater social expectancies, and greater craving for alcohol predicted greater drinking behavior.

**Table 12**
*Regression Results for Alcohol Expectancies and Subjective Ratings of Alcohol Predicting Total Drinking*

| | *B* | *SE B* | $\beta$ | Tolerance | VIF |
|---|---|---|---|---|---|
| AEM Sedating | -.03 | .01 | -.19* | .69 | 1.46 |
| AEM Negative | -.02 | .02 | -.08 | .69 | 1.47 |
| AEQ Global Positive | .01 | .02 | .04 | .64 | 1.56 |
| AEQ Social/Physical Pleasure | .25 | .07 | .31** | .57 | 1.73 |
| Valence | .05 | .05 | .09 | .61 | 1.63 |
| Arousal | .02 | .03 | .06 | .62 | 1.61 |
| Craving | .04 | .02 | .19* | .59 | 1.71 |
| $R^2$ | .39 | | | | |
| *Adjusted* $R^2$ | .36 | | | | |

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

The communality between all seven variables, determined by summing the squared regression weights, was determined to be roughly 19% of the variance in drinking behavior. The four expectancy subscales shared fifteen percent of the variance in drinking behavior, while the communality among subjective rating variables equaled five percent. These findings indicated that the explicit expectancy subscales and ratings of mood, arousal, and craving overlapped significantly in predicting total drinking in a sample of college drinkers.

Hierarchical regression was used to analyze unique variance in drinking behavior accounted for by psychophysiological reactivity to alcohol cues while controlling for explicit measures of expectancy (See Table 13). Alcohol expectancy subscales alone predicted 30% of the variance in total drinking in a sample of college drinkers (Adjusted $R^2 = .30$), with the AEQ Social and Physical Pleasure subscale the best predictor (ß = .38, $p < .01$) followed by the AEMax Sedating subscale (ß = -.23, $p < .01$). The addition of subjective ratings of alcohol cues significantly increased the amount of variance in drinking explained by predictors ($F(3) = 4.75$, $p < .01$), which indicated that subjective ratings predicted drinking behavior above and beyond alcohol expectancies.

**Table 13**
*Hierarchical Regression Results for Alcohol Expectancies and Subjective Ratings of Alcohol Predicting Total Drinking*

| | Model 1 | | | Model 2 | | |
|---|---|---|---|---|---|---|
| | *B* | *SE B* | *β* | *B* | *SE B* | *β* |
| AEM Sedating | -.03 | .01 | -.23** | -.03 | .01 | -.19* |
| AEM Negative | -.01 | .02 | -.05 | -.02 | .02 | -.08 |
| AEQ Global Positive | .02 | .02 | .07 | .01 | .02 | .04 |
| AEQ Social/Physical Pleasure | .31 | .08 | 38** | .25 | .07 | .31** |
| Valence | | | | .05 | .05 | .09 |
| Arousal | | | | .02 | .03 | .06 |
| Craving | | | | .04 | .02 | .19* |
| $R^2$ | .32 | | | .39 | | |
| *Adjusted* $R^2$ | .30 | | | .35 | | |
| *F for Change in* $R^2$ | | | | 4.75** | | |

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

**Psychophysiological reactivity and drinking**. With respect to cardiac response, skin conductance response, and acoustic startle reactivity to alcohol cues, no significant relationships were found with drinking behavior. These findings were not consistent with hypotheses, such that it was expected that appetitive psychophysiological reactivity to alcohol cues would be significantly correlated to heavier drinking behavior. As such, it was not possible to test the convergent and/or divergent predictive validity of cardiac response (A1), SCL, early acoustic startle response, and late acoustic startle response to alcohol on drinking behavior in this sample of college drinkers. Although it was hypothesized that there would be relationships between drinking behavior and psychophysiological reactivity to alcohol cues, the lack of relationship was consistent with the literature that implicit measures of expectancy were not as strongly related to downstream drinking behavior as explicit measures of expectancy.

### Hypothesis 3: Genetic Impact on Multiple Measures of Expectancy.

The third hypothesis posited that genetic risk would impact the relationships between alcohol expectancies and cue reactivity in a sample of college drinkers, due to the blunted psychophysiological responding seen in children of alcoholics. Specifically it was hypothesized that family history density (FHD) would be positively correlated with both positive and negative alcohol expectancies (indicative of greater drinking and greater risk) and negatively correlated to appetitive psychophysiological reactivity to alcohol cues (indicating blunting effect). The first part of this section presented descriptive statistics for genetic risk (family history density) and non-genetic risk variables (sensation seeking and negative consequences of drinking) and confirmed the basic study parameter that risk was positively related to drinking behavior. The second part examined the correlations between risk variables, alcohol expectancies, and risk variables.

**Family history**. In this sample a total of 93 individuals (68.4%) reported a positive family history of alcoholism (FH+) for at least one 1st degree relative and/or 2nd degree relative. A total of 47 individuals (34.6%) reported a positive family history of alcoholism (FH+) for at least one 1st degree relative. Among those with any family history for alcohol use disorders, Family History Density (FHD, calculations described in methods) ranged from .25 to 1.50, with a mean of 0.53 (SD = 0.29), meaning that on average, most FH+ individuals had the genetic risk equal to either had 1 parent or 2 grandparents with a history of alcoholism. For the entire sample, the mean of FHD was 0.34 (SD = 0.24; see Table 14). Due to the high numbers of individuals with zero family history, the skewness for FHD was high. As a result, a log transformation of this variable was used in subsequent analyses.

**Table 14**
*Descriptive Statistics for Risk Variables*

| | N | Min | Max | Mean | SD | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| FHD | 136 | 0.00 | 1.50 | 0.28 | 0.34 | 1.09 | 0.41 |
| ln (FHD + 1) | 136 | 0.00 | 0.92 | 0.22 | 0.24 | 0.74 | -0.66 |
| Sensation Seeking | 136 | 2.00 | 18.00 | 10.60 | 3.49 | -0.22 | -0.36 |
| RAPI | 136 | 0.00 | 47.00 | 9.81 | 8.42 | 1.51 | 3.07 |
| ln(RAPI + 1) | 136 | 0.00 | 3.87 | 2.04 | 0.92 | -0.72 | 0.08 |

*Note.* FHD = Family History Density. RAPI = negative consequences of drinking alcohol.

**Sensation Seeking**. Sensation Seeking was included as a measure of non-genetic risk for future alcohol use disorders, with higher scores indicating higher levels of sensation-seeking and impulsive behavior (see Table 14). The average Sensation-Seeking score was 10.11 (SD = 3.51), which was consistent with means in our previous studies on college-aged drinkers.

**RAPI**. The RAPI measure assessed problem drinking and consequences of drinking, with higher scores indicating greater alcohol-related problems in the past year. The average RAPI score in this sample was a 9.81 (SD = 8.42), which was consistent with studies on college-aged individuals (see Table 14). The RAPI variable was skewed positively, which indicated that there were a few individuals in this study with higher levels of problem drinking than the rest of the sample, but this was consistent with the nature of a sample of young adult drinkers. The natural log transformation of the RAPI score was used in all subsequent analyses.

**Risk and drinking behavior**. Confirming the basic study parameters, Family History Density (FHD) was positively and significantly correlated with drinking behavior, Sensation Seeking, and negative consequences of drinking (RAPI), with *r*s ranging from 0.19 to 0.53. These correlations indicated that individuals with greater FHD endorsed greater sensation seeking and negative consequences of drinking, and they reported drinking at greater quantities and frequency compared to individuals with lower genetic risk. The only non-significant relationship occurred between sensation seeking and average drinking, and this relationship was close to significant ($r = 0.17$, $p = 0.055$). These findings confirmed that individuals with greater genetic risk for alcohol use disorders also endorsed greater scores on non-genetic risk variables.

**Risk and alcohol expectancies**. Table 15 presents the correlations between alcohol expectancies and risk variables. The hypothesis that genetic risk for alcohol use disorders would be positive correlated to both positive and alcohol expectancies was not confirmed by these data. Family History Density (FHD) was not significantly correlated with any alcohol expectancy subscales. It was hypothesized that as FHD increased, both positive and negative alcohol expectancy types would also increase. It was possible that the high number of FH- individuals in this sample (despite the log transformation of the FHD variable) and non-normality of this particular variable might explain a lack of relationship to alcohol expectancies. However, excluding individuals with no family history of alcoholism (or FHD = 0) did not reveal any new relationships. This lack of relationship was likely due to the overall nature of this drinking sample endorsing positive, arousing, and social alcohol expectancies, regardless of level of risk for future alcohol use disorders.

**Table 15**
*Correlations between Risk and Alcohol Expectancies*

| | FHD | Sensation Seeking | RAPI |
|---|---|---|---|
| ***AEQ*** | | | |
| Global Positive | .00 | **.23**** | **.27**** |
| Social /Physical Pleasure | .06 | **.30**** | **.26**** |
| ***AEMax*** | | | |
| Sedating | -.04 | -.07 | -.22* |
| Negative | -.14 | -.02 | -.04 |
| Positive/Arousing | -.05 | .19* | .14 |

*Note.* AEQ = Alcohol Expectancy Questionnaire; AEMax = Alcohol Expectancy Multi-Axial Assessment; RAPI = negative consequences of drinking alcohol; FHD = Family History Density $*p < .05$. $**p < .01$.

Other risk variables emerged as significantly related to alcohol expectancies. Specifically, Global Positive and Social/Physical alcohol expectancies were positively correlated to non-genetic risk variables sensation-seeking and negative consequences of drinking. Though not significant after Bonferroni correction, Positive/Arousing alcohol expectancies were also positively correlated to the risk variable Sensation Seeking, as was expected. In addition, the Sedating subscale was negatively correlated to negative consequences of drinking, though this relationship, too, became non-significant after Bonferroni correction. These relationships indicated that college aged drinkers with greater positive, social, and sedating expectancies were likely at greater risk for alcohol use disorders.

**Risk and subjective ratings**. FHD was not significantly related to subjective ratings during alcohol cues (see Table 16). It was hypothesized that as FHD increased, subjective ratings of Valence, Arousal, and Craving would decrease, indicating blunted emotional reactivity to alcohol cues. These analyses were re-run excluding FH- individuals, and no significant relationships emerged among FH+ individuals. The lack of relationship might again have reflected non-normality in the FHD variable or the nature of a sample of drinkers, who overall rated alcohol cues as appetitive. Or, perhaps the lack of relationship indicated that as FHD increased, changes in subjective ratings toward salient cues were not continuous in nature.

**Table 16**
*Correlations between Risk and Subjective Ratings*

| | **Valence** | | **Arousal** | | **Craving** | |
|---|---|---|---|---|---|---|
| | **Neutral** | **Alcohol** | **Neutral** | **Alcohol** | **Neutral** | **Alcohol** |
| FHD | .00 | -.11 | .17* | .01 | .08 | .05 |
| Sensation Seeking | -.04 | .14 | .04 | .15 | .02 | .09 |
| RAPI | -.13 | .14 | .12 | .22* | .15 | **.25**** |

*Note.* RAPI = negative consequences of drinking alcohol; FHD = Family History Density. $*p < .05$. $**p < .01$.

Interestingly, FHD was positively correlated to arousal ratings during neutral cues, though this relationship was determined non-significant after Bonferroni correction. This finding might have indicated that individuals with greater genetic risk for alcohol use disorders endorsed heightened arousal during neutral cues. The hypotheses predicted that these individuals with greater genetic risk would rate alcohol cues as less arousing, which was not supported by the data. However, the heightened arousal ratings for neutral cues suggested that, overall, drinkers at higher genetic risk processed their environmental stimuli differently than their peers.

With regard to non-genetic risk variables, only the RAPI scale was correlated to subjective ratings of alcohol cues. The RAPI scale was significantly, positively correlated to craving ratings during alcohol cues, such that drinkers who endorsed more negative consequences rated alcohol cues as more craving-inducing. In addition, the RAPI scale was also positively correlated (though non-significant after Bonferroni correction) to arousal ratings, indicting that higher risk drinkers also rated alcohol cues as more arousing. Although no hypotheses were posited with regard to this correlation, it made sense that drinkers who endorsed greater problematic drinking behavior rated alcohol cues as more arousing and craving-inducing than their peers.

**Risk and cardiac reactivity**. FHD was related to cardiac reactivity to alcohol cues as hypothesized, though these relationships were determined non-significant after Bonferroni corrections. Specifically, FHD was positively related to initial cardiac deceleration (D1) during alcohol cues, indicating that drinkers with greater genetic risk for alcoholism displayed blunted attentional processing of alcohol cues. When FH-individuals were excluded from analyses, FHD was negatively related to cardiac acceleration (A1), which indicated blunted arousal to alcohol related cues. Both of these findings were consistent with hypotheses that individuals with increased genetic risk would display blunted psychophysiological reactivity to alcohol related cues. These relationships, though determined non-significant, indicated that the blunting phenomenon for cardiac reactivity was continuous in nature, such that greater cardiac blunting occurred with greater genetic risk for alcohol use disorders in this sample of drinkers.

With regard to non-genetic risk variables, no significant relationships were found with cardiac reactivity to alcohol cues (D1, A1 and Diff variables).

**Risk and skin conductance level**. No significant relationships were found between FHD and skin conductance reactivity to either alcohol or neutral cues. Excluding FH- individuals from the analyses did not cause any significant relationships to emerge. It was hypothesized that as FHD increased, SCL in the presence of alcohol cues would decrease, indicating blunted arousal to alcohol cues. Again, this null finding may have reflected non-normality in the FHD variable or perhaps that the blunted effect in SCL among high-risk drinkers was not continuous in nature.

With regard to non-genetic variables of risk, neither sensation seeking nor RAPI were significantly related to skin conductance level in the presence of alcohol cues.

**Risk and acoustic startle response**. No significant relationships were found between risk variables (FHD, sensation seeking, and RAPI scores) and early or late startle reactivity in the presence of alcohol or neutral cues. It was expected that as genetic risk increased, individuals would display blunted startle reactivity to alcohol cues. The null finding again might have resulted from non-normal distribution of the FHD variable; or perhaps, as suggested above, there existed a point along the FHD distribution at which a threshold for blunted reactivity existed.

**Hypothesis 4: COA Status.**

The fourth, exploratory hypothesis posited that children of alcoholics (COAs) would exhibit different relationships between alcohol expectancies and reactivity to alcohol cues, due to blunted cue reactivity to salient cues. In the first part of this section of the analyses, descriptive statistics regarding COA groups were presented. The second part of this section analyzed differences in psychophysiological reactivity to alcohol cues between COA groups and examined possible moderation by COA status on relationships between alcohol expectancy subscales and cue reactivity to alcohol cues.

**COA groups.** A total of 47 individuals (34.6% of the sample, 29 female) were identified as a child of an alcoholic (COA+), or having endorsed at least one biological parent with an alcohol use disorder (AUD). The COA+ and COA- groups did not differ in terms of gender ratio or mean age. However, a greater percentage of the COA- group identified themselves as Hispanic or Latino ($\chi^2(1) = 6.98$, $p < .001$) and the racial characteristics of the COA- group were more diverse ($\chi^2(4) = 9.60$, $p < .05$). The COA+ group consisted of primarily Caucasian individuals.

**COA groups and risk variables**. As expected, and consistent with the above FHD findings, COA+ individuals consumed alcohol more frequently and at greater quantities than COA- individuals (see Table 17). In addition, COA+ individuals endorsed higher levels of sensation seeking and drinking-related negative consequences compared to their COA- peers. In this sample, therefore, children of alcoholics displayed significantly greater levels of alcohol-related risk compared to their peers, which indicated that COA status was an appropriate variable to capture significant differences in overall level of risk (e.g. both genetic and non-genetic risk). In order to account for the possible confound of drinking behavior on psychophysiological reactivity to alcohol cues, drinking behavior added as a covariate in the remaining analyses.

**Table 17**
*Risk Variables by COA status*

| | Status | N | Mean | SD |
|---|---|---|---|---|
| Total Drinking | | | | |
| | COA - | 89 | 23.30 | 21.76 |
| | COA + | 47 | 38.77** | 31.01 |
| Quantity | | | | |
| | COA - | 89 | 3.72 | 2.25 |
| | COA + | 47 | 4.62* | 2.43 |
| Frequency | | | | |
| | COA - | 89 | 5.38 | 3.77 |
| | COA + | 47 | 7.85** | 4.83 |
| Sensation Seeking | | | | |
| | COA - | 89 | 10.13 | 3.71 |
| | COA + | 47 | 11.47* | 2.85 |
| RAPI | | | | |
| | COA - | 89 | 8.07 | 7.80 |
| | COA + | 47 | 13.11** | 8.64 |

*Note.* COA- = Not children of alcoholics; COA+ = children of alcoholics. Raw Total Drinking and RAPI variables were displayed. RAPI = negative consequences of alcohol. *$p$ < .05. **$p$ < .01.

**COA status and subjective ratings**. After controlling for drinking behavior, COA groups did not differ with regard to subjective ratings of alcohol cues, such that both COA+ and COA- individuals rated alcohol cues as pleasing, arousing, and craving-inducing. COA status affected ratings of neutral pictures, however, such that COA+ individuals rated neutral cues as more arousing than their COA- peers (t (132) = -2.26, $p$ < .05). These results were not necessarily consistent with hypotheses that individuals with greater genetic risk would process salient cues as less arousing than their peers; however, it was interesting that COA+ individuals rated non-salient cues differently than COA- individuals.

**COA status and alcohol expectancies**. After controlling for drinking, COA groups did not differ with regard to mean levels of positive (Global Positive, Social/Physical Pleasure, and Positive/Arousing) or negative (Negative and Sedating) alcohol expectancies. These findings indicated that young adult drinkers, regardless of COA status, endorsed similar explicit expectancies for drinking behavior.

**COA status and cue reactivity**. With respect to cardiac reactivity, COA+ individuals displayed blunted initial deceleration (D1) activity in the presence of alcohol cues compared to COA- individuals ($F(1) = 11.52$, $p < .01$) after controlling for drinking behavior. The mean level of D1 for COA+ individuals (-2.95) was greater than the mean level for COA- individuals (-4.00), indicating that COA+ individuals did not process alcohol-related cues as attention-grabbing as COA- individuals. These findings were consistent with the hypotheses that children of alcoholics displayed blunted processing of salient stimuli compared to their peers.

With respect to skin conductance level to alcohol cues, family history groups displayed no significant differences in SCL during alcohol pictures. It was hypothesized that COA+ individuals would display blunted arousal during alcohol cues, but the SCL data did not indicate evidence for this hypothesis.

With respect to acoustic startle response in the presence of alcohol cues, there were no significant differences in mean levels of early or late acoustic startle response due to COA status. It was hypothesized that COA+ individuals would display blunted acoustic startle response, but this blunted phenomenon was not observed in this sample of drinkers. Had different types of COA+ and COA- individuals, including abstainers and alcohol dependent individuals, been included in this sample, significant differences in acoustic startle reactivity in the presence of alcohol cues due to COA status may have emerged.

**Impact of COA status on relationships between upstream and downstream expectancy measures.** The next series of analyses examined the impact of COA status on the relationships between explicit expectancy subscales and cue reactivity, after controlling for differences in drinking across COA groups. In this sample of drinkers, COA status did not impact the relationships between alcohol expectancies and the following psychophysiological reactivity to alcohol cues: skin conductance level, cardiac reactivity, and late acoustic startle response. These null findings may have reflected the low power to observe differences between groups, given that the study design was correlational in nature.

However, despite lack of adequate power, significant changes in the relationships between alcohol expectancies and early acoustic startle response due to COA status emerged. Specifically, after controlling for drinking, negative correlations between early startle reactivity to alcohol cues and Social/Physical Pleasure and Global Positive and Positive Arousing became stronger (though not significant after Bonferroni corrections; compared to full sample in Table 9). These negative correlations were consistent with the hypotheses that greater positive, arousing, and social expectancies would be positively related to appetitive reactivity to alcohol cues (or attenuated early startle magnitude). Further, a significant positive relationship between Sedating alcohol expectancies and early startle response was strengthened in the sample of COA+ individuals, while Negative alcohol expectancies were close to significance. These correlations were consistent with hypotheses that negative and sedating alcohol expectancies would be negatively correlated with appetitive reactivity to alcohol cues (or potentiated early startle magnitude). With respect to the non-significant correlations (both due to Bonferroni corrections and those near significant), it was important to note that the nearly significant expectancy subscales would likely have been significant if there had been adequate power to detect these relationships.

**Table 18**
*COA+ group: Correlations between Alcohol Expectancies and Acoustic Startle*

| | **Early** | | **Late** | |
|---|---|---|---|---|
| | **Neutral** | **Alcohol** | **Neutral** | **Alcohol** |
| ***AEQ*** | | | | |
| Global Positive | -.03 | -.28 | .05 | -.01 |
| Social /Phy Pleasure | -.14 | **-.33*** | .23 | -.09 |
| ***AEMax*** | | | | |
| Sedating | .10 | **.39**** | -.18 | -.12 |
| Negative | -.09 | .29 | -.03 | .08 |
| Positive/Arousing | -.11 | -.26 | -.08 | -.06 |

*Note.* AEQ = Alcohol Expectancy Questionnaire. AEMax = Alcohol Expectancy Multi-axial Assessment. $^{*}p < .05$. $^{**}p < .01$.

Among COA- individuals, no new significant relationships between alcohol expectancies and startle were observed, and significant relationships between Sedating and Negative alcohol expectancies and early acoustic startle response (observed in Table 9) were no longer present among the COA- sample. That is to say, significant relationships between acoustic startle response and alcohol expectancies (both positive and negative subscales) were only observed in college drinkers who were children of alcoholics.  It was hypothesized that the differences across COA groups would result from blunted cue reactivity to alcohol pictures among COA+ individuals; instead, these results indicated that both COA groups displayed similar cue reactivity to alcohol pictures, but relationships between upstream and downstream alcohol expectancies were stronger in COA+ individuals (in the expected directions) and weaker in COA- individuals.

These findings supported the hypothesis that relationships between alcohol expectancies and early acoustic startle response to alcohol cues would change due to COA status. Not only were correlations between negative alcohol expectancies and blunted startle reactivity stronger, but also correlations between positive alcohol expectancies and appetitive reactivity emerged. It was interpreted that COA status represented a genetic threshold for stronger relationships between individual implicit reactivity to alcohol cues and explicit evaluations of their expectations for alcohol consumption.

**Moderation analyses**. Changes in the strength of the relationship between alcohol expectancies and startle response due to COA status suggested that COA status moderated the relationship between early acoustic startle response and alcohol expectancies. Specifically, significant relationships between positive alcohol expectancies and early acoustic startle response were not seen in the full sample, but they emerged within the sample of children of alcoholics. Further, negative and sedating alcohol expectancies were correlated to decreased appetitive (or blunted) acoustic startle reactivity in the full sample, but these relationships disappeared in a sample of COA- individuals while they remained significant (and nearly significant) in the COA+ sample.

Hierarchical regression was employed to test the significance of an interaction between alcohol expectancy subscales and COA status in predicting early acoustic startle reactivity to alcohol cues. Moderation analyses revealed that COA status moderated the relationships between two positive alcohol expectancy subscales (AEMax Positive/Arousing and AEQ Social and Physical Pleasure) and early startle response to alcohol cues (see Tables 19 and 20). Neither of these expectancy subscales were significantly correlated with acoustic startle response in the full sample, but the relationships were strengthened in the COA+ sample.

In Table 19, the interaction term ($B = -.56$, $p < .05$) was significant in predicting variance in early startle reactivity to alcohol cues. This finding indicated that COA status moderated the relationship between Positive/Arousing alcohol expectancies and early acoustic startle response to alcohol cues. The change in $R^2$ was significant after all three terms were included in the model ($F = 4.00$, $p < .05$), although the amount of variance explained by Positive/Arousing expectancies and the interaction between expectancies and COA status remained relatively small ($R^2 = .04$).

**Table 19**
*Hierarchical Regression Analyses for Positive/Arousing Expectancies and COA Status Predicting Early Acoustic Startle Response to Alcohol Cues.*

| | Model 1 | | | Model 2 | | | Model 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| Variable | *B* | *SE B* | *β* | *B* | *SE B* | *β* | *B* | *SE B* | *β* |
| AEM PosArs | .02 | .04 | .05 | .02 | .04 | .05 | .22 | .11 | .57* |
| COA Status | | | | -.37 | .63 | -.06 | 4.7 | 2.6 | .70 |
| AEM PosArs x COA Status | | | | | | | -.16 | .08 | -.56* |
| $R^2$ | | .00 | | | .01 | | | .04 | |
| *F* for change in $R^2$ | | .36 | | | .35 | | | 4.00* | |

*Note:* PosArs = Positive and Arousing subscale of the AEMax. COA = Children of Alcoholics; The AEM PosArs subscale and COA Status were centered at their means. *$p$ < .05. **$p$ < .01.

In Table 20, the interaction between AEQ Social and Physical Pleasure and COA status significantly predicted early acoustic startle response to alcohol cues (*B* = -1.24, $p$ < .05). This finding indicated that COA status moderated the relationship between Social and Physical Pleasure expectancies and early acoustic startle response to alcohol cues. Again, the change in $R^2$ was significant after all three terms were included in the model (F = 5.42, $p$ <. 05). However, the amount of variance in early acoustic startle explained by the interaction between expectancies and COA status remained relatively small ($R^2$ = .07).

**Table 20**
*Hierarchical Regression for AEQ Social and Physical Pleasure Expectancies and COA Status predicting Early Acoustic Startle Response to Alcohol Cues*

| | Model 1 | | | Model 2 | | | Model 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| Variable | *B* | *SE B* | *β* | *B* | *SE B* | *β* | *B* | *SE B* | *β* |
| AEQ Soc/Phy | -.30 | .19 | -.14 | -.29 | .19 | -.14 | .96 | .57 | .45 |
| COA Status | | | | -.36 | .62 | -.05 | -.25 | .61 | -.04 |
| AEQ Soc/Phy x COA Status | | | | | | | -.92 | .40 | -1.24* |
| $R^2$ | | .02 | | | .02 | | | .07 | |
| *F* for change in $R^2$ | | 2.40 | | | .34 | | | 5.42* | |

*Note:* Soc/Phy = Social and Physical Pleasure subscale of the AEQ; COA = Children of Alcoholics; The AEM Soc/Phy subscale was centered at its mean.
$^*p < .05$. $^{**}p < .01$.

A trend existed for COA moderation in the relationship between AEQ Global Positive alcohol expectancies and early acoustic startle response. Beta weights for COA*AEQ Global Positive ($B$ = .50, $p$ = .07) interaction terms were close to significant. It was possible that these analyses would have been significant if the study had been adequately powered to test moderation.

Though the strength in relationships between Negative and Sedating alcohol expectancies and decreased appetitive (or greater blunted) acoustic startle reactivity to alcohol cues appeared to be impacted by COA status, hierarchical regression analyses targeting Negative and Sedating expectancies were not significant. Consistent across models, however, was reduction of predictive power of Negative and Sedating alcohol expectancies predicting blunted acoustic startle. In other words, the beta weights of negative and sedating alcohol expectancies decreased in strength when genetic risk was added to the model; but beta weights for COA status and COA*expectancy interaction terms were not significant. It was apparent in the full sample that negative and sedating alcohol expectancies were related to less appetitive (or blunted) acoustic startle response to alcohol cues, and these relationships were strengthened in children of alcoholics. Again, these analyses lacked adequate power to determine moderation of COA status on the relationship with implicit and explicit measures of alcohol expectancies.

To summarize, COA status appeared to moderate the strength between positive alcohol expectancy subscales (Positive/Arousing and Social and Physical Pleasure) and early acoustic startle response to alcohol cues. These findings indicated that individuals at greater genetic risk for AUD displayed stronger relationships between positive alcohol expectancies and appetitive processing of alcohol cues. In other words, positive, explicit expectations of alcohol use were more strongly related to appetitive processing in children of alcoholics. This finding suggested that children of alcoholics were more likely to be physiologically drawn to alcohol cues and drinking behavior as their positive alcohol expectancies increased.

The changes in the strength between negative and sedating alcohol expectancy subscales and less appetitive (blunted) early acoustic startle response were not significantly attributed to COA status in these regression analyses. Due to inadequate power in regression analyses, these analyses were neither able to rule out or confirm that children of alcoholics displayed stronger relationships between negative alcohol expectances and blunted processing of alcohol cues. However, given the observable differences in correlations with negative/sedating expectancies and early acoustic startle response, it was possible that children of alcoholics were more likely to physiologically display blunted arousal to salient cues, including alcohol, as their negative and sedating alcohol expectancies increased.  Future research targeting a larger sample size of COA+ and COA- individuals would be necessary to determine definitively the extent of the impact of COA status on the relationships between implicit and explicit alcohol expectancy measures.

# DISCUSSION

## Overview

As an overview, this study provided evidence that multiple biopsychosocial measurements of alcohol expectancies shared modest overlap. Specifically, two traditional cue reactivity measures, subjective ratings and acoustic startle response, displayed significant relationships with traditional alcohol expectancy subscales, indicating that they were likely measuring components of the same construct. The remaining psychophysiological measures, heart rate, skin conductance, and late startle response, were not related to explicit alcohol expectancy subscales, which may have reflected the inability of these psychophysiological measures to pick up on subtle variations in expectancy in this sample of college drinkers.

Further, this study determined that genetic status did have an impact on psychophysiological reactivity to alcohol cues and the relationships between upstream and downstream measures of expectancy. Specifically, adult children of alcoholics demonstrated blunted cardiac reactivity to salient picture cues of alcohol, and the relationships between psychophysiological measures of expectancy (acoustic startle response in particular) were most strongly related to alcohol expectancies in children of alcoholics. In fact, one conclusion might be that the cue reactivity paradigm was best suited for picking up on expectancy variation in high-risk college drinkers.

In examining the overall findings (both null and significant), it was important to note that the basic study paradigms were met, such that college-aged drinkers endorsing a range of drinking behavior, alcohol expectancies and family history density were recruited. Consistent with the extensive literature on alcohol expectancies, college drinkers in this study who endorsed greater positive, arousing, and social alcohol expectancies reported drinking more frequently and at greater quantities than their peers. Also consistent with the literature, drinkers with more negative and sedating alcohol expectancies reported drinking less frequently and at lower quantities than their peers. The data presented in this study replicated many expectancy studies of college drinkers (see Goldman et al., 1999).

**Examining Overlap**

Once the basic study paradigms were met, it was hypothesized that not only would alcohol cues correspond to variations in downstream drinking behavior but also to variations in upstream psychophysiological reactivity to alcohol cues. Among all of the measures included in the cue reactivity paradigm, only subjective ratings and early acoustic startle response shared significant relationships with alcohol expectancy subscales, while cardiac reactivity, skin conductance level, and late acoustic startle response were not related to alcohol expectancy subscales. Interestingly, the two measures that displayed overlap with alcohol expectancies represented cue reactivity measures presented earliest and latest in the cue reactivity paradigm, such that the early acoustic startle noise was presented roughly 300 milliseconds post-cue and ratings were presented more than 6 seconds post-cue. That is to say, the most explicit and least explicit cue reactivity measures were related to traditional alcohol expectancies.

One explanation why the intermediate psychophysiological reactivity measures were not related to paper-and-pencil measures of expectancy was the nature of the sample. Overall, participants were current drinkers, indicating that they all endorsed relatively appetitive feelings toward alcohol consumption. It was possible that the majority of the psychophysiological measures were not sensitive enough to pick up on subtle variations in positive expectancies. Another possible explanation may have been the nature of the alcohol pictures, which the overall sample did not appear to process as particularly more arousing than neutral cues. Given that psychophysiological measures have been shown to be most sensitive to changes in arousal, it was possible that the pictures of beer were not provocative enough for this sample of drinkers, who are likely inundated with images of beer on a regular basis. It was possible that these drinkers were de-sensitized to alcohol images, given the relative frequency of encountering alcohol pictures in their natural environment.

Among the cue reactivity measures that were correlated with alcohol expectancies, it made sense that explicit valence, arousal, and craving evaluations of beer pictures would be associated with alcohol expectancy subscales. Both of these measures reflected more down-stream processing of the appetitive/arousing nature of alcohol. College drinkers with more positive, arousing, and social alcohol expectancies rated alcohol pictures as more pleasing, arousing, and craving-inducing than their peers. Further, they were also more likely to rate neutral cues as more craving-inducing, most likely reflecting a generally lower threshold for craving among heavier drinkers. Ratings were also sensitive to differences in negative types of alcohol expectancies, such that college drinkers with more sick and dangerous alcohol reported fewer craving for alcohol during alcohol picture-viewing. Overall, subjective ratings of beer pictures and alcohol expectancies were strongly related and provided support for the first hypothesis that positive, arousing, and social expectancy measures and traditional appetitive cue reactivity would be related to each other.

The relationships observed between early acoustic startle response and negative expectancy subscales further provided evidence that measurements of upstream implicit, automatic processing of alcohol cues converged onto the same expectancy construct as downstream explicit measures of expectancy. It was hypothesized that positive, social, and alcohol expectancies would be positively correlated with appetitive acoustic startle response, while negative and sedating alcohol expectancies would correlate with less appetitive startle response. However, no relationships were found with positive alcohol expectancies, while negative alcohol expectancies were related to less startle attenuation. Specifically, college drinkers with greater negative and sedating expectancies exhibited early startle response patterns consistent with processing pictures of beer as less arousing and less attention grabbing than their peers. This style of startle responding to salient cues was similar to that seen among high-risk populations (see Miranda et al, 2002b) and indicated that these individuals did in fact display blunted reactivity to alcohol cues. With regard to the lack of relationship with positive alcohol expectancy subscales, it was possible that nuances in early acoustic startle response to alcohol pictures were more reflective of individual expectancies that mapped onto negative associations with alcohol.

It was interesting that the acoustic startle reflex was more sensitive to changes in negative alcohol expectancies instead of positive alcohol expectancies. Though the entire sample of college drinkers processed alcohol cues as appetitive (given attenuated late startle response compared to neutral cues), the degree of appetitiveness was not related to individual positive or arousing alcohol expectancies. One explanation might rest in the very nature of the acoustic startle response, an automatic reflex thought important for survival. Acoustic startle response may likely have been more sensitive to threatening cues, and not cues associated with social, pleasurable activities (such as drinking alcohol). Bradley and colleagues (2001) have also found that acoustic startle was much more consistently sensitive to cues inducing fear or aversive reactions (e.g. photos of death) and not as consistently related to positive or appetitive cues. As such, it was possible that psychophysiological measures were not necessarily the best measurement paradigm for detecting variations in appetitive and arousing processing of alcohol cues in this sample of college drinkers.

**Predicting Drinking Behavior**

The second hypothesis posited that multiple upstream and downstream measures of expectancy not only would be related to each other (which was observed to some extent), but that these measures would also converge in predicting drinking behavior and perhaps even uniquely explain variations in drinking above and beyond each other. It was not surprising that subjective ratings, which were downstream, explicit cue reactivity measures of valence, arousal, and craving for alcohol, were strongly related to drinking behavior in this sample of college drinkers. Subjective ratings and alcohol expectancies displayed communality in predicting drinking, and craving ratings in particular emerged as explaining a significant amount of variance in drinking.

It was also hypothesized that the implicit psychophysiological measures would predict drinking behavior above and beyond explicit expectancy subscales; but in fact, skin conductance, heart rate, and acoustic startle response to alcohol cues were not related to drinking behavior in this sample of college drinkers. An explanation might rest in the implicit nature of psychophysiological reactions, such that they were too far upstream from complex drinking behavior to adequately predict variations in drinking behavior. Another possible confound was the altered processing of salient environmental stimuli among high-risk individuals (Drobes, Carter, Goldman, 2009), and the inclusion of both family history positive and family history negative individuals in the sample may have altered overall predictive ability of upstream measures of expectancy. Psychophysiological reactivity has been consistently shown to be sensitive to level of genetic risk for alcohol use disorders (e.g. Miranda et al, 2002b), and it was possible that these measures were much more sensitive to subtle variations in risk rather than overt drinking behavior.

**Impact of Genetic Risk**

The final purpose of this study was to examine the manner in which risk impacted the relationship between upstream psychophysiological reactivity to alcohol pictures and downstream, explicit alcohol expectancies. The continuous measure of family history density was strongly related to downstream risk factors, including sensation seeking, negative consequences due to drinking, and overt drinking behavior, as expected and consistent with the literature. Among upstream, implicit measures of expectancy, heart rate response emerged as the only psychophysiological measure most significantly related to family history density in the hypothesized direction. Specifically, as genetic risk increased, cardiac response during alcohol cues became increasingly blunted (or less appetitive). Overall, the continuous measure of genetic risk was most sensitive to overt drinking behaviors and alcohol-related risk behaviors and one psychophysiological cue reactivity measure (cardiac deceleration) in the hypothesized direction.

The continuous measure of family history density was not, however, as strongly related to explicit expectancy measures, subjective ratings, skin conductance, or acoustic startle response. As such, the family density measure did not emerge as a significant predictor of most explicit and implicit expectancies in this sample of drinkers. The exclusion of certain drinker types (abstainers and alcohol dependent individuals) or non-college peers may have restricted the range and variability of genetic risk in this sample, making it more difficult to observe relationships between the continuous measure of genetic risk and continuous upstream/downstream expectancy measures.

However, when analyzing the impact of risk as a "threshold phenomenon," genetic risk did impact relationships between upstream and downstream expectancy measures. Children of alcoholics (COAs) were thought to display blunted psychophysiological reactivity to salient cues; as a result, it was expected that relationships between cue reactivity measures and explicit expectancy measures would change. In fact, in this sample, COAs did not display robust blunted cue reactivity (with the exception of initial cardiac deceleration) or differences in expectancy levels compared to COA- individuals, but the relationships between upstream and downstream expectancy measures were affected by genetic risk. Specifically, children of alcoholics displayed much stronger relationships between acoustic startle reflex and both positive and negative alcohol expectancy subscales. Further, these relationships all but disappeared among COA- individuals. Conceptually, COA status moderated the strength in the relationships between upstream and downstream expectancy measures in a sample of college drinkers.

These findings indicated that subtle physiological arousal and appetitive/aversive processing of alcohol cues were strongly related to positive expectations for drinking behavior among children of alcoholics. In other words, split-second processing of salient cues were much more contributory to the development of expectations for drinking alcohol among children of alcoholics. The positive relationships were stronger and likely contributed to their increased levels of drinking compared to their peers, such that automatic affective processing was more likely to reinforce positive and alcohol expectancies, which likely led to heavier drinking. Given the fact that the COA+ drinkers in this sample consumed alcohol at a greater frequency and quantity than COA- peers, it was likely that the appetitive upstream and downstream processing of alcohol cues contributed to their heavier drinking behavior.

Further, the blunted reactivity to alcohol cues were much more likely to be associated with negative and sedating alcohol expectancies, which likely resulted from a COA's increased need for stimulation in their environment predicting more problematic associations with drinking behavior. The COAs endorsed greater levels of sensation seeking than their peers, which indicated that they sought out riskier and more arousing behaviors than their peers, and they endorsed more negative consequences of their drinking (as measured by the RAPI). In other words, COAs appeared to seek more stimulation from their environment, likely due to their blunted experience with salient cues. This risky, sensation-seeking behavior likely caused COAs to be at greater risk for consuming alcohol at larger quantities, which likely contributed to the development of more negative alcohol expectancies. Hence, the relationship between blunted upstream processing of alcohol cues were strongly related to negative alcohol expectancies in this sample of children of alcoholics.

If the COA sample had been large enough, it would have been interesting to examine the predictive properties of implicit cue reactivity on drinking behavior and possible mediation by explicit expectancies on the relationship between cue reactivity to alcohol and subsequent drinking behavior. Given this power problem, however, it was especially interesting that this study was able to identify significant moderation effects of COA status on the relationship between positive expectancy subscales and cue reactivity and trends for negative expectancy subscales in such a small sample of COA+ individuals. These moderation analyses were taken with caution, given inadequate power, but this study was successful in identifying COA status as a likely threshold for changing the relationships between upstream and downstream expectancy measures.

**Limitations and Future Directions**

There were several limitations in this study, including the nature of the sample. Though efforts were made to ensure a wide range of genetic risk for alcohol use disorders, the exclusion of heavier drinkers might have eliminated those at even higher risk and displaying even more problematic drinking associations. Further, only 47 individuals were identified as children of alcoholics, limiting power to detect moderation of COA status on the relationships between explicit and implicit expectancy measures. The fact that all of the participants included were college students also limits the generalizability of these findings to the population of young adult drinkers. A recent review highlighted factors that differed between college students and their non-college peers that influenced drinking behavior (Carter, Brandon & Goldman, in press), and it was likely that including only college students at a large, commuter college like the University of South Florida limited generalizability for all young adult drinkers. The participants in this study were likely higher functioning than most high-risk drinkers. Another limitation was the exclusion of abstinent drinkers, some of whom may also have been children of alcoholics who chose to abstain given their family history. Finally, the differences in ethnicity between COA groups must not be ignored, and this study was not able to tease apart ethnic/racial contributions to the differences attributed to COA status.

Despite limitations, this study was successful in determining that several different types of expectancy measures did, in fact, overlap, indicating that upstream and downstream measures of appetitive and aversive associations with alcohol use were likely tapping into the same expectancy construct. These findings provided evidence that alcohol expectancies were both cognitive and affective in nature and existed at an implicit (or split-second) and explicit (more thoughtful) level of consciousness. Further, this study was able to confirm that genetic vulnerability for alcoholism affected the manner in which these measures were related and identified the threshold of risk as the level of having one or more biological parents with an alcohol use disorder.

Future directions in this research might include examining the convergence and divergence of upstream and downstream measures of expectancy to other populations of various age range and experience with alcohol. Given the relationships observed among this small and limited sample of children of alcoholics, these analyses should be repeated in a larger sample with adequate power. Only then could this line of research determine how multiple measures of expectancy diverge or converge to predict drinking behavior and other risky outcomes, including the ultimate diagnosis of an alcohol use disorder.

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# APPENDICES

## Appendix A: Participant Demographics

1. Age _____                         Date of Birth __ __ / __ __ / __ __ __ __

2. What is your gender?     Female          Male

3. What is your ethnicity?

   __Hispanic or Latino (Spanish origin)
   __Not Hispanic or Latino

4. What is your race?

   __American Indian or Alaska Native
   __Asian
   __Black or African American
   __Native Hawaiian/ other Pacific Islander
   __White

5. Habits:

| | | | | |
|---|---|---|---|---|
| Do you drink coffee? | Yes | No | How often?_______ | Amount_________ |
| Do you smoke cigarettes? | Yes | No | How often?_______ | Amount_________ |
| Do you smoke cigars? | Yes | No | How often?_______ | |
| Do you use snuff? | Yes | No | How often?_______ | |
| Do you smoke a pipe? | Yes | No | How often?_______ | |

6. When was the last time you consumed alcohol? ______________________________
   What type/amount? ______________________________________________________

12. Do you have any problems with your hearing? If so, please describe:
_____________________________________________________________________________
_____________________________________________________________________________

13. Do you have any problems with your vision? If so, please describe:
_____________________________________________________________________________
_____________________________________________________________________________

## Appendix B: Alcohol Expectancy Questionnaire

This is a questionnaire about the effects of alcohol. Read each statement carefully and respond according to your own personal feelings, thoughts, and beliefs about alcohol **now**. We are interested in what **you** think about alcohol, regardless of what other people might think.

If you think that the statement is true, or mostly true, or true some of the time, then circle the number 1, for "AGREE." If you think the statement is false, or mostly false, then circle the number 0, for "DISAGREE." When the statements refer to drinking alcohol, you may think in terms of drinking any alcoholic beverage, such as beer, wine, whiskey, liquor, rum, scotch, vodka, gin, or various alcoholic mixed drinks. Whether or not you have had actual drinking experiences yourself, **you are to answer in terms of your beliefs about alcohol**. It is important that you respond to **every question**.

**PLEASE BE HONEST. REMEMBER, YOUR ANSWERS ARE CONFIDENTIAL.**

**RESPOND TO THESE ITEMS ACCORDING TO WHAT YOU PERSONALLY BELIEVE TO BE TRUE ABOUT ALCOHOL**

**0=DISAGREE 1=AGREE**

| | | |
|---|---|---|
| **0** | **1** | 1. Some alcohol has a pleasant, cleansing, tingly taste. |
| **0** | **1** | 2. Drinking adds a certain warmth to social occasions. |
| **0** | **1** | 3. When I'm drinking, it is easier to open up and express my feelings. |
| **0** | **1** | 4. Time passes quickly when I'm drinking. |
| **0** | **1** | 5. Drinking makes me feel flushed. |
| **0** | **1** | 6. I feel powerful when I drink, as if I can really influence others to do what I want. |
| **0** | **1** | 7. Drinking gives me more confidence in myself. |
| **0** | **1** | 8. Drinking makes me feel good. |
| **0** | **1** | 9. I feel more creative after I've been drinking. |
| **0** | **1** | 10. Having a few drinks is a nice way to celebrate special occasions. |
| **0** | **1** | 11. When I'm drinking I feel freer to be myself and do whatever I want. |
| **0** | **1** | 12. Drinking makes it easier to concentrate on the good feelings I have at the time. |
| **0** | **1** | 13. Alcohol allows me to be more assertive. |
| **0** | **1** | 14. When I feel "high" from drinking, everything seems to feel better. |
| **0** | **1** | 15. I find that conversing with members of the opposite sex is easier for me after I've had a few drinks. |
| **0** | **1** | 16. Drinking is pleasurable because it's enjoyable to join in with people who are enjoying themselves. |
| **0** | **1** | 17. I like the taste of some alcoholic beverages. |
| **0** | **1** | 18. If I'm feeling restricted in any way, a few drinks make me feel better. |
| **0** | **1** | 19. Men are friendlier when they drink. |

*Please continue on to next page*

## *Alcohol Expectancy Questionnaire (Page 2)*

**0=DISAGREE** **1=AGREE**

| | | |
|---|---|---|
| **0** | **1** | 20. After a few drinks, it is easier to pick a fight. |
| **0** | **1** | 21. If I have a couple of drinks, it is easier to express my feelings. |
| **0** | **1** | 22. Alcohol makes me need less attention from others than I usually do. |
| **0** | **1** | 23. After a few drinks, I feel more self-reliant than usual. |
| **0** | **1** | 24. After a few drinks, I don't worry as much about what other people think of me. |
| **0** | **1** | 25. When drinking, I do not consider myself totally accountable or responsible for my behavior. |
| **0** | **1** | 26. Alcohol enables me to have a better time at parties. |
| **0** | **1** | 27. Drinking makes the future seem brighter. |
| **0** | **1** | 28. I often feel sexier after I've had a couple of drinks. |
| **0** | **1** | 29. I drink when I'm feeling mad. |
| **0** | **1** | 30. Drinking alone or with one other person makes me feel calm and serene. |
| **0** | **1** | 31. After a few drinks, I feel brave and more capable of fighting. |
| **0** | **1** | 32. Drinking can make me more satisfied with myself. |
| **0** | **1** | 33. My feelings of isolation and alienation decrease when I drink. |
| **0** | **1** | 34. Alcohol helps me sleep better. |
| **0** | **1** | 35. I'm a better lover after a few drinks. |
| **0** | **1** | 36. Alcohol decreases muscular tension. |
| **0** | **1** | 37. Alcohol makes me worry less. |
| **0** | **1** | 38. A few drinks makes it easier to talk to people. |
| **0** | **1** | 39. After a few drinks I am usually in a better mood. |
| **0** | **1** | 40. Alcohol seems like magic. |
| **0** | **1** | 41. Women can have orgasms more easily if they've been drinking. |
| **0** | **1** | 42. Drinking helps get me out of a depressed mood. |
| **0** | **1** | 43. After I've had a couple of drinks, I feel I'm more of a caring, sharing person. |
| **0** | **1** | 44. Alcohol decreases my feelings of guilt about not working. |
| **0** | **1** | 45. I feel more coordinated after I drink. |
| **0** | **1** | 46. Alcohol makes me more interesting. |
| **0** | **1** | 47. A few drinks makes me feel less shy. |
| **0** | **1** | 48. Alcohol enables me to fall asleep more easily. |
| **0** | **1** | 49. If I'm feeling afraid, alcohol decreases my fears. |
| **0** | **1** | 50. Alcohol can act as an anesthetic, that is, it can deaden pain. |
| **0** | **1** | 51. I enjoy having sex more if I've had some alcohol. |
| **0** | **1** | 52. I am more romantic when I drink. |
| **0** | **1** | 53. I feel more masculine/feminine after a few drinks. |

*Please continue on to next page*

## *Alcohol Expectancy Questionnaire (Page 3)*

**0=DISAGREE** **1=AGREE**

| | | |
|---|---|---|
| **0** | **1** | 54. Alcohol makes me feel better physically. |
| **0** | **1** | 55. Sometimes when I drink alone or with one other person it is easy to feel cozy and romantic. |
| **0** | **1** | 56. I feel like more of a happy-go-lucky person when I drink. |
| **0** | **1** | 57. Drinking makes get-togethers more fun. |
| **0** | **1** | 58. Alcohol makes it easier to forget bad feelings. |
| **0** | **1** | 59. After a few drinks, I am more sexually responsive. |
| **0** | **1** | 60. If I'm cold, having a few drinks will give me a sense of warmth. |
| **0** | **1** | 61. It is easier to act on my feelings after I've had a few drinks. |
| **0** | **1** | 62. I can discuss or argue a point more forcefully after I've had a drink or two. |
| **0** | **1** | 63. A drink or two makes the humorous side of me come out. |
| **0** | **1** | 64. Alcohol makes me more outspoken or opinionated. |
| **0** | **1** | 65. Drinking increases female aggressiveness. |
| **0** | **1** | 66. A couple of drinks make me more aroused or physiologically excited. |
| **0** | **1** | 67. At times, drinking is like permission to forget problems. |
| **0** | **1** | 68. If I am tense or anxious, having a few drinks makes me feel better. |

## Appendix C: *Alcohol Expectancy Multi-Axial Assessment (AEMax)*

This page contains words describing possible effects of alcohol. For each word, imagine it completing the sentence: "**DRINKING ALCOHOL MAKES ONE ______**." Then, for each word **mark the number that indicates how often you think that this effect happens or would happen after drinking several drinks of alcohol**. "Drinking alcohol" refers to drinking any alcoholic beverage such as beer, wine, wine coolers, whiskey, scotch, vodka, gin, or mixed drinks.

There are no right or wrong answers. Answer each item quickly according to your first impression and according to your own personal beliefs about the effects of alcohol. The available responses/numbers and their meaning are indicated below:

| 0<br>Never | 1<br>Very Rarely | 2<br>Rarely | 3<br>Occasionally | 4<br>Frequently | 5<br>Very Frequently | 6<br>Always |
|---|---|---|---|---|---|---|

**"DRINKING ALCOHOL MAKES ONE ______________."**

| | | | |
|---|---|---|---|
| 1. Dizzy | ________ | 13. Attractive | ________ |
| 2. Arrogant | ________ | 14. Ill | ________ |
| 3. Horny | ________ | 15. Sleepy | ________ |
| 4. Light-headed | ________ | 16. Lustful | ________ |
| 5. Erotic | ________ | 17. Social | ________ |
| 6. Appealing | ________ | 18. Cocky | ________ |
| 7. Deadly | ________ | 19. Sick | ________ |
| 8. Beautiful | ________ | 20. Dangerous | ________ |
| 9. Sociable | ________ | 21. Outgoing | ________ |
| 10. Egotistical | ________ | 22. Hazardous | ________ |
| 11. Tired | ________ | 23. Drowsy | ________ |
| 12. Woozy | ________ | 24. Nauseous | ________ |

# Appendix D: *ZKPQ*

DIRECTIONS: You will find a series of statements that persons might use to describe themselves. Read each statement and decide whether or not it describes you. Then indicate your answer by circling the appropriate number.

If you agree with a statement or decide that it describes you, answer TRUE by circling the (1). If you disagree with a statement, or feel that it is not descriptive of you, answer FALSE by circling the (0).

**0 = FALSE** **1 = TRUE**

***Answer every statement*** either False (0) or True (1), even if you are not entirely sure of your answer.

| | FALSE | TRUE |
|---|---|---|
| 1. I tend to begin a new job without much advance planning on how I will do it. | 0 | 1 |
| 2. I usually think about what I am going to do before doing it. | 0 | 1 |
| 3. I often do things on impulse. | 0 | 1 |
| 4. I very seldom spend much time on the details of planning ahead. | 0 | 1 |
| 5. I like to have new and exciting experiences and sensations even if they are a little frightening | 0 | 1 |
| 6. Before I begin a complicated job, I make careful plans. | 0 | 1 |
| 7. I would like to take off on a trip with no preplanned or defined routes or timetables. | 0 | 1 |
| 8. I enjoy getting into new situations where you can't predict how things will turn out. | 0 | 1 |
| 9. I like doing things just for the thrill of it. | 0 | 1 |
| 10. I tend to change interests frequently. | 0 | 1 |
| 11. I sometimes like to do things that are a little frightening. | 0 | 1 |
| 12. I'll try anything once. | 0 | 1 |
| 13. I would like the kind of life where one is on the move and traveling a lot, with lots of change and excitement. | 0 | 1 |
| 14. I sometimes do "crazy" things just for fun. | 0 | 1 |
| 15. I like to explore a strange city or section of town by myself, even if it means getting lost. | 0 | 1 |
| 16. I prefer friends who are excitingly unpredictable. | 0 | 1 |
| 17. I often get so carried away by new and exciting things and ideas that I never think of the possible complications. | 0 | 1 |
| 18. I am an impulsive person. | 0 | 1 |
| 19. I like "wild" uninhibited parties. | 0 | 1 |

## Appendix E: RUTGERS ALCOHOL PROBLEM INDEX
## RAPI (23-item version)

Different things happen to people while they are drinking ALCOHOL or because of their ALCOHOL drinking. Several of these things are listed below. Indicate how many times each of these things happened to you WITHIN THE LAST YEAR.

Use the following code:

0 = None
1 = 1-2 times
2 = 3-5 times
3 = More than 5 times

HOW MANY TIMES HAS THIS HAPPENED TO YOU WHILE YOU WERE DRINKING OR BECAUSE OF YOUR DRINKING DURING THE LAST YEAR?

0 1 2 3 Not able to do your homework or study for a test
0 1 2 3 Got into fights with other people (friends, relatives, strangers)
0 1 2 3 Missed out on other things because you spent too much money on alcohol

0 1 2 3 Went to work or school high or drunk
0 1 2 3 Caused shame or embarrassment to someone
0 1 2 3 Neglected your responsibilities

0 1 2 3 Relatives avoided you
0 1 2 3 Felt that you needed more alcohol than you used to in order to get the same effect
0 1 2 3 Tried to control your drinking (tried to drink only at certain times of the day or in certain places, that is, tried to change your pattern of drinking)

0 1 2 3 Had withdrawal symptoms or felt sick because you stopped or cut down on drinking
0 1 2 3 Noticed a change in your personality
0 1 2 3 Felt that you had a problem with alcohol

0 1 2 3 Missed a day (or part of a day) of school or work
0 1 2 3 Wanted to stop drinking but couldn't
0 1 2 3 Suddenly found yourself in a place that you could not remember getting to

0 1 2 3 Passed out or fainted suddenly
0 1 2 3 Had a fight, argument or bad feeling with a friend
0 1 2 3 Had a fight, argument or bad feeling with a family member

0 1 2 3 Kept drinking when you promised yourself not to
0 1 2 3 Felt you were going crazy
0 1 2 3 Had a bad time

0 1 2 3 Felt physically or psychologically dependent on alcohol
0 1 2 3 Was told by a friend, neighbor or relative to stop or cut down drinking

## Appendix F: Family Grid

**This instrument is to be administered as a personal interview**

This questionnaire concerns your family and experiences that family members have had with alcohol. Please begin by describing your family by indicating in ***Column A*** the total number of biological (i.e., related by blood) relatives (both living and dead) that you have in each category on each side of your family. For example, although you have only one biological grandmother on your mother's side (as shown in Column A), you may have several aunts (your mother's biological sisters) or none at all. If you have no relatives in a particular category, put the letter "N" (for "None") in Column A in the space next to the category. If you don't know how many relatives you have in a category, put "DK" (for "Don't Know") in the space.

Next, please indicate in ***Column B*** the number of biological relatives (both living and dead) in each category that had in the past, or currently have, what you would call a significant drinking problem, one that did, or should have, led to treatment. Some signs that drinking may be a problem include legal problems (e.g., drunk driving violations), health problems (e.g., cirrhosis of the liver, alcohol withdrawal symptoms), relationship problems (e.g., arguments about alcohol with family members), or work/school problems (e.g., poor performance, absenteeism resulting from alcohol use), or actual treatment (e.g., detox or rehab, AA meeting attendance). If you have no relatives with alcohol problems in a particular category, put the letter "N" (for "None") in Column A in the space next to the category. If you don't know how many relatives you have in a category, put "DK" (for "Don't Know") in the space.

| **Biological Relative** | **A** | **B** |
|---|---|---|
| **Mother's Side** | **Number of biological relatives** | **Number of relatives with alcohol problems** |
| Grandmother | 1 | |
| Grandfather | 1 | |
| Mother | 1 | |
| Aunt(s) | | |
| Uncle(s) | | |
| **Father's Side** | | |
| Grandmother | 1 | |
| Grandfather | 1 | |
| Father | 1 | |
| Aunt(s) | | |
| Uncle(s) | | |
| **Siblings** | | |
| Brother(s) | | |
| Sister(s) | | |

## ABOUT THE AUTHOR

Ashlee C. Carter was born in Wilmington, DE, and she earned her B.S. in Psychology with a concentration in Neuroscience from Duke University in 2002. She will earn her Ph.D. in Clinical Psychology in 2010 at the University of South Florida under the mentorship of Mark S. Goldman, Ph.D. Ms. Carter completed her clinical psychology internship training at the Alpert Brown Medical School in 2010. She is continuing her training as a postdoctoral fellow at the Center for Alcohol Addiction Studies at Brown University and the Providence Veteran's Affairs Medical Center from 2010-2012. Ms. Carter is an author on several peer-reviewed articles in the topic areas of college drinking, alcohol expectancies, and psychophysiological cue reactivity.