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INDIVIDUAL DIFFERENCES IN
SUBJECTIVE RESPONSE TO ALCOHOL:
ASSOCIATED FACTORS AND
ALTERNATIVE ASSESSMENT STRATEGIES

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INDIVIDUAL DIFFERENCES IN SUBJECTIVE RESPONSE TO ALCOHOL: ASSOCIATED FACTORS AND ALTERNATIVE ASSESSMENT STRATEGIES

by

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INDIVIDUAL DIFFERENCES IN

SUBJECTIVE RESPONSE TO ALCOHOL:

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Individual differences in subjective response to alcohol have been implicated as a risk factor for the development of alcohol use disorders. There are, however, a variety of ethical, legal, and practical considerations surrounding alcohol administration studies which limit the extent to which this marker can be used to identify those believed to be at greater risk. The current research contains two related laboratory studies with the overall goal of identifying valid and reliable correlates of individual differences in subjective response to alcohol that can be used to discern emerging adults at greater risk for problematic drinking. Study 1 evaluated the associations between the actual subjective experience of a moderate dose of alcohol (BAC .08%) and three domains of potential correlates: anticipated subjective response based on a hypothetical drinking scenario (targeted .08% BAC); response to other physiological and perceptual challenges

(e.g., CO_2 challenge, spinning challenge); and indices of cognitive impairment implicated as risk factors for the development of alcohol use disorders. Study 2 examined each of these domains in relation to transitions in heavy drinking from high school to college to determine whether they were associated with changes in relative risk during this developmental period. Overall, the results provide support for the utility of examining individual differences in subjective response to alcohol based on a hypothetical drinking scenario. The evidence suggests that experienced drinkers are capable of reliably and accurately estimating their subjective response to alcohol, that these anticipated effects are distinct from general beliefs about the effects of alcohol on behavior (i.e., alcohol expectancies), and that they are associated with patterns of drinking in emerging adults. There was little evidence to suggest that individual differences in subjective response to alcohol were associated with subjective response to other physiological or perceptual challenges, or patterns of cognitive impairment previously shown to be related to an increased risk for alcohol dependence. The results of the current study support the utility of using measures of anticipated subjective response as a proxy for individual differences in subjective response to alcohol when the administration of alcohol is either not appropriate or feasible.

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CHAPTER 1: INTRODUCTION

It is well known that alcohol use is not typically initiated at the age of 21, the legal age for drinking in the United States. Rather, experimentation with alcohol begins on average at the age of 13 years, with over 40% of adolescents in the United States reporting that they have consumed alcohol, and nearly 1 in 5 admitting that they have been drunk at least once by the 8th grade (Johnston, O'Malley, Bachman, & Schulenberg, 2008). These rates increase throughout adolescence such that by the time students reach their senior year of high school, approximately 75% report having consumed alcohol and 55% admit to becoming intoxicated at least once in their lifetime; with nearly 45% acknowledging drinking and 30% getting drunk at least one time during the previous 30 days (Johnston et al., 2008).

Although most emerging adults arrive on college campuses with some drinking experience, the transition to college represents an important developmental period that is frequently associated with increased opportunities to engage in a variety of risky behaviors including heavy drinking. The typical college environment appears to facilitate increased drinking by providing students with a reprieve from adult responsibilities (e.g., full-time employment) in an atmosphere associated with increased acceptance of underage drinking, increased access to alcohol, and decreased supervision of behavior (Fromme & Kruse, 2003). Perhaps not surprisingly, in spite of the fact that college-bound high

school seniors (approximately 60% of young adults) report fewer heavy drinking episodes relative to their non-college bound peers (Johnston, O'Malley, Bachman, & Schulenberg, 2007a), upon matriculation to college this discrepancy reverses such that the prevalence of heavy drinking is higher (40%) in full-time college students than it is in 18 to 22 year-old non-students (35%; Johnston, O'Malley, Bachman, & Schulenberg, 2007b). Consistent with this discrepancy in heavy drinking, college students are also more likely to experience clinically significant alcohol-related problems and meet criteria for alcohol abuse than similar-aged emerging adults who are not in college (Slutske, 2005). Evaluated within a clinical context, it is estimated that 31.6% of college students meet diagnostic criteria for current alcohol abuse and 6.3% for current alcohol dependence [Diagnostic and Statistical Manual of Mental Disorders - Fourth Edition (American Psychiatric Association, DSM-IV); Knight, Wechsler, Kuo, Seibring, Weitzman, & Schuckit, 2002]; prevalence rates far exceeding those of the general population (4.7% & 3.8%, respectively; Grant, Dawson, Stinson, Chou, Dufour, & Pickering, 2004).

Heavy drinking in college is frequently dismissed as a normative rite of passage (e.g., Maggs, 1997); yet, it has become increasingly clear that adolescents and emerging adults may be particularly vulnerable to the negative consequences associated with heavy alcohol use. Evidence from both human and animal studies demonstrate that the repeated exposure of alcohol to the rapidly developing adolescent brain (particularly the prefrontal cortex and other forebrain dopamine

projection regions) results in neurocognitive deficits that may place adolescents at an increased risk for later problematic alcohol use (for reviews see Spear, 2002; Spear, 2000). Emerging adults also appear to be at an increased risk for suffering a number of adverse behavioral problems associated with acute alcohol consumption, many with potentially lifelong negative consequences, including risky sexual behavior (e.g., Cooper, 2002), sexual assault and victimization (e.g., Young, Grey, Abbey, Boyd, & McCabe, 2008; Parks, Romosz, Bradizza, & Hsieh, 2008; Hingson, Heeren, Zakocs, Kopstein, & Wechsler, 2002; Abbey, 1991), driving while under the influence of alcohol (e.g., Hingson et al., 2002), and academic failure (e.g., Wechsler, Lee, Nelson, & Kuo, 2002). Ultimately, underage alcohol consumption is a major factor in the four leading causes of adolescent and young adult death: motor vehicle crashes, unintentional accidents (e.g., drowning, alcohol poisoning), homicide, and suicide (Hingson et al., 2002). In spite of increased public awareness and enhanced efforts to reduce the problem of heavy drinking on college campuses, the rate of alcohol-related deaths in college students has continued to outpace the overall growth in this population by a margin of 6% (Hingson, Heeren, Winter, & Wechsler, 2005).

Despite the prevalence and severity of negative consequences associated with heavy drinking, many emerging adults view their own heavy drinking behavior as goal-directed, developmentally-normative, and time-delimited behavior that facilitates the establishment and strengthening of social relationships (e.g., Maggs, 1997). As the emphasis on social goal achievement

diminishes, evidence suggests that most emerging adults will naturally transition out of heavy drinking in response to life changes (e.g., solidifying an academic major, full-time employment, marriage; e.g., Bachman, O'Malley, Schulenberg, Johnston, Bryant, & Merline, 2002; Muthen & Muthen, 2000; Wood, Sher, & McGowan, 2000) in a process frequently referred to as "maturing out" (for review see Jochman & Fromme, in press). Unfortunately, there is also evidence that up to 40% of heavy drinking college students will maintain or even escalate their drinking patterns, and subsequent risk for alcohol-related problems, into young adulthood (Jackson, Sher, Gotham, & Wood, 2001).

The critical mandate for alcohol researchers has therefore become the identification of factors that reliably differentiate young heavy drinkers who are at a greater risk for experiencing alcohol-related problems and persisting in heavy drinking patterns from those who will naturally "mature out" in response to life changes (e.g., Jackson et al., 2001). Several lines of research have examined the short and long-term effects of a number of factors on the patterns and consequences of heavy drinking in college and beyond, with varying levels of success. Some of the more prolific areas of study have explored the effects of membership in high-risk groups, alcohol outcome expectancies, and family history of alcoholism.

Members of college fraternities and sororities have long been known to drink significantly more alcohol (e.g., Cashin, Presley, & Meilman, 1998), experience more alcohol-related problems (e.g., Engs, Diebold, & Hanson, 1996),

and demonstrate more symptoms of alcohol dependence (e.g., Baer, Kivlahan, & Marlatt, 1995) compared to students not involved in the Greek community, leading to speculation that membership in a fraternity or sorority subsequently increases risk for the persistence in heavy drinking patterns. Recent studies have demonstrated, however, that the elevated rates of drinking associated with the Greek community are often a result of a combination of selection and socialization processes, in which pre-existing tendencies towards heavy drinking in those who choose to join fraternities and sororities are exacerbated in a reciprocal manner by the influence of the Greek environment (e.g., Park, Sher, & Krull, 2008; Capone, Wood, Borsari, & Laird, 2007). Further, in spite of the often dramatic levels of heavy drinking observed in fraternity and sorority members, there is virtually no evidence of any long-term effects of Greek membership on post-collegiate heavy drinking levels (e.g., Bartholow, Sher, & Krull, 2003; Sher, Bartholow, & Nanda, 2001).

The influence of alcohol outcome expectancies, or beliefs about the effects of alcohol, cognition, and behavior, on the drinking patterns of emerging adults has also been evaluated extensively (for reviews, see Patel & Fromme, in press; Jones, Corbin, & Fromme, 2001). Alcohol expectancies are thought to develop during childhood, become more positive and potent during adolescence (Schell, Martino, Ellickson, Collins, & McCaffrey, 2005), and are believed to be shaped by both social factors (e.g., through observation of the effects of alcohol on the behavior of others; influence of mass media) as well as an individual's personal

drinking experiences. Over the last 25 years, several lines of research have produced a reliable pattern of results consistently documenting a direct correlation between self-reported drinking and greater expectations for the positive effects of alcohol (e.g., increased sociability) and an inverse association with stronger beliefs that alcohol leads to negative outcomes (e.g., cognitive behavioral impairment; e.g., Fromme, Stroot, & Kaplan, 1993; Brown, Christiansen, & Goldman, 1987). Expectancies have also been shown to differentiate between alcoholic and non-problem drinking samples (e.g., Connors, O'Farrell, Cutter, & Thompson, 1986). There is also some evidence, however, that the overall influence of alcohol expectancies as a predictor of drinking behavior changes with age. Specifically, positive alcohol expectancies are generally a more robust predictor of drinking patterns in adolescents and young adults under the age of 35, whereas negative expectancies are more strongly associated with the drinking behavior (in particular, abstention) of older adults (Leigh & Stacy, 2004). Further, whereas alcohol expectancies have been demonstrated to prospectively predict patterns of drinking in adolescent (e.g., Smith, Goldman, Greenbaum, & Christiansen, 1995) and college samples (e.g., Sher, Wood, Wood, & Raskin, 1996); these effects are generally modest in size and there is no evidence that alcohol expectancies during adolescence contribute significantly to the prediction of long-term patterns of drinking into adulthood.

Most studies evaluating the influence of family history of alcoholism have consistently found that children of alcoholics are significantly more likely to

experience alcohol-related problems in college (e.g., Capone & Wood, 2008) and are approximately four times more likely to develop alcohol use disorders themselves (e.g., Chassin, Pitts, & Prost, 2002; Schuckit, 2000; Dawson, Harford, & Grant, 1992; West & Prinz, 1987; Cotton, 1979). Evidence from twin studies have historically documented that monozygotic (identical) twins have higher concordance rates for alcohol dependence than fraternal twins suggesting a strong genetic component in the risk for alcoholism (e.g., Pickens, Svikis, McGue, Lykken, Heston, & Clayton, 1991). Whereas there has traditionally been debate regarding the relative contributions of genetic and environmental factors in determining the specific causal mechanisms underlying the influence of family history (e.g., Reich, 1997), one phenotype has emerged as a robust predictor of the persistence in heavy drinking patterns: individual differences in subjective response to alcohol.

Individual Differences in Subjective Response to Alcohol

In general, the acute neurological effects caused by alcohol consumption typically result in the subjective experience of cognitive and behavioral arousal or stimulation during the initial stages of a drinking episode (i.e., ascending limb), followed by the subjective experience of sedation during later stages of intoxication (i.e., descending limb; e.g., Addicot, Marsh-Richard, Mathias, & Dougherty, 2007; Holdstock & de Wit, 1998; Martin, Earleywine, Musty, Perrine, & Swift, 1993). There are, however, significant between-individual differences in

the subjective experience of alcohol's pharmacological effects, and variability in subjective response has been consistently identified as a risk factor for the development of alcohol use disorders (for review see Munct, Perrine, & Searles, 1997; also Schuckit & Smith, 2000; Heath et al., 1999).

During the past two decades, increased emphasis has been placed on the identification of factors that are reliably associated with the significant between-individual variability in subjective response to alcohol (Li, 2003). Several studies have provided evidence that individual differences in subjective response to alcohol are strongly influenced by genetic factors, with heritability estimates ranging from 0.45 to 0.60 (e.g., Viken, Rose, Morzorati, Christian, & Li, 2003; Slutske, Heath, Madden, Bucholz, Statham, & Martin, 2002; Heath et al., 1999). In fact, early research suggested that young adult men with a family history of alcoholism were nearly four times more likely to experience low levels of subjective response to a moderate dose of alcohol relative to matched controls (Schuckit, 1980, 1984). Further, a low level of subjective response to alcohol is prospectively associated with a fourfold greater likelihood of developing alcoholism 10 years later, even after controlling for the influence of family history (Schuckit, 1994).

Later studies extended this research to an evaluation of differences in subjective response between heavy and light drinking young adults across the ascending and descending limbs of absorption (King, Houle, de Wit, Holdstock, & Schuster, 2002). Consistent with earlier findings, heavy drinkers were found to

be less sensitive to the sedative effects of alcohol (e.g., feeling "sluggish") on both the ascending and descending limbs of absorption; further, heavy drinkers also reported experiencing more of the stimulant effects (e.g., feeling "energized") on the ascending limb relative to their light drinking peers (King et al., 2002). Results from both of these lines of research generally support reinforcement models of alcohol abuse and dependence. Specifically, these findings suggest that individuals with a low subjective response need to drink to higher blood alcohol levels in order to experience alcohol's psychoactive effects; and yet even at these higher concentrations, they may be more likely to experience only the positive (and reinforcing) effects of alcohol. As a consequence, greater levels of intoxication are positively reinforced thereby increasing the likelihood of continued heavy drinking. Continued heavy drinking subsequently leads to the development of further tolerance and, over time, may result in an increased risk for the development of physiological dependence to alcohol due to repeated exposure of the brain to higher concentrations of ethanol (e.g., Schuckit, 1994).

Taken together, evidence from alcohol administration studies suggest that evaluation of individual differences in self-reported subjective response to alcohol is an effective way to identify those who are at a greater risk for experiencing alcohol-related problems and persisting in heavy drinking patterns. Unfortunately, there are a variety of ethical, legal, and practical considerations which often preclude at-risk individuals (particularly those under the legal

drinking age) from participating in alcohol administration studies. As a result, there are currently significant limitations in the extent to which this marker can be effectively utilized to identify those believed to be at greater risk. The reliance on self-report measures of subjective response as a primary outcome variable, however, suggests that it may be possible to extend this line of research to experienced drinkers (including those under the legal drinking age) for whom alcohol challenge protocols are either inappropriate or infeasible. Through the use of retrospective self-report, experienced drinkers may be able to rely on their previous subjective experiences of alcohol's effects to provide valid and reliable estimates of how they would feel if they consumed alcohol in accordance with a hypothetical drinking scenario commensurate with their prior drinking experiences.

Effect Drinking and Self-Report Measures of Anticipated Subjective Response to Alcohol

The construct of effect drinking offers one clear example of the potential feasibility of evaluating individual differences in subjective response to alcohol based on prior drinking experiences. In recent years there has been a shift in focus away from traditional objective self-report measures of alcohol consumption (i.e., typical quantity and frequency indices) as indicators of problematic drinking and towards an increasing reliance on the individual's subjective experience of drinking episodes (e.g., effect drinking status). Effect

drinking status is based on the individual's classification of his/her subjective experience of alcohol's psychoactive effects relative to feeling "high or lightheaded" and getting "drunk" (e.g., Midanik, 1999). Based on Sher and colleagues' typology (Jackson et al., 2001), individuals can be grouped into one of four effect drinking categories based on self-reported classification of drinking episodes: (a) Abstainers (report no alcohol consumption); (b) Limited Effect Drinkers (endorse drinking but deny getting "high or lightheaded" or "drunk" on alcohol); (c) Moderate Effect Drinkers (endorse getting "high or lightheaded" but deny getting "drunk" on alcohol); and (d) Large Effect Drinkers (endorse getting "high or lightheaded" and "drunk" on alcohol). Relative to the most frequently utilized objective measure of heavy drinking (i.e., binge drinking – defined as the consumption of 4 or more alcoholic beverages at one sitting for women, 5 or more for men; Wechsler, Dowdall, Davenport, & Rimm, 1995), frequency of large effect drinking (i.e., frequency of getting drunk) is a stronger predictor of social consequences of drinking, alcohol-related problems, and symptoms of alcohol dependence (Midanik, 1999).

The transition towards an emphasis on effect drinking has sparked interest in the identification of factors associated with underage large effect drinking status (i.e., getting "drunk"). Utilizing a sample of 17-19 year-old first-semester college students (N = 184, 53% female), analyses from a preliminary study conducted in our laboratory revealed that large effect drinking status was independent of personality measures of impulsivity, sensation seeking, novelty

seeking, and harm avoidance (Kruse & Fromme, unpublished data). Self-reported number of standard drinks to feel "drunk", however, significantly predicted large effect drinking status. Specifically, students who reported a greater number of drinks in order to feel "drunk" reported that they got drunk more frequently than those who estimated a lower number of standard drinks necessary to feel intoxicated. This finding remained significant even after controlling for the influence of gender, ethnicity, family history of alcohol problems, and typical frequency of alcohol consumption. It also offered tentative evidence suggesting that the general construct of anticipated subjective response to alcohol (in this particular case, the number of drinks necessary to feel intoxicated) may be a significant predictor of drinking to intoxication in underage emerging adults.

The evaluation of anticipated effects of alcohol dates back historically to the measurement of alcohol expectancies, and the field of expectancy research provides support for the potential feasibility of examining individual differences in subjective response to alcohol via hypothetical drinking scenarios. One of the first attempts to combine the methodology of expectancy research (i.e., asking emerging adults to anticipate how they would feel after consuming a proscribed amount of alcohol) with the outcomes examined in alcohol challenge procedures resulted in the development of the Anticipated-Biphasic Effects of Alcohol Scale (A-BAES; Earleywine, 1994a; 1994b; Earleywine & Martin, 1993). The A-BAES provides a measurement of the anticipated stimulant and sedative effects of alcohol that would be expected after consuming a set number (either 4 or 2) of

standard drinks within one hour at two different time points: immediately after finishing the last drink (anticipated ascending limb) and 90 minutes after finishing the last drink (anticipated descending limb). The findings from this line of research are generally consistent with the results obtained from alcohol administration studies: (1) individuals anticipate greater stimulant effects on the ascending limb and more of the sedating effects on the descending limb (Earleywine & Martin, 1993); (2) the overall strength of the anticipated effects are dose dependent (i.e., stronger effects are anticipated for 4 standard drinks than 2; Earleywine & Martin, 1993); (3) level of anticipated effects differ by risk for alcoholism (e.g., sons of alcoholics anticipate greater stimulant effects on the ascending limb; Earleywine, 1994a); and (4) anticipated effects are significantly associated with patterns of drinking (Earleywine, 1994b). In addition, in two of these studies (Earleywine & Martin, 1993; Earleywine, 1994b), women anticipated more intense effects of alcohol across both limbs of absorption (stimulation on ascending limb, sedation on descending). Even though these studies did not take into account differences in estimated peak-BACs (based on participant gender and weight) in analyses, the pattern of results from the research conducted with the A-BAES suggests that emerging adults may be able to provide reliable estimates of the anticipated effects of alcohol based on a hypothetical drinking scenario.

A second approach to identifying individual differences in subjective response to alcohol is based on the retrospective recollection of the number of

standard drinks that were required to experience each of four effects of alcohol. The Self-Rating of the Effects of Alcohol Scale (SRE; Schuckit, Tipp, Smith, Wiesbeck, & Kalmijin, 1997) evaluates the number of standard drinks needed to first feel intoxicated, slur speech, create a stumbling gait, and fall asleep without wanting to during three distinct time periods: the first five times alcohol was ever consumed; the most recent consecutive three month period in which drinking occurred; and during the heaviest period of drinking. There is evidence for the criterion validity of the SRE measure, as SRE scores are both highly correlated with the SRE scores of close family members (Schuckit, Smith, Danko, Kuperman, Bierut, & Hesselbrock, 2005) and accurately differentiate individuals categorized as "low" and "high" responders to alcohol as assessed via alcohol challenge protocols (Schuckit et al., 1997). Further, lower subjective response to alcohol as measured by the SRE (i.e., higher number of standard drinks required to feel the four effects during the first five drinking occasions) prospectively predict quantity and frequency indices of drinking, the experience of alcohol-related problems, and DSM-IV diagnostic criteria for alcohol abuse and dependence five years later (Schuckit et al., 2007). As was the case for the A-BAES, these findings were significant in spite of the fact that differences in level of intoxication (i.e., estimated BAC based on the number of drinks reported to feel each effect) do not appear to have been controlled statistically or otherwise taken into consideration.

The association between anticipated and actual individual differences in subjective response to alcohol in the absence of drinking cues has also been examined in a sample of heavy drinkers (Ray, Meskew-Stacer, & Hutchison, 2007). In this study, experienced drinkers completed the Subjective High Assessment Scale (SHAS; Judd, Hubbard, Janowsky, Huey, & Attewell, 1977; adapted by Schuckit, 1984) based on how they anticipated they would feel after consuming three standard drinks in 30 minutes, and then three additional times based on how they currently felt after being administered alcohol doses intravenously to BAC levels of .02%, .04%, and .06%. Only a modest association was observed between anticipated and actual subjective response to alcohol in this study (r = .41 between estimated and .06% BAC SHAS scores), leading the authors to conclude that modifications to existing subjective response measures were necessary in order to accurately assess individual differences in subjective response to alcohol outside of the laboratory.

The most prominent limitation of each of these studies is the failure to account for the inherent variability in estimated BACs derived from the hypothetical drinking scenarios used to assess anticipated subjective response to alcohol. There are a myriad of factors which contribute to the variability in achieved blood alcohol level given a standardized dose of alcohol [e.g., genetic differences in pharmacokinetics (e.g., Baraona et al., 2007), body mass, duration since most recent meal, use of prescription medications]; however, close approximations of achieved peak BAC can typically be derived from gender, the

number of standard drinks consumed, participant weight, and the duration of alcohol consumption through the use of standardized dosing formulas (Matthews & Miller, 1979):

- Est. BAC_{MEN} = (# of standard drinks/2) * (7.5/weight in lbs) – (# of hours * .016)
- Est. BAC_{WOM} = (# of standard drinks/2) * (9.0/weight in lbs) – (# of hours * .016)

Based on these formulas, the estimated peak BAC for a 200-pound man who consumed four standard drinks in one hour (the hypothetical drinking scenario utilized with the A-BAES) is .059%, which is generally considered to be a modest-to-moderate level of intoxication. By comparison, the estimated peak BAC for a 150-pound man who also consumed four drinks in one hour is .084% which exceeds the threshold for legal intoxication; and the estimated peak BAC for a 120-pound woman is .134% or more than twice the blood alcohol level estimated for the 200-pound man in response to the same hypothetical drinking scenario. Thus, the finding that women anticipated higher stimulant effects on the ascending limb and greater sedative effects on the descending limb on the A-BAES (e.g., Earleywine & Martin, 1993; Earleywine, 1994b) may not be indicative of a gender difference in sensitivity to the effects of alcohol. Rather, the observed gender discrepancies are probably better understood as the likely consequence of higher anticipated blood alcohol levels, a finding consistent with dose-dependent effects of alcohol (e.g., Holdstock & de Wit, 1998). Similarly,

the modest association between anticipated and actual subjective response scores on the SHAS (Ray et al., 2007) is not unexpected given that the targeted BAC to which anticipated response scores were compared (.06%) would only be equivalent for 198-pound women and 175-pound men based on the hypothetical drinking scenario used in this study (i.e., three standard drinks in 30 minutes). It is likely that a significant portion of the women in the study (those who weighed less than 198 pounds) provided estimates of anticipated subjective response based on a BAC above the .06% comparison point. It is also likely that ratings for a significant number of the men (those who weighed more than 175 pounds) were based on an estimated BAC below .06%. Combined, the most likely outcome of these patterns is a net reduction in the strength of the correlation between the hypothetical and actual subjective response scores.

The failure to account for potentially significant differences in estimated BAC across these hypothetical drinking scenarios severely limits the interpretability of specific findings from previous studies on individual differences in anticipated subjective response to alcohol. Specifically, it is unclear whether observed differences in the anticipated measures are reflective of baseline physiological differences or whether they are merely artifacts of different anticipated doses. In spite of this limitation, however, the overall pattern of results from these studies and research on alcohol expectancies indicate that emerging adults are able to provide reliable estimates of the effects of alcohol they expect to experience based on a hypothetical drinking scenario. Further,

these findings offer evidence that by reducing the variability in estimated BAC through the development of a hypothetical drinking scenario that creates an equivalent anticipated BAC for all participants, it may be possible to improve the precision and accuracy of these anticipated measures.

BAC-Specific Measure of Anticipated Subjective Response to Alcohol

In an attempt to minimize the effects of variability in estimated BAC on the measurement of individual differences in anticipated subjective response to alcohol, standardized dosing procedures from alcohol administration studies (e.g., Kruse & Fromme, 2005; Hartzler & Fromme, 2003) were used to create a hypothetical drinking scenario targeting a BAC of .08%. The individualized number of standard drinks participants were asked to imagine consuming was determined by gender and weight using standardized dosing calculations to estimate the amount of alcohol necessary to reach, on average, a BAC of .08% if consumed within a 30-minute time span (women 2.174 ml/kg of body weight; men 2.389 ml/kg). Weight ranges were calculated separately for men and women by rounding the calculations to the nearest .5 standard drink (1 standard drink = 44 ml of 80-proof alcohol and is equivalent to 12 ounces of beer, 5 oz. of wine, or 1.5 oz. of liquor either straight or in a mixed drink; see Appendix B).

In a preliminary study, 119 (58% female) underage large effect drinkers (i.e., those who reported getting drunk at least once in the preceding three months) were tested to identify the latent variables contributing to the factor structure of a

measure of anticipated subjective response to alcohol based on a hypothetical drinking scenario targeting a BAC of .08% (Kruse, Wetherill, Corbin, & Fromme, June 2004). Perceptions of subjective response to the psychoactive effects of alcohol were assessed via three self-report measures: the Subjective High Assessment Scale (SHAS; Judd et al., 1977), the Biphasic Alcohol Effects Scale (BAES; Martin et al., 1993), and visual analog scales for "high or lightheaded" and "drunk" (the two items comprising the effect drinking status classification system). Exploratory factor analyses (EFA) identified four distinct factors of anticipated subjective response to the hypothetical drinking scenario which together accounted for 58% of the covariation among the variables: Positive (9 items; e.g., relaxed, charming, joyful), Stimulant (7 items; e.g., energized, vigorous, elated), Impaired (9 items; e.g., dizzy, slurred speech, clumsy), and Sedative (7 items; e.g., sleepy, sluggish, down; Kruse et al., June 2004). Consistent with results from alcohol administration studies (e.g., Schuckit 1980, 1984; King et al., 2002), subsequent analyses revealed that lower anticipated impairment was associated with greater typical quantity and frequency of alcohol consumption, increased frequency of drunkenness, greater number of alcohol-related problems, and higher number of standard drinks needed to feel "drunk". Additionally, higher anticipated stimulant ratings based on the hypothetical drinking scenario were associated with greater typical quantity of alcohol consumption and frequency of drunkenness in this sample of underage large effect drinkers.

Results from this preliminary study demonstrated that individual differences in anticipated subjective response to a hypothetical drinking scenario are associated with patterns of alcohol consumption in experienced underage drinkers. These findings provide initial evidence for the criterion validity of this assessment technique and were generally consistent with patterns of data from both alcohol challenge (e.g., King et al., 2002) and other studies of anticipated subjective response to alcohol based on retrospective recall of prior drinking experiences (e.g., Schuckit et al., 2007). Further, this assessment paradigm has the potential to significantly advance understanding of the association between anticipated and actual subjective response to alcohol by eliminating the significant variability in estimated BAC which severely limits the interpretation of previous findings. Whereas it is hypothesized that this method of assessment will prove to be useful as a screening device to identify emerging adults at an increased risk for persisting in problematic patterns of drinking, additional research needs to be conducted in order to further evaluate the factor structure, internal consistency, construct, discriminant, and criterion validity of these instruments prior to their use in applied settings.

Potential Correlates of Individual Differences in Subjective Response to Alcohol

The preponderance of evidence from alcohol administration studies generally suggests that a low subjective response to the pharmacological effects

of alcohol is associated with a greater risk for experiencing alcohol-related problems and persisting in heavy drinking patterns (e.g., Viken et al, 2003; Shuckit, 1994). Whereas individual differences in the subjective experience of alcohol's effects are physiologically based (e.g., highly heritable) and the perception of physiological sensations is neurologically mediated; virtually nothing is known about physiological and/or neurological correlates of individual differences in subjective response to alcohol. Of particular interest is the extent to which individual differences in subjective response to alcohol are correlated with differences in the subjective experience of other physiological sensations, and whether low subjective response to alcohol is associated with patterns of cognitive functioning (e.g., neurocognitive abilities and decision-making processes).

General Sensitivity to Physiological Sensations. It is unclear whether individual differences in subjective response to alcohol are indicative of an underlying physiological mechanism specific to the pharmacological effects of ethanol, or alternatively, whether these individual differences are representative of a general pattern of responsiveness to all types of physiological sensations. Significant variability in the sensitivity to internal (e.g., tingling, dizziness) and external (e.g., temperature, touch) sensations has been identified using a variety of physiological and perceptual challenge procedures with young adults and adolescents. For example, researchers that utilize carbon dioxide challenge procedures regularly report significant individual differences in the subjective

experience of a variety of carbon dioxide-induced physiological sensations (e.g., feeling dizzy or lightheaded, the experience of panic; e.g., Telch, Jacquin, Smits, & Powers, 2003; Perna, Romano, Caldirola, Cucchi, & Bellodi, 2003; for review, see Ozcan, Levine, & Potter, 2000). Similarly, the Cold Pressor Test is frequently used to evaluate individual differences in the perception of, sensitivity to, and tolerance of physical pain (e.g., Flora, Wilkerson, & Flora, 2003; Efran, Chorney, Ascher, & Lukens, 1989).

The acute effects of alcohol are widespread within the central nervous system and are known to affect both our objective response to and subjective experience of (i.e., perception) a variety of physiological and perceptual sensations. For example, the analgesic (i.e., pain-reducing) properties of acute alcohol intoxication are well-documented (e.g., Perrino, Ralevski, Acampora, Edgecombe, Limoncelli, & Petrakis, 2008), and there are several studies which demonstrate that problem-drinkers and alcoholics (e.g., Cutter, Malouf, Kurtz, & Jones, 1976; Brown & Cutter, 1977), as well as those at an increased risk for alcoholism by virtue of family history (Stewart, Finn, & Pihl, 1995), are more sensitive to the acute pain-reducing effects associated with a moderate dose of alcohol. Acute alcohol consumption has also been demonstrated to affect vestibular sensitivity and balance control by impairing the ability to use gravitational vestibular cues to determine orientation (Hafstrom, Modig, Karlberg, & Fransson, 2007). In addition, there are two lines of research documenting a significant association between alcohol and sensitivity to the effects of carbon-

dioxide challenge. First, during the acute stages of intoxication, alcohol is associated with hyposensitivity in response to the effects of carbon-dioxide sensations induced through hyperventilation (e.g., Johnston & Reier, 1973). Second, relative to non-alcohol dependent controls, recently detoxified alcohol dependent individuals display marked behavioral hypersensitivity to sensations induced by carbon dioxide challenges (breath holding and 5% carbon dioxide challenge), although it was not clear whether these differences were driven by the effects of long-term dependence or an acute response associated with the initial stages of withdrawal (Rassovsky, Hurliman, Abrams, & Kushner, 2004).

Acute alcohol intoxication is also known to affect perception of sensory stimuli. For example, research examining the effects of alcohol on audiology has documented that blood alcohol level is positively associated with the magnitude of increase in hearing threshold (i.e., the level at which auditory discriminations can be accurately performed), with the greatest level of impairment observed for lower frequencies including 1000 Hz (the most critical frequency for the discrimination of speech/vowel sounds; Upile et al., 2007). Acute alcohol consumption has also been demonstrated to affect numerous visual functions including acuity, spatial contrast sensitivity, and dark adaptation; findings which some recent research suggests may be driven primarily by an alcohol-induced decrease in lateral inhibition of sensory receptors in the retina (Johnston & Timney, 2008).

Clearly, the results of these studies highlight the pervasiveness of the acute effects of alcohol intoxication on physiological and perceptual sensations and functioning, and in some instances posit potential mechanisms of increased risk for the persistence in problematic drinking (e.g., greater sensitivity to the analgesic properties of alcohol). To date, however, there have been no laboratory studies comparing an individual's subjective experience of the sensations induced by these physiological and perceptual challenge procedures, or subjective perceptions of the stimuli themselves, with subjective response to a moderate dose of alcohol. Given the broad range of acute effects of alcohol in the central nervous system, it is possible that individual differences in the subjective experience of alcohol's pharmacological effects may be tied to individual differences in the subjective experience of other physiological and perceptual sensations as well. That is, subjective response to alcohol may be "low" in some individuals because they also have relatively stable physiological and perceptual sensations that are generally unaffected by moderate doses of alcohol. Conversely, subjective response to alcohol may be "high" in emerging adults whose physiological and perceptual systems are less stable and more susceptible to the effects of alcohol.

If differences in subjective response to alcohol are in fact representative of a general pattern of responsiveness to physiological sensations, individuals with a low subjective response to alcohol would also be expected to exhibit a lower response to other psychoactive substances (e.g., carbon dioxide inhalation,

caffeine, nicotine) as well as a reduced reaction to external stimulation (e.g., tactile, visual, auditory). To the extent that a significant association between subjective response to alcohol and a general pattern of sensitivity to physiological sensations can be empirically validated, it may provide insight into one physiological mechanism potentially underlying the co-morbidity between alcohol use, other drug use, anxiety, and mood disorders (see Stinson, Grant, Dawson, Ruan, Huang, & Saha, 2005). Such an association would also then suggest that physiological and perceptual challenge procedures may represent a viable strategy for identifying underage drinkers who may be at an increased risk for the development of alcohol use disorders.

Cognitive Processes. It is well documented that chronic alcohol use and dependence are associated with significant impairments in neuropsychological functioning in both adult (for review see Parsons & Nixon, 1998) and adolescent clinical populations (e.g., Tapert et al., 2003; Tapert, Granholm, Leedy, & Brown, 2002; Tapert & Brown, 1999). Relatively little, however, is known about the neuropsychological factors that may be associated with individual differences in subjective response to alcohol in relatively high cognitive functioning adolescents (e.g., college students). Given that the perception of physiological sensations is neurologically mediated, it is possible that a low level of subjective response to the pharmacological effects of alcohol may be usefully interpreted, at least in part, as a deficit in neuropsychological functioning related to a reduced ability to process cues related to the perception of physiological sensations. Whereas

previous research efforts have failed to demonstrate a consistent association between neuropsychological functioning and adolescent alcohol consumption patterns (i.e., typical quantity and frequency estimates), it may be important to evaluate the associations between various aspects of neuropsychological performance and a presumed genetically-driven risk factor for the development of alcoholism: individual differences in subjective response to alcohol.

Several studies with college student social drinkers have failed to provide consistent evidence in support of a significant association between typical quantity and frequency indices of alcohol use and cognitive functioning (e.g., Bates & Tracy, 1990; Hannon et al., 1987). There is some evidence, however, that impaired attentional, visuospatial, and motor speed processes are associated with diagnostic criteria for alcohol dependence in high cognitive functioning adolescents, even after controlling for several potential confounding variables (e.g., family history of alcoholism, anxiety, depression; Sher, Martin, Wood, and Rutledge, 1997). This finding suggests that domains of neuropsychological functioning may be associated with an increased risk for alcohol use disorders and highlights the potential utility of determining whether these domains of functioning are associated with other risk factors including individual differences in subjective response to alcohol.

In addition, a series of studies have implicated a characteristic decision-making deficit as a potential mechanism underlying the transition from casual alcohol use to alcohol abuse among some alcohol-dependent adults (Bechara,

Dolan, & Hindes, 2002; Bechara & Damasio, 2002; Behcara, Dolan, Denburg, Hindes, Anderson, & Nathan, 2001; Bechara, Tranel, & Damasio, 2000; Mazas, Finn, & Steinmetz, 2000). According to this research, a subset of alcohol-dependent adults tend to engage in a marked pattern of persistent selection of responses that, in spite of greater immediate rewards, result in significantly poorer outcomes. This pattern of responding is also characteristic in patients with lesions to the ventromedial prefrontal cortex, an area of the brain that is known to be significantly impacted by alcohol exposure (e.g., Bechara & Damaiso, 2002). It remains largely unknown, however, whether this pattern of responding is simply the consequence of the brain's repeated exposure to alcohol's toxic effects, or, alternatively, whether this task is tapping into baseline differences in neuropsychological functioning which may be a marker for a greater risk for problematic drinking. Further, it is unclear whether this potential risk factor is associated with individual differences in subjective response to alcohol or exerts its influence independent of other risk factors.

Impaired behavioral control over alcohol intake is the hallmark of alcohol use disorders and associations between impulsive behavior and alcohol use are well-documented (e.g., Baker & Yardley, 2002; Cloninger, 1988). Whereas self-report measures of impulsivity (i.e., behavioral undercontrol) are frequently associated with drinking patterns and alcohol-related problems (e.g., McCarthy, Miller, Smith, & Smith, 2001); evidence suggests that personality and behavioral measures of impulsivity assess relatively distinct constructs (e.g., Reynolds,

Ortengren, Richards, & de Wit, 2006). Further, behavioral measures have gained favor as more appropriate indicators of biologically-based models of impulsivity because they provide objective measurements of performance that are relatively immune from subjective self-report biases (e.g., Swann, Bjork, Moeller, & Dougherty, 2002; Finn, Mazas, Justus, & Steinmetz, 2002; Finn, Justus, Mazas, & Steinmetz, 1999).

Compelling evidence for the role of behavioral impulsivity in the development of alcohol dependence comes from a recently published prospective study with 471 heavy drinking young adults (Rubio et al., 2008). Impairment in behavioral inhibition at baseline (as measured by the Go-Stop Paradigm; Logan, 1994) was identified as a marker for increased likelihood of alcohol dependence 4-years later by virtue of the association between this measure and maintenance of heavy drinking. Preliminary data from an alcohol administration study conducted in our laboratory (N = 148, 50% female; Corbin et al., unpublished data), provides further support for this particular measure of behavioral impulsivity as a physiologically-based risk factor for persistence in problematic drinking. Specifically, decreased behavioral control (i.e., greater impulsivity) as measured by the Go-Stop Paradigm prior to consuming alcohol was associated with subsequent lower ratings of intoxication after controlling for differences in BAC. Combined, evidence that behavioral tendencies toward impulsivity and poor behavioral control are associated with low subjective response to alcohol (Corbin et al., unpublished data), and prospectively predict maintenance in heavy drinking

and the onset of alcohol dependence 4-years later (Rubio et al., 2008), strongly suggest that these behavioral markers may function as useful screening devices for the identification of emerging adults who may be at a greater risk for the persistence in patterns of problematic drinking.

Overview of Research and Aims

In recent years, increased research efforts have focused on the identification of factors that reliably differentiate underage drinkers who are at a greater risk for experiencing alcohol-related problems and persisting in heavy drinking patterns from those who will naturally "mature out" of heavy drinking in response to life changes (e.g., Li, 2003). More than two decades of experimental research utilizing alcohol challenge techniques have implicated low levels of subjective response to the pharmacological effects of alcohol as a critical risk factor for the development of alcohol use disorders (e.g., Munct et al., 1997; Schuckit, 1994). Whereas alcohol administration studies are inappropriate for underage drinkers, there may be significant associations between individual differences in subjective response to alcohol and a variety of factors more suitable for assessment with underage emerging adults including: self-report measures of anticipated subjective response to alcohol based on a hypothetical drinking scenario commensurate with prior drinking experiences, individual differences in subjective response to physiological and perceptual challenge procedures, and

patterns of cognitive functioning including neuropsychological abilities and behavioral measures of decision-making processes.

The current research comprises two related laboratory studies with the overall goal of identifying factors associated with individual differences in subjective response to alcohol which can be utilized as screening devices for emerging adults at an increased risk for the development of alcohol use disorders. Of particular interest is the extent to which these factors may be able to differentiate underage drinkers who maintain, transition into, or transition out of large effect drinking status during the critical developmental period associated with matriculation from high school to college. By combining questionnaire, laboratory, and standardized alcohol-administration methodologies in a sample of 21-23 year-old experienced drinkers, Study 1 was designed to: (1) assess the factor structure, internal consistency, construct validity, discriminant validity, and criterion validity of self-report measures of anticipated subjective response to alcohol based on a hypothetical drinking scenario targeting a BAC of .08%; and (2) examine the associations between individual differences in the subjective experience of a moderate dose of alcohol and differences in response to a variety of physiological and perceptual challenge procedures, and performance on a series of neuropsychological tests and behavioral measures of decision-making processes. Study 2 incorporated the methodology established in the laboratory session of Study 1 into a preliminary cross-sectional study in a sample of first-year, underage, college students participating in a longitudinal research project.

Specifically, students who had transitioned into, transitioned out of, or maintained heavy drinking patterns from high school to the Fall semester of their first year in college were examined to determine whether they differed: on the measures of anticipated subjective response to alcohol, in response to the physiological and perceptual challenges, or in cognitive functioning.

CHAPTER TWO: METHODS COMMON TO STUDIES 1 AND 2

Participant Characteristics and Subject Recruitment

All participants in the two studies reported here were undergraduate students enrolled at The University of Texas at Austin (UT). Students meeting study-specific inclusion criteria were randomly selected for participation, contacted by trained research assistants, and invited to participate. Interested students were scheduled for participation in laboratory session(s) and instructed to refrain from the use of alcohol or other psychoactive substances for 24 hours prior to their appointment(s).

Self-Report Measures (Appendix A)

Demographics. Participants provided information about their age, gender, racial/ethnic identity, and familial socio-economic status (i.e., mean annual income).

Typical Alcohol Consumption. Estimates of typical alcohol consumption were obtained from the widely-used Daily Drinking Questionnaire (DDQ; Collins, Parks, & Marlatt, 1986). The DDQ provides measures of the typical quantity (i.e., number of drinks per drinking day) and frequency (i.e., number of drinking episodes per week) of alcohol consumption over the previous three months.

Alcohol-Related Consequences. The experience of negative alcohol-related consequences was assessed with the Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989). The 23-item RAPI measures the frequency of physical (e.g., had withdrawal symptoms, passed out or fainted suddenly), psychological (e.g., noticed a change in your personality, felt that you had a problem with alcohol), and social (e.g., caused shame or embarrassment to someone, had a fight, argument, or bad feelings with a friend) consequences experienced during the past three months using a 5-point scale with response options ranging from 0 (never) to 4 (more than 10). Responses were summed to yield a single alcohol consequence score. Internal reliability for the 23-item RAPI is excellent (α= .94; White & Labouvie, 1989).

Family History of Problem Drinking. Perceptions of problematic drinking in the biological parents, grandparents, and siblings of participants were evaluated with the Family Tree Questionnaire (FTQ; Mann, Sobell, Sobell, & Pavan, 1985). Each family member was classified into one of five categories based on the participant's knowledge and impressions of the relative's drinking behavior: Abstainer, Social Drinker, Possible Problem Drinker, Definite Problem Drinker, or Don't Know (used for family members the participants did not know or could not remember). The FTQ has demonstrated satisfactory test-retest reliability for use in clinical and research samples (Mann et al., 1985), and evidence for the criterion validity of the FTQ is based on consistent findings that alcohol abusers report a higher number of family history positive relatives than

non-alcohol abusers (e.g., Vogel-Sproft, Chipperfield, & Hart, 1985). Participants were identified as family history positive who classified at least one family member as a Definite Problem Drinker.

Hypothetical and Actual Subjective Response to Alcohol. The 32-item Subjective Response to Alcohol Scale (Kruse et al., June 2004) was used to evaluate individual differences in the subjective experience of alcohol's pharmacological effects (1) after consuming a moderate dose of alcohol (i.e., actual; Study 1 only) and (2) based on a hypothetical drinking scenario targeting a blood alcohol level of .08 mg% (i.e., hypothetical; Studies 1 & 2): "Imagine how you would feel if you drank ____ standard drinks over a 30-minute period. Even if you have never consumed that many beverages in that amount of time, please answer the following questions based on how you think you would feel if you did." As previously described (pp. 14-15), the individualized number of standard drinks used in the hypothetical drinking scenario was determined by participant gender and weight using standardized dose calculations to estimate the amount of alcohol necessary to reach a BAL of .08% if consumed within a 30-minute time span (women 2.174 ml/kg of body weight; men 2.389 ml/kg; e.g., Kruse & Fromme, 2005; Hartzler & Fromme, 2003). Weight ranges were derived separately for men and women by rounding the calculations to the nearest .5 standard drink (1 standard drink = 44 ml of 80-proof alcohol and is equivalent to 12 ounces of beer, 5 oz. of wine, or 1.5 oz. of liquor either straight or in a mixed drink; see Appendix B). The subjective response scale was created using items

obtained from the Subjective High Assessment Scale (SHAS; Judd et al., 1977), Biphasic Alcohol Effects Scale (BAES; Martin et al., 1993), and two items corresponding to the effect drinking typology criteria ("high or lightheaded" and "drunk"; e.g., Jackson et al., 2001; Midanik, 1999) and yields four empirically-derived factor scores: Positive (α= .93; 9 items; e.g., relaxed, charming, joyful); Stimulant (α= .94; 7 items; e.g., energized, vigorous, elated); Impaired (α= .87; 9 items; e.g., dizzy, slurred speech, clumsy); and Sedative (α= .72; 7 items; e.g., sluggish, sleepy, down; Kruse et al., June 2004). Factor scores range from 0-100 with higher scores indicative of greater anticipated subjective response to the pharmacological effects of alcohol.

Perceived Tolerance to Alcohol. The 10-item Subjective Tolerance Index (STI; Mallett, Larimer, & Turrisi, June 2003), was used to measure subjective beliefs about participants' behavioral tolerance to the pharmacological effects of alcohol relative to their peers. Participants rated each item (e.g., "I don't get drunk as quickly as the average drinker") on a seven-point scale with options ranging from 1 ("strongly disagree") to 7 ("strongly agree"). Responses were summed to yield a single factor score with higher scores indicative of greater perceived tolerance. The STI has demonstrated good internal consistency, construct and predictive validity, as well as test-retest reliability (Mallett et al., June 2003).

In addition, participants reported how many standard drinks they would need to consume during a 30 minute period in order to feel "a little high or

lightheaded" and "drunk". The wording of these two items reflects the terminology used by Sher and colleagues to determine effect drinking status (Jackson et al., 2001) and the time frame is consistent with the hypothetical drinking scenario utilized for the hypothetical SRS measure and commonly used in alcohol administration protocols (e.g., Kruse & Fromme, 2005; Hartzler & Fromme, 2003).

Alcohol Expectancies. In order to evaluate the discriminant validity of the measures of anticipated subjective response to alcohol based on the hypothetical drinking scenario, participants completed the 38-item Comprehensive Effects of Alcohol Questionnaire (CEOA: Fromme et al., 1993), a measure of alcohol expectancies or beliefs about the effects of alcohol on cognition, emotion, and behavior. The CEOA assesses expectations for and evaluations of 20 positive and 18 negative effects of alcohol across seven domains: Sociability (8 items; e.g., "It would be easier to talk to people"), Tension Reduction (3 items; e.g., "My body would be calm"), Liquid Courage (5 items; "I would be brave and daring"), Enhanced Sexuality (4 items; e.g., "I would be a better lover"), Risk/Aggressiveness (9 items; e.g., "My responses would be slow"), Negative Self-Perception (4 items; e.g., "I would feel self-critical"), and Cognitive/Behavioral Impairment (5 items; e.g., "I would act aggressively"). Each of the seven subscales has adequate test-retest (r = .66- 81; Fromme et al., 1993) and internal reliability (coefficient alpha = .59-.89; Fromme & D'Amico, 2000). Scores were calculated for each CEOA subscale by

multiplying the rated expectations for (4 point scale; 1 = "disagree" to 4 = "agree") and evaluations of (5 point scale; 1 = "bad" to 5 = "good") each potential effect of alcohol.

Response to Physiological and Perceptual Challenges. A shortened version of the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971) was administered to provide measures of baseline and induced subjective mood states prior to and following the completion of the Carbon-Dioxide Challenge and Cold Pressor Test procedures. The 20-item POMS measured the extent to which participants were currently experiencing each of 6 positive (e.g., lively, friendly) and 14 negative (e.g., angry, nervous) subjective mood states using a scale from 1 ("not at all") to 5 ("a lot"). Composite scores were calculated for the positive and negative mood state items at each assessment and changes in mood state were calculated by subtracting the pre-challenge from the post-challenge factor scores. Positive values (i.e., greater than 0) represented an increase in mood state following the protocol, whereas negative values (i.e., less than 0) were indicative of a decrease in mood state.

Similarly, the strength of baseline and induced perceptions of physiological sensations was evaluated with a modified version of the Body Sensations Questionnaire (BSQ; Chambless, Caputo, Bright, & Gallagher, 1984) and items taken from the Acute Panic Inventory (API; Dillon, Gorman, Liebowitz, Fyer, & Klein, 1987). The BSQ was originally designed to measure the fear associated with the perception of physiological sensations (Chambless et

al., 1984); however, it was modified for use in the current study to evaluate the strength of the original 16 physiological sensations utilized in the BSQ (e.g., pressure in chest, feeling disoriented and confused, dizziness) along with 17 additional items taken from the API using visual analog scales from 0 (no sensation) to 100 (most extreme sensation possible). Again, composite scores were calculated for each measure and the value of the discrepancy between pre and post-physiological challenge procedures documented the intensity of the change in physiological sensations (higher positive scores indicative of more intense sensations as a result of the Carbon Dioxide Challenge or Cold Pressor Test).

Sensitivity to perceptual stimulation was assessed by evaluating the intensity of tactile (Cold Pressor), vestibular (spinning challenge), auditory (tones), and visual (light) stimuli according to a scale ranging from 0 (not at all) to 100 (extremely). For the Cold Pressor Test, participants provided a subjective units of distress (SUDS) rating between 0-100 (a measure of the intensity of the pain associated with the immersion of their arm in the cold water) immediately upon immersion and every thirty seconds thereafter before providing a final rating immediately upon removal from the water. Prior to and immediately after performing the spinning challenge, participants rated the intensity of four physiological sensations (dizziness, lightheadedness, wobbly/rubber legs, and nausea) using the 100 point scale. Ratings of the intensity of each auditory (i.e., loudness of the tones) and visual (brightness of the lights) stimuli were also

evaluated with the 100 point scale. At the conclusion of each of the five physiological and perceptual challenge procedures (Carbon Dioxide Challenge, Cold Pressor Test, Spinning Challenge, Auditory & Visual Perception Tests), participants provided single item ratings of the overall intensity of the sensations induced by the protocols, the positive valence of these sensations, and the negative valence of these sensations with response options ranging from 1 ("not at all") to 7 ("extremely").

Potential Moderators: Anxiety Sensitivity, Mindfulness, Body Vigilance, and Distress Tolerance. Given the reliance of the current research on self-reported perceptions of physiological sensations, several constructs known to affect either awareness or interpretation of physiological sensations were measured. Fear of physiological sensations was assessed with the Anxiety Sensitivity Index (ASI; Peterson & Reiss, 1992). Anxiety sensitivity, as measured by the ASI, has previously been shown to be a significant predictor of response to physiological challenges (e.g., Carbon-Dioxide Challenge) in both panic disorder and non-clinical populations (e.g., Telch, Silverman, & Schmidt, 1996). The ASI is a 16-item self-report questionnaire designed to assess fear of anxiety-related symptoms based on the belief that these symptoms are dangerous or harmful. In addition to providing a composite score, the ASI yields three factor scores related to the physical (8 items; e.g., "It scares me when my heart beats rapidly"), mental incapacitation (i.e., psychological; 5 items; e.g., "When I am nervous, I worry that I might be mentally ill"), and social (3 items; e.g., "It is important to me not to

appear nervous") elements of anxiety response. Participants rated the extent to which each item applied to them using 5-point scales with response options ranging from 1 ("very little") to 5 ("very much"). Higher scores are indicative of greater anxiety sensitivity. The ASI is the most widely used measure of anxiety sensitivity, and the instrument's psychometric properties are well-established (for review, see Peterson & Plehn, 1999).

The potentially important theoretical construct of mindfulness was assessed with the 15-item Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003). Participants were asked to rate how frequently they experienced each of the 15 statements on this scale using a 6-point Likert scale with response options ranging from 1 ("almost always") to 6 ("almost never"). High scores on the MAAS suggest mindfulness is associated with a variety of well-being constructs, including enhanced self-awareness, self-regulated behavior, and positive emotional states.

The Body Vigilance Scale (BVS; Schmidt, Lerew, & Trakowski, 1997**)** is a 4-item scale designed to assess the extent to which participants attend to a variety of internal bodily sensations (e.g., dizziness, tingling). Participants were asked to indicate the extent to which they pay attention to, are sensitive to changes in, and how much time they spend "scanning" their body for physiological sensations using a scale from 0 ("none" or "not at all like me") to 10 ("all of the time" or "extremely like me"). The fourth item on the BVS reflected the average amount of attention paid to 15 different physiological

sensations (e.g., numbness, tingling, upset stomach) with response options ranging from 0 ("none") to 10 ("extreme"). Higher scores on the BVS are indicative of greater vigilance for the subjective experience of physiological sensations.

Participants also completed a modified version of the Distress Tolerance Scale (DTS; Simons & Gaher, 2005; Telch, unpublished data). This modified version of the DTS is a 16-item self-report measure designed to evaluate the extent to which participants can tolerate physical (6 items; e.g., "I'll take fairly extreme measures to stop physical discomfort or pain") and emotional (10 items; e.g., "I usually follow through with tasks that are emotionally upsetting") distress. Participants rated the extent to which they agreed with each item using 6-point Likert scales with response options ranging from 1 ("strongly agree") to 6 ("strongly disagree"). Summary scores were created by calculating the average for items across the physical and emotional subscales, and higher scores were indicative of greater tolerance of physical and emotional distress, respectively.

Procedures

Carbon Dioxide Challenge (CO_2). Whereas previous research suggested that a 5-minute 8% carbon dioxide (CO_2) challenge would reliably induce a variety of physiological sensations without causing panic in healthy college student volunteers (Maresh et al., 1997), pilot testing of this protocol in our laboratory revealed no significant changes in the perception of physiological sensations in a sample of 104 18-19 year old adolescents (Kruse & Fromme,

unpublished data). Consequently, a 10-minute 20% CO_2 (80% oxygen) challenge protocol was utilized in the current research in order to evaluate individual differences in subjective response to CO_2 inhalation.

Prior to the start of the 20% CO_2 challenge protocol, participants received standardized instructions and completed a POMS and modified BSQ/API to establish pre-challenge baseline levels of subjective mood state and perception of physiological sensations. Participants were instructed to place a mask over their mouth and nose and breathe normally. Gas mixtures were medical grade, suitable for instrument calibration, and stored in standard gas tanks. The gas was fed through medical tubing into a medical grade mask which completely covered the participants' mouth and nose. A timer was started once the gas mixture had been turned on and the participant's mask was properly placed. After 8 minutes, participants completed the modified BSQ/API to rate the magnitude of their experience of physiological sensations as they continued to breathe the mixture. At the end of the 10 minute inhalation trial, participants were instructed to remove the mask; they thencompleted the POMS again to measure post-CO_2 challenge subjective mood state and rated the overall intensity, positive and negative valence of the sensations induced by the CO_2 challenge using a scale from 1 ("not at all") to 7 ("extremely").

Cold Pressor Test. A modified version of the Cold Pressor Test standardized by Efran and colleagues (CPT; Efran et al., 1989) at a temperature of 10 degrees Celsius (as opposed to 1 degree C) was used to evaluate individual

differences in the perception of and tolerance to physical pain. Participants received standardized instructions and then completed the POMS and modified BSQ/API to measure pre-CPT subjective mood state and perception of physiological sensations. Prior to immersion in the cold water, participants placed their non-dominant arm in a 32 degree C warm water bath up to the elbow for 1 minute to ensure that participants all began the CPT trial with approximately the same surface skin temperature.

At the end of the 1 minute standardization period, participants placed their non-dominant arm up to the elbow into the circulating cold bath maintained at 10 degrees C. Immediately upon immersion into the cold water, participants provided a SUDS rating (0-100) of the intensity of the sensations they were experiencing and research assistants began a stop watch to time the duration participants kept their arm immersed in the water. Verbal SUDS ratings were obtained from participants every thirty seconds until they voluntarily removed their arm from the water or the procedure was terminated (maximum = 300 seconds). Upon termination of the trial (either due to voluntary termination or the conclusion of the 300 second procedure), participants provided one final SUDS rating and complete a post-CPT POMS and modified BSQ/API to measure post-CPT subjective mood state and perception of physiological sensations. Finally, participants rated the overall intensity, and positive and negative valence of the sensations induced by the CPT using a scale from 1 (“not at all”) to 7 (“extremely”).

15-Second Spinning Challenge. Sensitivity to vestibular sensations was evaluated with a 15-second spinning protocol. Participants were situated in the middle of an open space directly under a circular "target" attached to the ceiling. They were asked to look up at the target on the ceiling and spin as quickly as they could until they were instructed to stop. Participants received standardized instructions informing them that if they became too uncomfortable, they should stop spinning and end the protocol. Prior to and at the end of the spinning protocol, participants were asked to rate the extent to which they were currently experiencing four physiological sensations (dizziness, lightheadedness, wobbly/rubber legs, and nausea) using a scale from 0 ("not at all") to 100 ("most extreme sensation possible"). Participants also provided overall ratings of the intensity, positive valence, and negative valence of the sensations they experienced during the spinning procedure using scales from 1 ("not at all") to 7 ("extremely"). Number of rotations completed and duration of spinning were recorded by research staff.

Auditory Perception Test. Individual differences in the perception of auditory stimuli were evaluated with an auditory tone perception test. Participants were escorted to a quiet room and placed in a chair so that their head was positioned exactly four feet (48 inches) from two stereo speakers through which the stimuli were presented. After being provided with standardized instructions explaining the task, participants listened to and rated the intensity of two sets of five identical auditory tones (20 db, 40 db, 60 db, 80 db, and 100 db) using a scale

from 0 (“not at all”) to 100 (“most extreme possible”). Beginning with the 60 db tone (mid-range) for all participants on the first set, participants were exposed to each of the subsequent tone levels presented in random order so that each tone level was presented in both sets of five (i.e., the first five tones and again in the second five tones) and no tone was presented twice in secession. The tones were filtered at 2500 cycles and presented for a period of five seconds each followed by a 5-second between-trial period of silence during which they were asked to provide their ratings. At the conclusion of the test, participants rated the overall intensity and positive/negative valence of the stimuli using single-item ratings with response options ranging from 1 (“not at all”) to 7 (“extremely”).

Visual Perception Test. Individual differences in perception of visual stimuli were evaluated with a visual light perception test. Participants were escorted into a private room and placed in a chair so that their head was positioned exactly four feet (48 inches) from the center of a platform containing 4 light bulbs of varying wattage and lumens (40 watts, 475 lumens; 60 watts, 830 lumens; 75 watts, 1040 lumens; and 100 watts, 1550 lumens). Participants were provided with standardized instructions describing the task and then the lights were turned off in the room for a period of 20 seconds to allow the participant to become accustomed to the dark. After the 20-second adjustment period, the visual stimuli were presented in random order so that each light was presented twice (once in the first four trials, again during the second four trials) and no light was presented twice in secession. The lights were presented for a total of 5

seconds with a 20-second between-trial period of darkness in between each presentation during which they were asked to provide their ratings of the intensity the visual stimuli using a scale from 0 ("not at all") to 100 ("most extreme possible"). After providing all eight ratings (each of the four stimuli twice), participants rated the overall intensity, positive valence, and negative valence of the stimuli using single-item ratings with response options ranging from 1 ("not at all") to 7 ("extremely").

Assessment of Neuropsychological Functioning. Each participant was administered five neuropsychological tests which have previously been shown to be associated with alcohol use disorders (Evert & Oscar-Berman, 1989) and to be sensitive to detecting impairment associated with symptoms of alcohol dependence in high cognitive functioning adolescents (Sher et al., 1997). The Block Design subtest of the Wechsler Adult Intelligence Scale (WAIS-III; Psychological Corporation, 1997) and Visual Reproduction (Immediate and Delayed Memory) subtest of the Wechsler Memory Scale (WMS-III; Psychological Corporation, 1997) assessed visuospatial functioning and non-verbal memory. The Digit Symbol Coding subtest of the WAIS-III and Trail Making Tests (Part A) of the Halstead-Reitan Neuropsychological Test Battery (Reitan, 1969) were used to measure psychomotor processing speed. Attentional and working memory processes were evaluated with the Digit Span subtest of the WAIS-III and Trail Making Tests (Part B). The ratio of time required to complete Trails B relative to Trails A was evaluated as an index of the effect of increased

cognitive demand on cognitive functioning. Reliability coefficients of these neuropsychological tests with adolescents (ages 18-19; alphas = .80 - .91) and young adults (ages 20-24; alphas = .83 - .90) are strong. Trained research assistants administered each of the five neuropsychological tests beginning with the Visual Reproduction test of the WMS-III. During the 25-35 minute delay between immediate and delayed recall on Visual Reproduction, participants completed the Digit Symbol, Digit Span (Forwards and Backwards), and Block Design tests of the WAIS-III, followed by the Trail Making Tests (Parts A & B) of the Halstead-Reitan.

Computer-Administered Behavioral Measures of Decision Making. Impulsivity and inhibitory control were evaluated with a modified version of the Go-Stop Paradigm (GSP; Logan, Schachar, & Tannock, 1997). The GSP involved two concurrent tasks: a "go" task which required participants to discriminate between visual stimuli, and a "stop" task that involved the delayed presentation of an auditory stimulus that signaled participants to inhibit their response. Each trial consisted of the presentation of a fixation point in the center of the screen for 500 ms, followed by presentation of one of four visual go-stimuli (A, B, C, or D) for 1000 ms. After an initial practice session consisting of 48 trials designed to familiarize participants with the task, participants completed 192 test trials, of which 48 (25%) included presentation of the stop signal (a tone). Participants received instructions to click the left button on a serial mouse as quickly as they could if the target stimulus was either A or B, and the right button

if the stimulus was either C or D, but not to press either button if the stop signal (tone) was presented. The standardized instructional set also informed participants that they should not wait for the stop signal because the tone would occur infrequently and it was expected that they would be unable to inhibit some responses.

In the modified version used in the current research, the delay between go and stop signals on each stop trial was dependent on the participant's performance on the immediately preceding stop trial. Initially set at 250 ms, the delay between go and stop signal presentations either increased by 50 ms (if the participant failed to inhibit) or decreased by 50 ms (if the participant successfully inhibited a response) on each subsequent stop trial (e.g., Osman, Kornblum, & Meyer, 1986, 1990; Logan, et al., 1997). The modified GSP produced a mean "go" reaction time (the average of all reaction times across trials where no stop signal was presented), an estimated stop signal reaction time (stop signal delay at which each participant inhibited 50% of the time) which served as the primary measures of impulsivity and inhibitory control, and two accuracy measures incorporating the correct number of "go" responses (accurate responding in the absence of a stop signal) and "stop" responses (successful inhibition of a response in the presence of a stop signal; Logan et al., 1997).

A computer-based, modified version of the Iowa Gambling Test (IGT; Bechara et al., 2000) provided a behavioral measure of decision-making processes implicated as a potential mechanism underlying the transition from casual alcohol

use to alcohol abuse (Bechara & Damasio, 2002). Participants were informed that they would play a game with the goal of winning as much "money" as possible. They were told that the money rewards in the game were imaginary and that they would not be able to keep the money that they won. Further, they were encouraged to treat the imaginary money in the game as if it were real money, and to make decisions based on how they would if they were gambling with their own money. The game involved using the computer mouse to select cards, one at a time, from any of four card decks appearing on the computer screen (labeled A, B, C, and D). Participants were told that each time they selected a card from any of the four decks, they would win an unspecified amount of money; however, in some instances they would also lose money. Standardized instructions informed participants that they were free to select from any deck they wished on each trial and that, although some decks were worse than others, the game was set up so that they would win money if they could stay away from the worst decks. The card decks of the modified IGT were created such that selection of cards from Deck A or Deck B resulted in an average win of $100 across each card in the respective decks, whereas selection of cards from Decks C and D resulted in an average gain of only $50. In spite of the larger wins associated with Decks A and B, the penalties associated with the first block of 10 cards in each deck resulted in a net loss of $250, whereas selection of the first 10 cards in Decks C and D resulted in a net gain of $250. The magnitude of losses and gains associated with each deck increased for each subsequent block of 10 cards with losses associated

with Decks A and B increasing by $150 (block 2 results in a net loss of $400, block 3 results in a net loss of $550, and so on) and gains associated with Decks C and D increasing by $50 (block 2 results in a net gain of $300, block 3 results in a net gain of $350, and so on). The distinction between Decks A and B and Decks C and D is that for Decks A and C the magnitude of punishment remained the same but the frequency of punishment increased, whereas in Decks B and D the frequency of punishment remained constant while the magnitude of punishment increased. Each participant was given a starting imaginary balance of $2000 and 6 seconds to make each of 100 selections. Performance on the Iowa Gambling Test was evaluated by four outcome variables: Motivation (high scores indicate that choices were driven more strongly by anticipated gains vs. the losses associated with a deck); Learning-Rate (high scores reflect that choices were driven by more recent outcomes of a particular deck); and Choice Consistency (high scores indicate selections are consistent with the learned expectations for each deck as opposed to being made randomly).

CHAPTER 3: STUDY 1

Rationale, Aims, and Hypotheses

Previous research provides compelling evidence that differences in subjective response to alcohol may identify young adult drinkers who are at a greater risk for experiencing alcohol-related problems and persisting in heavy drinking patterns (e.g., Viken et al., 2003; King et al., 2002; Schuckit, 1994). A variety of ethical, legal, and practical [e.g., time, resources, funding; (e.g., Schuckit et al., 2007)] considerations, however, often preclude the administration of alcohol to at-risk individuals, thereby significantly limiting the extent to which this marker has been effectively utilized to identify those presumed to be at greatest risk. This is particularly true within the population of emerging adults below the legal drinking age, thereby necessitating the identification of self-report measures and/or physiologically-based behavioral markers (e.g., general sensitivity to physiological sensations, neuropsychological processes) that are reliably associated with subjective response to alcohol and may be useful screening devices for underage drinkers. Consequently, utilizing a sample of young adult large effect drinkers in a within-subjects design, Study 1 combined questionnaire, laboratory, and standardized alcohol-administration methodologies in order to: (1) assess the factor structure, internal consistency, construct validity, discriminant validity, and criterion validity of self-report measures of anticipated subjective response to alcohol based on a hypothetical drinking scenario; and (2)

evaluate the associations between individual differences in the subjective experience of a moderate dose of alcohol and response to a variety of physiological and perceptual challenge procedures, aspects of cognitive functioning, and behavioral indices of decision-making processes.

Hypothesis 1.

It was predicted that the self-report measures of anticipated subjective response to alcohol based on a hypothetical drinking scenario targeting a BAC of .08% would be strongly associated with actual subjective response following consumption of a moderate dose of alcohol also to a BAC of .08%.

Hypothesis 1a. It was expected that the factor structures for both the hypothetical and actual self-report measures of subjective response to alcohol would each consist of the four previously identified factors of Stimulant, Positive, Impaired, and Sedative (Kruse et al., June 2004), and that the internal consistency/reliability for each of these factors in both the hypothetical and actual measures would be strong.

Hypothesis 1b. Further, it was predicted that factor scores for the hypothetical and actual measures of subjective response would yield similar means and be strongly correlated with one another in a sample of experienced college drinkers. It was also anticipated that the strength of the correlations between the hypothetical and actual subjective response scores would improve as a function of increased familiarity/experience with the hypothetical drinking

scenario (i.e., frequency of drinking experiences consistent with hypothetical drinking scenario).

Hypothesis 1c. Whereas modest but statistically significant correlations between the measures of hypothetical subjective response to alcohol and measures of alcohol expectancies are anticipated, it was believed that expectancies would fail to contribute significantly to the prediction of actual subjective response to alcohol factor scores.

Hypothesis 1d. Consistent with preliminary evidence from our laboratory (Kruse et al., June 2004), hypothetical and actual measures of subjective response were expected to be associated with a variety of alcohol consumption patterns within this sample of young adult drinkers. Specifically, heavier drinking patterns were predicted to be associated with lower anticipated and actual Impaired and Sedative factor scores and higher anticipated and actual Positive and Stimulant effects of alcohol.

Hypothesis 1e. Differences in hypothetical and actual measures of subjective response to alcohol were expected based on family history of problematic drinking. Specifically, students who identified at least one family member as a problem drinker were predicted to endorse higher Positive and Stimulant effects (e.g., Earleywine, 1994a), and lower Impaired and Sedative effects of alcohol on both the hypothetical and actual measures (e.g., King et al., 2002).

Hypothesis 2.

It was hypothesized that individual differences in subjective response to alcohol would be representative of a general pattern of responsiveness to physiological sensations, rather than indicative of a subjective response pattern unique to alcohol ingestion. As such, **y**oung adults who experience a low subjective response to a moderate dose of alcohol were predicted to endorse fewer and less intense physiological sensations induced by the five physiological and perceptual challenges.

Hypothesis 3.

It was hypothesized that baseline differences in neuropsychological functioning (measures of cognitive abilities and behavioral indices of decision-making processes) would be associated with individual differences in subjective response to a moderate dose of alcohol in this sample of non-alcohol-dependent, high-functioning, young adult, college students.

Hypothesis 3a. Consistent with previous research demonstrating that attentional, visuospatial, and motor speed processes are associated with alcohol dependence in a sample of college students (Sher et al., 1997), it was hypothesized that individuals with a low subjective response to a moderate dose of alcohol would perform more poorly on the attentional, visuospatial, and motor speed tasks.

Hypothesis 3b. Consistent with prospective findings implicating impaired behavioral inhibition as a risk factor for the development of alcoholism

(e.g., Rubio et al., 2008) and preliminary evidence from our own laboratory (Corbin et al., unpublished data), it was anticipated that young adults who report a low level of subjective response to alcohol would exhibit greater impairment in behavioral inhibition on the Go-Stop Paradigm (i.e., slower stop signal reaction time).

Hypothesis 3c. Based on the work of Bechara and colleagues implicating a deficit in the ventromedial prefrontal cortex as a potential mechanism underlying the transition from casual alcohol use to alcohol abuse and dependence (e.g., Bechara & DaMasio, 2002), it was hypothesized that individuals who demonstrate a low level of subjective response to alcohol would perform in a similar manner on the Iowa Gambling Test. That is, it was predicted that the risk associated with a low subjective response to alcohol would be correlated with a behavioral manifestation of increased risk assessed by this procedure. Specifically, lower ratings of the impairing and sedative effects of alcohol were hypothesize to be associated with more frequent selection of cards from decks 'A' and 'B' (which offer a larger initial reward, average of $100 vs. $50 for decks 'C' and 'D'), even after participants begin to experience the more significant losses associated with those two decks. This behavioral pattern would be indicated by higher scores on the Motivation subscale which are interpreted to reflect behavior being more strongly driven by anticipated rewards than consideration of potential loss.

Method

Participants

A total of 132 unmarried, 21 to 23 year-old, male and female social drinkers were successfully recruited for participation in Study 1 from a variety of sources at UT including the subject pool of introductory psychology students, flyers posted around campus, and an advertisement placed in the student newspaper. All participants were screened for eligibility and inclusion criteria was based on classification as a large effect drinker (i.e., endorsement of at least one instance of getting drunk on alcohol during the previous three month period), as well as the absence of symptoms of alcohol dependence and/or contraindications (medical, personal, or ethical) to the ingestion of alcohol. Of those successfully recruited, a total of 16 were identified as ineligible (see below for details) and data obtained from these individuals were excluded from all subsequent analyses resulting in a final sample size of 116 participants (51% male; *M* age = 21.4 years, *SD* = 0.6). The majority of these 116 participants self-identified as Non-Hispanic Caucasian (72%), 12% were Asian American/Pacific Islander, 10% Hispanic/Latino/a, 1% African-American, and 5% endorsed multiple racial/ethnic categories. Participants enrolled in introductory psychology courses received up to 3.5 hours of course credit and financial compensation ($5/hr) thereafter, and those recruited from the larger university community received $5/hr towards a maximum of $50 as compensation for their participation in this study.

Procedures

Students interested in participating were screened through the use of an on-line survey or by telephone interview to determine eligibility. Eligible students were scheduled for one individual laboratory session and one group (2-4 participants) alcohol administration session, separated by approximately 2 weeks and counterbalanced to control for order effects (see description below). The day prior to each session, all participants received reminder e-mails and/or phone calls with the time of the appointment, a reminder of study requirements (e.g., abstinence from alcohol and other non-prescription drugs for 24 hours), and directions to the laboratory. At the conclusion of the first session, participants received an appointment card with the date and time of their second scheduled appointment. After completing the second session, all participants were fully debriefed, provided with financial compensation, and given the appropriate paperwork to receive partial course credit for their participation (if applicable).

Individual Laboratory Session. Upon arrival for the laboratory session, participants provided photo identification, completed the informed consent form, and submitted to a breathalyzer test (Intoxilyzer 5000, CMI, Inc. Owensboro, KY) to ensure .00% BAC. All participants were weighed and trained research assistants used each student's gender and weight to determine the number of standard drinks each participant was asked to imagine consuming for the self-report measures of anticipated subjective response to alcohol (Appendix B).

Participants then completed a packet of self-report questionnaires assessing demographics, family history of alcoholism, typical alcohol consumption, experience of alcohol-related problems during the past three months, perceived subjective tolerance to alcohol, and anxiety sensitivity. Next they completed the measures of anticipated subjective response to alcohol based on the hypothetical drinking scenario. Upon completion of these self-report measures, trained research assistants administered the five neuropsychological tests to participants (Visual Reproduction, Digit Symbol Coding, Digit Span, Block Design, and Trail Making Parts A & B) followed by the 15-second spinning challenge protocol.

All subsequent procedures for the laboratory session were paired and counter-balanced so that participants completed one of two sets of physiological and perceptual challenge procedures [either (a) the CO_2 Challenge and Visual Perception tests, counter-balanced; or (b) the Cold Pressor and Auditory Perception tests, counter-balanced], followed by the two computer-administered behavioral measures of decision-making processes (the Go-Stop Paradigm and the Iowa Gambling Test, counter-balanced), and then the remaining set of physiological and perceptual challenge procedures.

Group Alcohol Administration Session. In addition to abstaining from alcohol and other non-prescription drug use, all participants were instructed to eat a full meal four hours prior to their scheduled appointment and to refrain from driving themselves to the laboratory as they would be provided with

transportation home by the research staff at the end of the protocol. Upon arrival for the alcohol administration session, participants provided photo identification as proof of legal drinking age, completed the informed consent form, were weighed (for the purpose of performing alcohol administration dose calculations) and submitted to a breathalyzer test (Intoxilyzer 5000) to ensure .00% BAC. Female participants were also required to test negative for pregnancy prior to being administered alcohol. Each female participant was provided with a urine pregnancy test and instructions on how to self-administer the test in a private bathroom by a female member of the research team. After the requisite time period, the outcome of the test was viewed by the participant and confirmed by the female research team member.

Participants then completed a packet of self-report questionnaires assessing alcohol expectancies, distress tolerance, mindfulness, and body vigilance prior to being escorted to a simulated bar where they were given 10 minutes to consume each of three beverages (30 minutes total) containing a 1:3 mixture of 80 proof vodka (men: 2.389 ml/kg of body weight; women: 2.174 ml/kg of body weight) to cranberry and orange juice mixer to achieve a target BAC of .08%. Following a 30-minute absorption period (beginning individually with the completion of each participant's third drink), participants rinsed with alcohol-free mouthwash and had their BACs assessed with two instruments: the Intoxilyzer 5000 and Alco-Sensor IV. BACs were assessed a second time 60-minutes after completion of the third beverage at which time participants

completed the measures of subjective intoxication based on how they currently felt. BACs were measured again at 90 and 120-minutes post-absorption and then every hour thereafter. Participants were driven home by licensed and insured project staff once their BACs were below .02%.

Results

Preliminary Analyses and Sample Characteristics

Identification of Ineligible Participants. Prior to conducting analyses, a total of 16 ineligible participants (12.1%) were identified and removed from the sample. Five participants (3.8%) did not complete both study sessions (four did not complete the individual laboratory assessment and the fifth did not return for the alcohol-administration session), and two others (1.5%) arrived at the alcohol administration session with a positive BAC and were prevented from continuing their participation in the study. Five participants (3.8%) failed to reach the minimum threshold for BAC pre-determined by the researchers to be a pharmacologically effective dose for the current study (BAC of .05%). The remaining four participants (3.0%) were excluded because they provided excessive missing data (n = 2) or were identified as extreme outliers (n = 2) on the key variables of interest (i.e., hypothetical and actual subjective intoxication measures). In the case of both identified outliers, discrepancy scores between the hypothetical and actual subjective response measures were far greater than three standard deviations for each of the examined factors. Visual inspection of the

data provided by these two participants revealed minimal within measure variability with responses anchored towards the opposite extremes across the hypothetical and actual measures (e.g., one participant endorsed the highest level for each of the hypothetical items and the lowest response option for all of the items on the actual subjective response to alcohol measure) which called into question the validity of responses. This pattern of responding was not observed for any of the participants included in the analyses.

Estimated and Actual BAC. Mean estimated peak BAC based on the drinking scenario described in the hypothetical subjective response measures was .081% (*SD* = .006). Mean actual BAC measured immediately prior to completion of the actual subjective response measures was .075% (*SD* = .012%), slightly lower than the targeted .080%. There were no differences in estimated or actual BAC by gender, *p*'s > .50.

Family History of Problem Drinking. Almost one quarter of participants (n = 26; 23%) identified at least one biologically-related family member (parents, grandparents, siblings) as a definite problem drinker (*M* = 1.3, *SD* = 0.5). When the identification criteria was relaxed from "definite" to "probable," an additional 24% (n = 27) reported that they suspected that at least one family member had a problem with drinking, *M* = 1.3, *SD* = 0.7. In total, nearly half of Study 1 participants (47%; n = 53) acknowledged some level of family history of problematic drinking, *M* = 1.5 family members, *SD* = 0.7. There

were no gender differences in family history of problematic drinking groups (none, probable, definite), χ^2 (2, N = 113) = 0.02, p = .99.

Typical Alcohol Consumption, Large Effect Drinking, and Alcohol-Related Problems. Participants acknowledged consuming alcohol on average 3.14 days per week (*SD* = 1.23; range 0-7) and reported that they typically consumed 4.07 standard drinks per drinking occasion (*SD* = 2.37; range 1-15.5). The average number of drinking episodes reported in the last three months was 33.77 (*SD* = 22.49), with drinking to intoxication (i.e., large-effect drinking) occurring on slightly less than one-third of these occasions (*M* = 10.29; *SD* = 11.98). Over 90% of the sample acknowledged experiencing at least one negative alcohol-related consequence in the past three months, *M* = 7.18, *SD* = 6.77.

Results of a 2 (gender) x 3 (family history of problematic drinking: none, probable, definite) multivariate analyses of variance (MANOVA), revealed a significant multivariate main effect of gender, $F(5, 104) = 5.37$, $p < .001$, with follow-up univariate analyses demonstrating that women reported lower typical quantities of alcohol consumption (*M* = 2.98, *SD* = 1.43), $F(1, 107) = 21.63$, $p < .001$, and less frequent drinking to intoxication (*M* = 7.62, *SD* = 9.07), $F(1, 107) = 4.85$, $p < .05$, than men (*M* = 4.90, *SD* = 2.80 and *M* = 12.82, *SD* = 13.81, respectively). Men and women did not differ in reported average number of drinking episodes per week (p = .30), total number of drinking episodes in the past three months (p = .92), or total number of alcohol-related consequences experienced in the past three months (p = .45). The multivariate main effect of

family history, $F(5, 104) = 1.38$, $p = .24$, was not significant suggesting that level of familial risk was unrelated to self-reported typical drinking. There multivariate family history x gender interaction was not statistically significant, $F(5, 104) = 0.94$, $p = .46$.

Perceived Tolerance and Estimated BAC to Feel "Drunk."

Participants in the current study reported an average score of 38.23 (*SD* = 11.03; observed range 15-62) on the Subjective Tolerance Index, suggesting that as a group these young adults rated their tolerance as roughly equivalent to their average peers' (scale possible range 10-70; 40 indicates same perceived tolerance as peers). Estimated BAC to feel intoxicated was calculated according to standardized dosing formulas incorporating gender, weight, and number of standard drinks to feel "drunk" if consumed within 30 minutes (Matthews & Miller, 1979). The average estimated BAC needed to feel drunk was .117% (*SD* = .044%; range .037-.249%), or nearly 50% higher than the legal level of intoxication and the targeted BAC level in the current study (.08%).

Group differences in these indices of subjective tolerance were examined with a 2 (gender) x 3 (family history of problematic drinking) MANOVA. A significant multivariate gender by family history of problematic drinking group interaction was observed, $F(2, 107) = 3.47$, $p < .05$, with follow-up analyses demonstrating that women with no reported family history of problematic drinking estimated their tolerance to the effects of alcohol as lower than all other groups, $F(2, 107) = 3.46$, $p < .05$. The multivariate main effect of gender was

also significant, $F(2, 106) = 7.23$, $p < .001$, with follow-up analyses revealing conflicting findings: overall, women endorsed lower levels of subjective tolerance to alcohol than men ($M = 35.07$, $SD = 10.67$ vs. $M = 41.22$, $SD = 10.61$), $F(1, 107) = 4.31$, $p < .05$; however, they also estimated that they would, on average, need to achieve higher levels of BAC before feeling drunk, $M = .128\%$, $SD = .048\%$, than the men in the current study, $M = .107\%$, $SD = .038\%$, $F(1, 107) = 6.72$, $p < .05$. The multivariate main effect of family history of problematic drinking failed to reach statistical significance, $F(2, 107) = 2.73$, $p = .07$, suggesting that level of familial risk was not associated with estimates of subjective tolerance in this sample.

Familiarity with Hypothetical Drinking Scenario for the Anticipated Subjective Response to Alcohol Measures. More than 97% of study participants reported that they had consumed the amount of alcohol within the time frame described in the drinking scenario utilized to measure hypothetical subjective response to alcohol at least once in the last three months, $M = 7.82$, $SD = 10.53$. This finding suggests that the vast majority of these young adults were able to rely on recollections of their recent drinking experiences when completing the hypothetical measures of subjective response to alcohol. A 2 (gender) x 3 (family history of problematic drinking) analyses of variance (ANOVA) revealed no significant main effects of gender, $F(1, 107) = 0.12$, $p = .73$, or family history of problematic drinking, $F(2, 107) = 1.49$, $p = .23$, on familiarity with the hypothetical drinking scenario used to evaluate anticipated subjective response to

alcohol. In addition the multivariate gender by family history interaction failed to reach statistical significance, $F(2, 107) = 0.16$, $p = .85$.

Hypothetical and Actual Measures of Subjective Response to Alcohol

Factor Structure. Given the relatively small sample size (N = 119) relative to the total number of variables (32) used to identify the factor structure of the measures of subjective response to alcohol in our preliminary study (Kruse et al., June 2004), and an inadequate sample size in the current study to rigorously test the factor structure through confirmatory factor analyses [3.6:1 ratio of sample size to number of variables, well below the 20:1 ratio minimum for CFA suggested by Kline (1994)]; the identical exploratory factor analytic techniques used in the preliminary study were repeated separately for both the hypothetical and actual measures of subjective response collected in Study 1 to examine the consistency of the factor structure for these measures across samples. All raw scores were z-transformed prior to analysis to control for shared measurement variance. Exploratory factor analysis with principal components extraction and promax rotation was used to identify the latent variables contributing to the factor structure for both the hypothetical and actual measures of subjective response to alcohol.

As seen in Table 1, although both sets of analyses yielded four factor solutions with identical item overlap for two of the four previously identified factors (Factor 1 – Positive, 9 items; Factor 2 – Stimulant, 7 items); there were

some discrepancies between the factor loadings for both the hypothetical and actual Impaired (Factor 3) and Sedative (Factor 4) subscales relative to previous findings. On the hypothetical measure, one of the nine items originally included in the Impaired subscale ("muddled or confused") loaded more highly onto the Sedative subscale and a second Impaired item ("uncomfortable") did not load on any of the factors. On the actual measure of subjective response (completed while under the influence of alcohol), four of the seven items originally associated with the Sedative subscale ("slow thoughts," "sleepy," "sluggish," and "lonely") loaded more highly onto the Impaired subscale. Analyses of the component correlation matrices revealed that the items comprising the Impaired and Sedative factors within these exploratory factor analyses were strongly correlated (*r*'s = .63 and .53 for the hypothetical and actual subjective response measures, respectively). Further, the correlations between the Impaired (9 items) and Sedative (7 items) subscales originally suggested in our preliminary study were even higher (*r*'s = .74 and .71 for the hypothetical and actual subjective response measures, respectively). Given the inconsistencies in factor loadings relative to preliminary findings (Kruse et al., June 2004) and the strength of the correlations between these factors, the results of these analyses call into question the relative independence of the Impaired and Sedative subscales previously identified as distinct factors. Subsequent factor analyses were therefore conducted to determine whether the variance in these items could be more parsimoniously explained by a single-factor (i.e., overall subjective response), two-factor (e.g.,

Positive/Stimulant and Impaired/Sedative), or three-factor model in which some or all of the variables originally included in the Impaired and Sedative subscales loaded onto a single combined factor.

In the forced single-factorial analyses, all of the items loaded onto the single factor (i.e., overall subjective response) for the hypothetical measure as did most on the actual measure (28/32; exceptions "uncomfortable", "sedated", "inactive", and "down"); however, these single factors accounted for only 39.1% and 40.4% of the shared variance, respectively, for the measures of hypothetical and actual subjective response to alcohol. The amount of shared variance explained by the forced two-factorial models increased to 56.8% for the hypothetical and 57.2% for the actual measures of subjective response, with item loadings consistent with the combined Positive/Stimulant and combined Impaired/Sedative factors.

In both sets of forced three-factorial analyses (hypothetical and actual), factor loadings were identical to the initial solutions for both the Positive and Stimulant factors and all 16 variables originally associated with the Impaired and Sedative subscales loaded onto a single combined factor (see Table 2). The percentage of total variance accounted for by these 3-factor models (65.1% hypothetical; 64.3% actual) was also similar to the percentage accounted for the initial 4-factor solutions (69.6% hypothetical; 68.7% actual). Combined, the inconsistent pattern of overlap between items originally contained in the Impaired and Sedative subscales across both the hypothetical and actual subjective response

measures, and the finding that all of the items loaded onto a single combined factor in both sets of forced three-factorial analyses while not significantly decreasing the total amount of variance explained, suggest that a three-factorial model is better able to account for the covariation among the variables in the hypothetical and actual measures. Consequently, all subsequent analyses examining the associations between the potential correlates of subjective response to alcohol were examined using this three-factor solution (Positive, Stimulant, and combined Impaired/Sedative).

Internal Consistency. The homogeneity of items within each of the three factors was examined with Cronbach's coefficient alpha for both the hypothetical and actual measures of subjective response to alcohol. Internal consistency ratings were excellent for each factor on both the hypothetical (Hyp) and actual (Act) measures: Positive (9 items; $\alpha_{Hyp} = .94$; $\alpha_{Act} = .95$); Stimulant (7 items; $\alpha_{Hyp} = .94$; $\alpha_{Act} = .95$); and the combined Impaired/Sedative factor (16 items; $\alpha_{Hyp} = .94$; $\alpha_{Act} = .93$).

Construct Validity. The construct validity of the measures of anticipated subjective response to alcohol based on the hypothetical drinking scenario was examined through comparison to subjective response measures completed while under the influence of alcohol. Significant similarities were noted in hypothetical (Hyp) and actual (Act) subjective response scores on all three factors examined: Positive, $M_{Hyp} = 36.73$, $SD = 19.68$, $M_{Act} = 38.18$, $SD = 23.78$; Stimulant, $M_{Hyp} = 48.89$, $SD = 18.98$, $M_{Act} = 48.14$, $SD = 21.37$; and the combined

Impaired/Sedative factor, M_{Hyp} = 25.19, *SD* = 15.18, M_{Act} = 26.52, *SD* = 15.13 (Figure 1). In addition to similar means, analyses of bivariate correlations revealed significant associations and shared variance between each of the three hypothetical and actual factors evaluated: Positive, *r* =.63; Stimulant, *r* = .53; and the Impaired/Sedative factor, *r* = .67; all *p*'s < .001.

It was hypothesized that the strength of the correlations between the hypothetical and actual subjective response measures would vary as a function of participants' experience/familiarity with the drinking scenario used to elicit anticipated levels of subjective response to alcohol. As the number of times participants had reported consuming alcohol in a manner consistent with the hypothetical drinking scenario in the past three months was not normally distributed (*M* = 7.62, *SD* = 10.47; range 0-65; skewness = 3.19; kurtosis = 11.66), a z-transformation was conducted on this variable. Three participants with values greater than three standard deviations above the mean (65, 50, and 48) were removed in order to reduce the influence of these extreme cases on subsequent analyses of the effects of familiarity with the drinking scenario on the concordance between hypothetical and actual scores. Even after removal of these outliers, however, the distribution was not normalized (*M* = 6.38, *SD* = 7.13; range 0-40; skewness = 2.65; kurtosis = 8.52). As such, the results of subsequent analyses on the effects of this variable should be interpreted judiciously. Three different sets of analyses demonstrated that, after removal of statistical outliers, level of experience/familiarity with the hypothetical drinking scenario was not

significantly associated with the concordance between hypothetical and actual subjective response factor scores: evaluation of the association between level of experience/familiarity and discrepancy scores for each factor (*r*'s range from -.05 to .11, all *p*'s > .24); association between familiarity and overall accuracy of the hypothetical measures relative to actual subjective response ratings (calculated as the absolute value of the discrepancy score for each factor; *r*'s range from -.13 to .05; all *p*'s > .18); and changes in partial correlations between the hypothetical and actual subjective response measures after controlling for level of experience/familiarity (all 1-tail *p*'s > .47).

Finally, a median split was conducted based on the number of times participants had consumed alcohol in the manner described in the hypothetical drinking scenario for all of the participants (including the three outliers removed from previous analyses) in order to reduce the influence of extreme cases of this variable on examination of the concordance between hypothetical and actual factor scores. Participants who reported drinking the amount of alcohol within the 30-minute time frame described in the hypothetical drinking scenario 4 or less times in the last three months were classified as less experienced (n = 61; *M* = 2.1, *SD* = 1.3; 49% male; 77% Caucasian), and those who acknowledged 5 or more instances were classified as more experienced (n = 55; *M* = 13.6, *SD* = 12.7; 53% male; 67% Caucasian). As expected, the concordance between the hypothetical and actual subjective response scores was greater for the more experienced group on the combined Impaired/Sedative factor, $r = .78$ vs $r = .54$; $z = -2.31$, $p < .05$.

Level of experience/familiarity with the hypothetical drinking situation, however, did not differentiate the correlations for either the Positive, $r = .64$ vs $r = .63$; z = -0.09, $p = .47$, or Stimulant factors, $r = .58$ vs $r = .47$; z = -0.80, $p = .21$ [significance tests derived from Cohen & Cohen (1983) as implemented by Preacher (May 2002)].

The potential effect of gender on the concordance between hypothetical and actual subjective response to alcohol factor scores was also examined. The correlations were generally higher for women (W) than men (M), although these differences failed to reach statistical significance: Positive $r_W = .69$ vs. $r_M = .56$, z = 1.14, $p = .25$; Stimulant $r_W = .60$ vs. $r_M = .41$, z = 1.36, $p = .17$; and the combined Impaired/Sedative factor $r_W = .72$ vs. $r_M = .58$, z = 1.35, $p = .18$ [Cohen & Cohen (1983) as implemented by Preacher (May 2002)].

Discriminant Validity. Given the methodological similarities between the assessment of anticipated subjective response to alcohol based on the hypothetical drinking scenario and the measurement of alcohol expectancies (i.e., both procedures request participants to anticipate how they would feel after consuming alcohol), the discriminant validity of the hypothetical subjective response measures was evaluated with two sets of analyses. First, bivariate correlations between each of the three factors and the seven CEOA subscales were performed to identify any significant associations between perceptions of subjective response to alcohol (hypothetical) and alcohol expectancies. Second, a series of linear regression analyses were conducted to determine whether

expectancy measures predict individual differences in actual subjective response to alcohol, and if so, whether they account for significant variance beyond shared association with the hypothetical measures.

Based on the total number of independent correlations examined (n = 21; 7 for each of the three hypothetical SR factors), the threshold for statistical significance was adjusted to $p < .002$ via Bonferroni correction to reduce the chance of Type I error. As expected, there were several correlations which reached the adjusted threshold for statistical significance. Both anticipated Positive and Stimulant factors were positively correlated with the CEOA Sociability, Liquid Courage, and Risk and Aggression subscales (r's = .30-.40; all p's < .002). In addition, Positive factor scores were also significantly correlated with expectations for greater Sexual Enhancement ($r = .33$, $p < .001$). The combined Impaired/Sedative subscale was not significantly correlated with any of the CEOA subscales. See Table 3 for correlations between all subjective response factors based on the hypothetical drinking scenario and the CEOA subscales.

A series of linear regression analyses were performed to determine whether any of the seven CEOA measures predicted individual differences in the actual subjective response factor scores (Positive, Stimulant, and combined Impaired/Sedative). None of the expectancy measures predicted actual Stimulant (all p's > .15) or combined Impaired/Sedative (all p's > .30) factor scores. The overall regression model, however, was significant for the prediction of actual Positive factor scores, $F(7, 107) = 2.66$, $p < .05$, with greater expectations for

sexual enhancement associated with the subjective experience of greater positive effects from a moderate dose of alcohol, $\beta = .24$, $t = 2.03$, $p < .05$.

To examine whether expectations for Enhanced Sexuality contributed significantly to the prediction of the experience of Positive effects of a moderate dose of alcohol, independent of it's shared variance with the hypothetical measure ($r = .33$), both variables were entered simultaneously into a second linear regression analysis predicting actual Positive factor scores. As expected, the hypothetical Positive factor score significantly predicted the actual subjective response measure, $\beta = .58$, $t = 7.57$, $p < .001$; with greater expectations for sexual enhancement just missing the cutoff for making a statistically significant independent contribution to the model, $\beta = .15$, $t = 1.97$, $p = .051$.

Criterion Validity. The criterion validity of the measures of perceived and actual subjective response to alcohol was evaluated separately with a series of linear regression analyses predicting five elements of drinking behavior: typical quantity of alcohol consumption, frequency of drinking episodes, frequency of large effect drinking (i.e., drinking to the point of feeling "drunk"), the experience of alcohol-related problems, and estimated BAC to feel drunk.

Greater anticipated Positive effect scores (assessed with the hypothetical measure) were associated with an increased frequency of drinking, $\beta = .37$, $t = 3.07$, $p < .01$, and greater number of alcohol-related consequences, $\beta = .33$, $t = 2.74$, $p < .01$; however, higher actual Positive effects ratings (assessed under the influence of alcohol) were only associated with more frequent drinking, $\beta = .28$, t

= 2.05, $p < .05$. The combined Impaired/Sedated factor score based on the hypothetical drinking scenario was inversely associated with estimated BAC to feel drunk, $\beta = -.46$, $t = -4.68$, $p < .001$, and frequency of drinking, $\beta = -.28$, $t = -2.70$, $p < .01$. In addition, there was a non-significant trend between lower anticipated Impaired/Sedated factor scores and greater typical quantity of alcohol consumed per drinking occasion, $\beta = -.19$, $t = -1.78$, $p = .08$. The associations between the actual combined Impaired/Sedated factor scores and drinking outcome variables were similar, with lower actual scores significantly associated with higher estimated BAC to feel drunk, $\beta = -.24$, $t = -2.22$, $p < .05$, greater typical quantity of alcohol consumed per drinking episode, $\beta = -.22$, $t = -2.01$, $p < .05$, and a non-significant trend towards increased frequency of drinking, $\beta = -.20$, $t = -1.86$, $p = .07$. The Stimulant factors assessed by the hypothetical drinking scenario and while under the influence of alcohol were not significantly associated with any of the drinking outcome variables.

Given evidence of lower subjective response to alcohol in individuals with a family history of alcoholism (e.g., Schuckit, 1984; 1980), analyses of variance (ANOVAs) was conducted to determine whether hypothetical and/or actual subjective response factor scores differed by self-reported family history of problematic drinking (none, probable, and definite). No significant differences in either hypothetical or actual subjective response factor scores were observed by level of family history (all p's > .23). Similarly, no significant differences in either hypothetical ($p = .74$) or actual ($p = .60$) subjective response factor scores

were observed when participants who endorsed any level of family history of problematic drinking (probable or definite; n = 53) were compared to those who did not (n = 60).

Finally, the association between anticipated and actual subjective response to alcohol factor scores were examined in relation to perceptions of subjective tolerance through separate linear regression analyses. In both sets of analyses a similar trend was noted; lower anticipated, $\beta = -0.24$, $t = -2.26$, $p < .05$, and actual, $\beta = -0.30$, $t = -2.76$, $p < .01$, Impaired/Sedative scores were significantly associated with increased perceptions of subjective tolerance to alcohol relative to peers. Individual differences in anticipated and actual Positive (p's > .18) and Stimulant (p's > .25) were unrelated to an individual's perception of his/her tolerance to alcohol.

Potential Correlates of Subjective Response to Alcohol

Psychological Factors. Given the reliance of both the hypothetical and actual self-report measures of subjective response to alcohol on perception of internal physiological sensations, it was presumed that each participant's ability to identify and accurately rate these stimuli would be naturally influenced by a variety of psychological factors including mindfulness, body vigilance, anxiety sensitivity, and distress tolerance. Simple bivariate correlations were used to identify any significant associations between these constructs and individual differences in hypothetical and actual subjective response. Given the large

number of independent comparisons examined (two sets of 24 comparisons; 8 psychological variables for each of the three subjective response factors), the threshold for statistical significance was adjusted to $p < .002$ via Bonferroni correction to reduce the chance of committing Type I errors.

There were a number of small correlations between the subjective response factor scores and psychological variables were significant at the $p < .01$ level (6 of 48) and $p < .05$ level (3 of 48); however, none of these small to modest associations broached the Bonferroni-corrected threshold for statistical significance. These results therefore suggest that the hypothetical and actual ratings of subjective response to alcohol were unrelated to differences in anxiety sensitivity, mindfulness, body vigilance, or distress tolerance in this sample of young adults (see Table 4 for bivariate correlations).

Second, the potential effect of each psychological variable on the strength of the association between the hypothetical and actual subjective response measure factors was examined with a series of partial correlations. The correlations between each set of hypothetical and actual factor scores were not significantly changed after statistically controlling for any of the personality measures, suggesting that none of the psychological factors examined had a significant influence on the strength of these associations (i.e., the accuracy of the hypothetical subjective response measures; all p's > .80).

Finally, given the known associations between these psychological constructs and response to certain physiological challenge procedures (e.g.,

anxiety sensitivity and response to the Carbon-Dioxide challenge; physical distress tolerance and performance on the Cold Pressor Test), these variables were identified as potential moderators to be included in any analyses of significant associations between measures of actual subjective response to alcohol and the physiological and perceptual challenges.

Subjective Response to Physiological and Perceptual Challenges. Prior to examining the associations between the subjective experience of each of the physiological and perceptual challenges and actual subjective response to a moderate dose of alcohol, we first sought to examine whether there was evidence for shared variance between reactions to the five challenge protocols (Carbon Dioxide Challenge, Cold Pressor Test, Spinning Challenge, Auditory Perception Test, and Visual Perception Test). Analyses of a single-item ratings of the overall intensity of the sensations induced by each protocol identified a modest but statistically significant correlation between ratings for the Auditory and Visual Perception tests, even after adjusting for multiple comparisons, $r = .32$, $p < .001$. No other correlations, however, reached the Bonferroni-adjusted criteria for statistical significance.

Examination of the associations between induced physiological sensations for the Carbon-Dioxide Challenge (BSQ & API), Cold-Pressor Test (BSQ & API), and Spinning Challenge (average of induced dizziness, lightheadedness, wobbly/rubber legs, and nausea) also revealed no significant correlations (all r's < .15), suggesting that individual differences in the subjective experience to and

ratings of these challenges were associated with distinct mechanisms of action and not a single underlying construct. Mean ratings of the most intense (100 db tone; 100 watt light bulb) and least intense (20 db tone; 25 watt light bulb) stimuli from the Auditory and Visual Perception Tests were significantly associated, *r*'s = .40 and .36, respectively, *p*'s < .001, providing some additional evidence that these two tasks may have been assessing a similar perceptual construct. The overall magnitude of these statistically significant correlations (and the resulting percentage of variance explained), however, was modest suggesting that other non-shared factors were likely contributing to observed individual differences in these ratings.

Given the absence of significant evidence demonstrating a common mechanism underlying individual differences in subjective response to these five physiological and perceptual challenge procedures, outcome variables from each protocol were examined separately in relation to the three factors of actual subjective response to alcohol in a series of analyses. First, simple bivariate correlations were used to identify any statistically significant associations between the level of sensations induced by each of the five physiological and perceptual challenge protocols and the three actual subjective response to alcohol factor scores (Positive, Stimulant, and combined Impaired/Sedative). Second, variables identified as significantly associated with actual subjective response to alcohol factor scores were entered into regression analyses with the hypothetical

measure to determine whether they contributed significantly to the prediction of individual differences in the subjective experience of a moderate dose of alcohol.

Carbon-Dioxide Challenge (CO_2). Six outcome variables were obtained for the Carbon-Dioxide Challenge: change in positive mood states (POMS), change in negative mood states (POMS), change in physiological sensations as measured independently by the BSQ and API, a single item assessing the overall intensity of the sensations experienced during the protocol, and a dichotomous variable measuring voluntary termination of the CO_2 challenge. Internal reliability was good for each of the four combined change score measures: change in positive mood states (6 items; $\alpha = .85$), change in negative mood states (14 items; $\alpha = .84$), change in BSQ ratings (16 items; $\alpha = .85$), and change in API ratings (17 items; $\alpha = .84$). As anticipated, participants reported on average a slight decrease in positive mood states, $M_{\Delta} = -0.75$, $SD = 0.72$, and a slight increase in negative mood states, $M_{\Delta} = 0.19$, $SD = 0.43$, as assessed by the POMS after completing the carbon dioxide challenge relative to pre- CO_2 ratings. Participants also reported on average slightly elevated levels of physiological sensations relative to pre- CO_2 levels on both the modified BSQ, $M_{\Delta} = 3.96$, $SD = 6.17$, and API, $M_{\Delta} = 3.95$, $SD = 6.01$. The mean overall intensity rating of the physiological sensations induced by the CO_2 challenge was 2.97, $SD = 1.50$, observed range 1-6. Five (4%) of the participants voluntarily terminated the procedure by removing the mask prior to the end of the 10-minute protocol, $M = 4$ minutes, 39.2 seconds, $SD = 3$ minutes, 8.7 seconds.

There were a total of fifteen bivariate correlations evaluated which resulted in a Bonferroni-adjusted $p < .003$ criterion for statistical significance. None of the correlations examined reached this threshold, suggesting that responsiveness to the carbon dioxide challenge was unrelated to the subjective experience of the pharmacological effects of a moderate dose of alcohol (*r*'s range -.23 to .26). As such, regression analyses were not conducted. The small number of participants who voluntarily terminated the carbon dioxide challenge (n = 5) relative to those who completed the protocol (n = 107) precluded meaningful analyses of differences between these two groups.

Cold-Pressor Test (CPT). A total of nine different outcome variables were measured for the Cold-Pressor Test: change in positive mood states, change in negative mood states, change in physiological sensations as assessed separately by the BSQ and API, immediate SUDS rating, peak SUDS rating, final SUDS rating, a single item assessing the overall intensity of the sensations experienced during the protocol, and a dichotomous variable measuring voluntary termination of the protocol. Internal reliability was adequate for each of the four combined change score measures: change in positive mood states (6 items; $\alpha = .75$), change in negative mood states (14 items; $\alpha = .78$), change in BSQ ratings (16 items; $\alpha = .77$), and change in API ratings (17 items; $\alpha = .77$). On average, participants reported a slight decrease in positive mood states, $M_{\Delta} = -0.54$, $SD = 0.66$, and slight increase in negative mood states, $M_{\Delta} = 0.20$, $SD = 0.42$, as assessed by the POMS relative to pre-CPT levels. Ratings of physiological sensations were

increased relative to pre-CPT levels on both the modified BSQ, M_{Δ} = 9.39, *SD* = 7.53, and API, M_{Δ} = 3.19, *SD* = 5.49. The average immediate SUDS rating (assessed as soon as the participant immersed his/her hand in the water) was 47.96 (*SD* = 25.27), the highest SUDS rating for participants averaged 75.55 (*SD* = 22.40), and on average participants reported a SUDS rating of 61.96 (*SD* = 29.89) at the termination of the protocol (either 300 seconds or at the point when the procedure was voluntarily terminated). The mean overall intensity of the physiological sensations induced by the CPT protocol was 6.10, *SD* = 0.87, observed range 4-7. Fifty-one (44%) of the participants voluntarily terminated the task by removing their hand from the water prior to the end of the 5-minute protocol, *M* = 57.88 seconds, *SD* = 50.94.

None of the bivariate correlations between Cold Pressor Test outcome variables and the three factors of subjective response to alcohol met the Bonferroni-adjusted criteria for statistical significance ($p < .002$; *r*'s range -.28 to .29), so planned follow-up regression analyses were not conducted. Whereas scores were slightly higher for those participants who voluntarily terminated the CPT protocol on all three subjective response to alcohol factors assessed, none of these differences reached statistical significance (Table 5). Combined, these analyses suggest that individual differences in subjective response to alcohol are also relatively independent of the subjective experience of sensations induced by the Cold Pressor challenge.

Spinning Challenge. The 15-second Spinning Challenge yielded four outcome variables: (1) change in the four physiological sensations assessed pre and post-spinning (lightheadedness, dizziness, wobbly-rubber legs, and nausea); (2) the number of rotations completed prior to termination of the protocol; (3) a single item assessing the overall intensity of the sensations experienced during the protocol; and (4) a dichotomous variable representing voluntary termination of the task prior to the end of the 15-second challenge. Internal reliability was adequate for the four-item physiological sensation change score measure ($\alpha = .68$). On average, participants reported significantly increased physiological sensations relative to pre-Spinning levels, $M_{\Delta} = 37.14$, $SD = 19.26$. The average number of completed rotations prior to termination of the protocol was 9.5 ($SD = 2.7$). The mean overall intensity of the physiological sensations induced by the spinning challenge was 5.01, $SD = 1.20$, observed range 2-7. Only three (2.6%) of the participants voluntarily terminated the task by stopping spinning prior to the end of the 15-second protocol, $M = 12.7$ seconds, $SD = 0.6$.

There were no statistically significant correlations between the spinning outcome measures and the actual subjective response to alcohol factor scores (r's range -.05 to .15), so follow-up regression analyses were not performed. Once again, the small number of participants who voluntarily terminated the spinning challenge (n = 3) relative to those who completed the procedure (n = 113) precluded meaningful analyses of between-group differences.

Auditory Perception Test. No significant correlations (*r*'s range -.07 to .18) were observed between the actual subjective response to alcohol factor scores and the outcome variables derived from the auditory perception test: (1) 20 db average intensity rating, *M* = 10.37, *SD* = 10.12; (2) 40 db average intensity rating, *M* = 14.87, *SD* = 11.00; (3) 60 db average intensity rating, *M* = 24.85, *SD* = 14.68; (4) 80 db average intensity rating, *M* = 36.71, *SD* = 17.31; (5) 100 db average intensity rating, *M* = 59.78, *SD* = 21.93; or (6) a single item assessing the overall intensity of the sensations experienced, *M* = 3.57, *SD* = 1.21, observed range 1-6.

Visual Perception Test. No significant correlations (*r*'s range -.08 to .18) were observed between the actual subjective response to alcohol factor scores and the outcome variables derived from the visual perception test: (1) 25 Watt average intensity rating, *M* = 28.01, *SD* = 13.12; (2) 40 Watt average intensity rating, *M* = 37.60, *SD* = 15.24; (3) 75 Watt average intensity rating, *M* = 58.36, *SD* = 18.84; (4) 100 Watt average intensity rating, *M* = 67.08, *SD* = 19.56; and (5) a single item assessing the overall intensity of the sensations experienced during the protocol, *M* = 3.85, *SD* = 1.38, observed range 1-6.

Neuropsychological Functioning. In general, participants in the current study performed quite well on the measures of neuropsychological functioning. Visuospatial abilities, as measured by performance on the Block Design subtest, *M* = 52.6, *SD* = 9.7, Standard Score Equivalent (SS) = 13.1, and non-verbal memory as assessed by the Visual Reproduction Immediate, *M* = 94.1, *SD* = 8.1,

SS = 11.8, and Delayed recall, *M* = 76.9, *SD* = 17.13, SS = 11.8, were above average relative to similar-aged peers. Processing speed abilities, as assessed by the Digit Symbol Coding, raw score *M* = 97.42, *SD* = 12.88, and Trail Making A test, completion time *M* = 19.1 seconds, *SD* = 5.7, were also in the high average range relative to same-aged peers with 93.9% and 74.1% performing at or above expectations on these tests, respectively. Attentional processes and working memory, as measured by performance on the Digit Span subtest of the WAIS-III, *M* = 19.7, SS = 11.6, and completion of Trails B, *M* = 59.0 seconds, *SD* = 9.8, were also in the high end of the average range. Finally, an estimate of reduced performance in the context of increased cognitive demand (the ratio of time to complete Trails B relative to the time to complete Trails A) was within normal limits, *M* = 2.3, *SD* = 0.6, for participants in the current study.

Similar to the strategy employed for the physiological and perceptual challenge procedures, simple bivariate correlations were first performed between the three actual subjective response to alcohol factor scores and outcome variables from the neuropsychological tests administered by functional domain: non-verbal memory and visuospatial abilities; psychomotor processing speed; attention and working memory. Next, variables identified as significantly associated with any of the actual subjective response to alcohol factor scores were entered into regression analyses with the hypothetical factor score to determine whether the indices of cognitive functioning contributed significantly to the prediction of alcohol's experienced effects. Given the number of outcomes within each of the

three cognitive functional domains (non-verbal memory and visuospatial abilities n = 3; psychomotor processing speed n = 3; attention and working memory n = 2), the threshold for statistical significance was adjusted to $p < .01$ via Bonferroni correction for all correlations.

Only one association achieved statistical significance. Participants who reported experiencing higher levels of impairment and sedation from a moderate dose of alcohol were also likely to experience greater reductions in processing speed/working memory in the context of increased cognitive demands (determined from the ratio of time required to complete Trail Making B relative to the time needed to complete Trail Making A), $r = .24$, $p = .008$. Subsequent regression analyses demonstrated that the Trails B to Trails A completion time ratio significantly contributed to the prediction of the combined Impaired/Sedative factor score, $\beta = .19$, $t = 2.73$, $p < .01$, even after accounting for the influence contributed by the hypothetical measure for this factor, $\beta = .66$, $t = 9.66$, $p < .001$, providing initial evidence for a cognitive correlate of low subjective response to alcohol. The range of correlations for all other comparisons was -.20 to .10.

Behavioral Measures of Decision-Making. The potential associations between behavioral measures of decision-making processes (outcome variables from the Go-Stop Paradigm and Iowa Gambling Test) and measures of actual subjective response to alcohol were initially evaluated with simple bivariate

correlations followed by hierarchical linear regression analyses for significantly correlated variables.

Go-Stop Paradigm. A significant portion of the participants (16.4%) responded in a manner on this behavioral measure to render their test results invalid. Specifically, the mean reaction time for these participants across all trials where no stop signal was presented was greater than 750 ms, suggesting that they systematically delayed their responding in an effort to prevent making a "go" response (pressing a button) on a "stop" trial (indicated by the presence of a tone) in spite of standardized instructions encouraging them not to do so as the tones would sound infrequently and it was expected that they would be unable to inhibit some responses. As a result of this pattern of responding, we were unable to obtain a valid estimated stop signal reaction time (stop signal delay at which each participant inhibited 50% of the time) which served as the primary measure of impulsivity and inhibitory control for this study. Consequently, bivariate calculations were examined between the factors of actual subjective response to alcohol and each of the Go-Stop outcome variables (go reaction time, stop signal reaction time, number of correct go responses, and number of correct stop responses) for the subset of participants (n = 97) who provided valid data. None of the outcome variables from the Go-Stop Paradigm were significantly correlated with the actual subjective response to alcohol factor scores (*r*'s range -.11 to .09).

Iowa Gambling Test. None of the outcome variables associated with the Iowa Gambling Test (Motivation, Learning-Rate, or Choice-Consistency) were

significantly associated with any of the actual subjective response factor scores after adjusting the criterion for significance due to multiple comparisons (Bonferroni-adjusted $p < .005$; observed r's range -.22 to .20).

Discussion

Study 1 of this dissertation was designed to accomplish two primary objectives. The first was to assess the factor structure, internal consistency, construct validity, discriminant validity, and criterion validity of a self-report measure of anticipated subjective response to a moderate dose of alcohol based on a hypothetical drinking scenario is a sample of experienced young adult drinkers. The second goal was to examine whether response to variety of physiological and perceptual challenges and several indices of cognitive functioning were associated with individual differences in the subjective experience of a moderate dose of alcohol.

The overall pattern of consistency in the factor structure of the subjective response measures across two relatively small samples (Study 1 and Kruse et al., June 2004) is promising. In particular, three separate sets of analyses yielded identical factors structures for the anticipated and actual subjective experience of the positive and stimulant effects of alcohol. Observed variability in factor loadings for a subset of the items associated with the impairing and sedative effects of alcohol, however, raised doubt about the relative independence of these two subscales previously identified as distinct factors. Given the inconsistent

pattern of factor loadings between items originally contained in the Impaired and Sedative subscales, the correlations between the previously identified Impaired and Sedative factors, and the finding that all of the items originally associated with these two scales loaded onto a single combined factor with only minimal loss of total variance explained; the decision was made to conduct all subsequent analyses examining individual differences in hypothetical and actual subjective response to alcohol based on the three-factor solution (Positive, Stimulant, and combined Impaired/Sedative) rather than the 4-factor model previously suggested (Kruse et al., June 2004).

Internal consistency/reliability estimates were excellent for each of the three factors examined for the hypothetical and actual subjective response measures suggesting that the individual items within each of the final factors were closely associated with one another. Strong evidence was obtained in support of the construct validity of the hypothetical measures of subjective response as indicated by similar means and moderate-to-strong correlations between these measures and those obtained from a similar dose of alcohol. Only partial evidence was obtained to support the prediction that the strength of the associations between the hypothetical and actual factor scores would vary as a function of level of experience/familiarity with the hypothetical drinking scenario. First, the vast majority (over 97%) of students in Study 1 reported at least some recent familiarity with the hypothetical drinking scenario thereby preventing analyses of whether any experience was a necessary and/or sufficient condition

for providing accurate estimates of anticipated subjective response to alcohol. When analyzed as a continuous variable, the number of times a participant reported that he/she had consumed alcohol in a manner similar to the scenario had no bearing on the concordance between the hypothetical and actual measures. The non-normal distribution of this variable (even after the removal of statistical outliers), however, requires caution to be used when interpreting the absence of findings given the potential disproportionate influence of extreme cases. Finally, when analyzed based on a median split there was some evidence that students with relatively "more" experience (i.e., 5 or more drinking episodes in the preceding three months) with the hypothetical drinking scenario were able to provide more concordant estimates of subjective response to alcohol than those who were comparably "less" experienced (i.e., 4 or less episodes). It is important to note, however, that the line of demarcation between the "more" and "less" experienced groups was arbitrarily defined, and there is little reason to believe that these two groups represent distinct classifications of drinkers. As such, the potential effect of familiarity with the hypothetical drinking scenario on the concordance between anticipated and actual measures of subjective response to alcohol remains unknown and will need further exploration in future research efforts within a sample of emerging adults with a broader range of drinking experiences.

Evidence for the discriminant validity of the measures of anticipated subjective response to alcohol was obtained through identification of only a

limited number of modest associations between hypothetical factor scores and measures of alcohol expectancies, in spite of similar assessment methodologies (i.e., instructional sets). Further, only one of the seven expectancy measures predicted level of actual subjective response to a moderate dose of alcohol for the three factors examined (greater expectations for sexual enhancement was associated with the experience of more of the positive effects of alcohol); and this contribution was no longer statistically significant after accounting for the anticipated positive effects from the hypothetical measure.

In terms of evaluating the criterion validity of the measures of anticipated subjective response to alcohol based on the hypothetical drinking scenario, evidence was mixed. Partial support was obtained from findings consistent with our preliminary study (Kruse et al., June 2004), demonstrating that hypothetical subjective response factor scores were associated with some drinking outcome variables in this sample of experienced college drinkers. Specifically, young adults who anticipated that they would feel more of the Positive effects of a moderate dose of alcohol (e.g., joyful, on top of the world) reported that they drank more frequently and also acknowledged that they had experienced more negative alcohol-related consequences as a result of their drinking. In addition, students with lower anticipated combined Impaired/Sedative (e.g., dizzy, sluggish) factor scores reported consuming alcohol more frequently and needing to reach a higher estimated BAC before feeling drunk. There were no significant associations between level of anticipated stimulant (e.g., energized, excited)

effects of alcohol based on the hypothetical drinking scenario and the drinking outcome variables. A similar pattern of findings was observed for the actual subjective response measures (higher Positive factor scores were associated with more frequent drinking; lower combined Impaired/Sedative scores associated with greater typical quantity of alcohol consumed and higher estimated BAC to feel drunk; no significant associations for Stimulant factor), further reinforcing the construct validity of the hypothetical measures. On the other hand, there was no evidence to support the hypothesis that individuals with a family history of problematic drinking would anticipate or actually experience significantly different effects from a moderate dose of alcohol than those who denied a family history of problem drinking.

Finally, there was some evidence that lower anticipated and actual experience of the Impaired/Sedative effects of alcohol is modestly associated with perceptions of tolerance. This finding raises the important theoretical issue of whether the frequently observed risk factor for the development of alcohol use disorders (i.e., lower response to the impairing effects of a moderate dose of alcohol) is better understood as a biologically-based individual difference factor that guides drinking behaviors, or whether the association between a low subjective response and heavier patterns of drinking exists because of the tolerance that develops from heavier alcohol consumption patterns. The most likely answer is that both genetic and behavioral factors play a large role. Whereas it is beyond the scope of this research to examine the relative influence

of genetic and behavioral factors in the origination of a critical risk factor for the development of alcohol dependence, it will be important to continue to consider the possibility that the significant associations between lower ratings of impairment and sedation, and heavier patterns of drinking, may be due at least in part to tolerance.

Overall, the results from this first study provide support for the potential utility of examining individual differences in subjective response to alcohol based on a hypothetical drinking scenario. The evidence suggests that, on average, experienced drinkers are quite capable of reliably and accurately estimating how they would feel in response to a hypothetical drinking scenario targeting a BAC of .08%, that these ratings are distinct from general beliefs about the effects of alcohol on cognition and behavior (i.e., alcohol expectancies), and that these anticipated sensations correspond well to subjective experience of alcohol's actual pharmacological effects at a similar dose.

One of the most prominent limitations of Study 1 is the modest sample size. In addition to the resulting limited power to detect significant effects, the modest sample size also prevented the use of confirmatory factor analytic techniques to rigorously test the previously identified factor structure of the self-report measures of subjective response to alcohol based on the hypothetical drinking scenario. Instead, based on an additional exploratory factor analysis, the constructs of anticipated and actual subjective response to alcohol were defined by a three-factor solution comprising the Positive, Stimulant, and combined

Impaired/Sedative effects of alcohol. As a result, we were unable to examine whether patterns of drinking (or any other factors) were differentially influenced by anticipated and/or actual individual differences in the subjective experience of the impairing versus the sedative effects of alcohol. Earlier findings demonstrated that lower anticipated impairment based on the hypothetical drinking scenario was associated with a variety of heavier drinking behaviors (e.g., increased quantity and frequency of alcohol consumption, more frequent drinking to intoxication) in underage first-year college students (Kruse et al., June 2004), but that the anticipated sedative effects of alcohol were not. In the current study, lower ratings on the hypothetical combined Impaired/Sedative factor score were associated with some of the same drinking outcome variables (e.g., estimated BAC to feel drunk, frequency of drinking), but not others (e.g., typical quantity of alcohol consumption, frequency of drinking to intoxication, alcohol-related problems). The observed discrepancies in findings begs the question of whether the pattern of associations is somehow different between the populations evaluated in the two studies (i.e., underage adolescents vs. experienced 21-23 year old drinkers), or whether by combining items from the two factors the true effects of lower impairment from a moderate dose of alcohol on patterns of drinking were obscured. Regardless of the ultimate answer to this question, future efforts to further solidify the factor structure of the measures of subjective response to alcohol (in particular the Impaired and Sedative effects) in a larger sample are certainly warranted.

In regards to the second objective of Study 1, the identification of potential correlates of individual differences in subjective response to alcohol, the findings were surprisingly straightforward. Of all outcome variables examined for potential correlates, only one correlation achieved statistical significance after adjusting the threshold for statistical significance to reduce the likelihood of Type I error: the ratio of time required to complete a processing speed task made more difficult by the inclusion of a working memory component (Trails B; a 25-item connect-the-dots task requiring alternation between numbers and letters in ascending order; i.e., 1-to-A-to-2-to-B-to-3-to-C…) relative to the time needed to complete a similar but conceptually simpler version of the task (Trails A; a 25-item connect-the-dots task in numerical order; i.e., 1-to-2-to-3…). Participants who required a greater proportion of time to complete Trails B relative to Trails A endorsed higher levels of the impairing and sedative effects of alcohol. It should be clarified that this finding does not suggest that young adults who experience greater impairment/sedative effects from a moderate dose of alcohol have slower processing speed (Trails A) or perform more poorly on working memory tasks (Trails B) in absolute terms. In fact, individual differences in subjective response to alcohol were not significantly associated with any other measure of cognitive functioning examined. Rather, this finding instead suggests that the overall effect of increased cognitive demand on performance of this task, again relative to each individual's baseline level of processing speed, is more extreme in young adults who are also more sensitive to sensations of impairment and sedation after

drinking alcohol. Although this isolated finding should be interpreted judiciously, it does support the possibility that individual differences in subjective response to alcohol might be associated with relatively subtle differences in cognitive functioning that exist independent from the acute effects of alcohol (i.e., are present when sober).

Contrary to prediction, there was no evidence obtained to support the hypothesis that individual differences in subjective response to alcohol would be associated with subjective response to any of the five physiological and perceptual challenges administered in Study 1 (Carbon-Dioxide Challenge, Cold Pressor Test, 15-Second Spinning Challenge, Auditory and Visual Perception Tests). The lack of significant associations between subjective response to alcohol and response to the physiological and perceptual challenge procedures was surprising given that alcohol is known to cause hyposensitivity to CO_2 response (e.g., Rassovsky et al., 2004), impair vestibular functioning (e.g., Hafstrom et al., 2007), and reduce pain sensitivity (e.g., Perrino et al., 2008), as well as disrupt the perception of auditory (e.g., Upile et al., 2007) and visual stimuli (e.g., Johnston & Timney, 2008) during the acute stages of intoxication. Although the physiological and perceptual challenges administered in the current study are not presumed to provide a comprehensive measurement of sensitivity to physiological sensations in general (in fact, other than a modest association between responses to the auditory and visual perception, there were no significant associations among response to these protocols), these results provide evidence

that individual differences in subjective response to alcohol are unique to the pharmacological properties of ethanol and are therefore not representative of a larger construct of general sensitivity to physiological sensations.

Given the reliance of the subjective response to alcohol measures on the perception of physiological sensations, it was somewhat surprising that the psychological constructs assessed (anxiety sensitivity, mindfulness, body vigilance, and distress tolerance) were not significantly related to either the hypothetical or actual subjective response measures, or affected the correlations between these two sets of factors. In fact, the existence of significant associations had been presumed to the extent that the decision to include measurement of these psychological constructs had been driven primarily by the belief that they would potentially moderate any of the significant effects found for the subjective response to alcohol measures (e.g., mindfulness and body vigilance were anticipated to moderate the concordance between hypothetical and actual subjective response factors; anxiety sensitivity and distress tolerance were predicted to moderate any significant associations between response to the physiological and perceptual challenge procedures and subjective response factors). Whereas the lack of significant associations between these two sets of variables was unanticipated, it serves to further reinforce evidence that individual differences in subjective response to alcohol represent a distinct and unique construct.

In spite of the one significant finding suggesting that heightened experience of the impairing and sedating effects of alcohol is associated with relatively greater impairment resulting from an increase in cognitive demand, the results of Study 1 offered no clear evidence of an association between individual differences in subjective response to alcohol and neuropsychological functioning. Previous research had demonstrated that impairment on tests of attentional, visuospatial, and motor speed processes are associated with diagnostic criteria for alcohol dependence in high cognitive functioning adolescents (Sher et al., 1997). The current results, however, suggest that poorer performance on these cognitive domains is not related to a presumed risk factor for alcohol dependence (i.e., low subjective response), but instead might be better conceptualized as an additional consequence of heavy drinking on the emerging adult brain (e.g., Tapert et al., 2003; Tapert et al., 2002).

Two behavioral measures of decision-making processes (the Iowa Gambling Test and Go-Stop Paradigm) were also examined as potential correlates of individual differences in subjective response to alcohol. Previous research had demonstrated that a subset of alcohol-dependent adults were significantly more likely to persistently select responses that, in spite of greater immediate gains, ultimately resulted in substantially poorer outcomes (e.g., Bechara et al., 2002). These findings had suggested that this decision-making deficit (associated with ventromedial prefrontal cortex functioning) might be a potential mechanism underlying the transition from casual alcohol use to dependence in at least some

individuals. The results of the current study, however, failed to provide evidence in support of an association between impaired performance on the Iowa Gambling Test and subjective response to alcohol. The lack of a significant finding indicates that either these two risk factors exert their respective influences independently or this cognitive deficit is perhaps better conceptualized as a consequence of heavy drinking rather than a risk factor. Further, there was no evidence to support the existence of a significant association between individual differences in subjective response to alcohol and behavioral measures of impulsivity as assessed by the Go-Stop Paradigm. Although impaired behavioral control over alcohol intake is the hallmark of alcohol use disorders, associations between impulsive behavior and patterns of drinking are well-documented (e.g., Baker & Yardley, 2002), and impaired behavioral control has been prospectively linked to the persistence in heavy drinking patterns and development of alcohol use disorders (Rubio et al., 2008); the results of the current study again suggest that any effects of behavioral control (as measured by the Go-Stop) exist independent of an association with differences in subjective response to alcohol.

In summary, the results of Study 1 provide evidence for the feasibility of using measures of anticipated subjective response to alcohol based on a hypothetical drinking scenario as a proxy for measuring individual differences in subjective response to a moderate dose of alcohol. These hypothetical measures may prove to be particularly useful for the identification of experienced drinkers who may be at greater risk for the development of alcohol use disorders, but for

whom alcohol challenge procedures are inappropriate. The second study of this dissertation was designed to examine the extent to which these measures of anticipated subjective response to alcohol could be implemented in sample of underage, emerging adult, experienced drinkers to differentiate between those who transitioned into, transitioned out of, or maintained heavy drinking during the initial transition from high school to college.

CHAPTER 4: STUDY 2

Rationale, Aims, and Hypotheses

Whereas it is well-established that most heavy drinking adolescents and emerging adults will naturally moderate or "mature out" of problematic drinking patterns in response to life changes (e.g., Bachman et al., 2002; Jochman & Fromme, in press), there is evidence that as many as 40% will maintain or escalate their drinking patterns, and subsequent risk for alcohol-related problems, into adulthood (Jackson et al., 2001). Crucial to an understanding of the etiology of alcohol use disorders is the identification of factors that differentiate heavy drinkers who will eventually moderate their alcohol consumption from those who will persist in problematic patterns of heavy drinking. Study 2 was designed as a preliminary, cross-sectional investigation with the goal of identifying factors associated with the initiation, moderation, and maintenance of heavy drinking patterns during the initial transition from high school to college. Of particular interest was the extent to which first-year college students who had transitioned out of heavy drinking during the initial transition from high school to the first-semester of college differed from those who transitioned into or maintained heavy drinking in terms of anticipated subjective response to alcohol. Response to the five physiological and perceptual challenges (e.g., Carbon-Dioxide Challenge, Cold Pressor Test, Spinning Challenge) were also examined as potential differentiators of heavy drinking transition groups, as were group differences in

cognitive functioning as measured by five neuropsychological tests (e.g., Trail Making A & B, Digit Span, Block Design) and two behavioral measures of decision-making processes (Iowa Gambling Test and Go-Stop Paradigm). In addition, given the variability in factor loadings on the hypothetical measures of subjective response to alcohol between preliminary research (Kruse et al., June 2004) and Study 1 of this dissertation, the factor structure, internal consistency, discriminant validity, and criterion validity of these measures were evaluated as a secondary goal of Study 2.

Hypothesis 1.

It was predicted that the self-report measures of anticipated subjective response to alcohol based on the hypothetical drinking scenario would differentiate heavy drinking transition groups.

Hypothesis 1a. It was expected that anticipated reinforcing effects of alcohol (i.e., positive and stimulant) would be lowest in those students who reliably transitioned out of heavy drinking from high school to the first semester of college, and that these same effects would be highest in those who maintained their heavy drinking during this transition.

Hypothesis 1b. It was also anticipated that students who transitioned out of heavy drinking would report higher levels of impairment and sedation in response to the hypothetical drinking scenario, and that these anticipated effects would be the lowest in students who had maintained heavy drinking from high school to college.

Hypothesis 2.

Based on evidence that individual differences in subjective response to alcohol serves are a risk factor for heavy drinking, transition groups were also expected to differ in response to the physiological and perceptual challenge procedures administered. Specifically, **s**tudents who transitioned out of heavy drinking were predicted to endorse higher levels of physiological sensations induced by the physiological challenges than those who maintained heavy drinking.

Hypothesis 3.

Students who maintained heavy drinking during the initial transition from high to college were predicted to perform more poorly on the tests of cognitive functioning.

Hypothesis 3a. Based on evidence suggesting that the young adult brain is more susceptible to the detrimental effects of alcohol (e.g., Tapert et al. 2003) and prior research documenting differences in cognitive abilities in college students based on symptoms of alcohol dependence (e.g., Sher et al., 1997), it was expected that students who had maintained heavy drinking from high school to college would perform more poorly on the neuropsychological tests administered.

Hypothesis 3b. Based on evidence implicating impaired behavioral inhibition as a risk factor for the development of alcoholism (e.g., Rubio et al., 2008), it was predicted that students who had transitioned out of heavy drinking

from high school to college would demonstrate less impairment on a measure of this construct (stop-signal reaction time) on the Go-Stop Paradigm.

Hypothesis 3c. Consistent with findings suggesting that poor decision making (i.e., persistence in making choices based on perceptions of greater immediate gain in spite of poorer long-term outcomes) has been implicated as a risk-factor in the transition from casual alcohol use to alcohol dependence in some adults (e.g., Bechara et al., 2002), students who had reliably transitioned out of heavy drinking were predicted to demonstrate less susceptibility to this pattern of decision making. Specifically, students who transitioned out of heavy drinking were predicted to score lower on the outcome measure labeled Motivation, which is calculated based on the overall proportion of "bad" choices (choices from decks 'A' and 'B' which in spite of greater immediate initial gains are associated with progressively poorer outcomes) and are interpreted as an indicator of hypersensitivity to reward to the exclusion of consideration of potential long-term costs in decision-making.

Method

Participants

Participants successfully recruited for Study 2 (N = 152; 59% female; M_{age} = 19.1 years, *SD* = 0.3) were selected from a sample of 2,077 (56% female) first-year university students participating in a larger longitudinal research project (Fromme, Corbin, & Kruse, in press). Eligibility for the longitudinal study was

limited to incoming freshmen who had not previously attended college, were not married, and were between the ages of 17-19 at the time of recruitment. As detailed below, participants were randomly selected and recruited from the subsample of students who transitioned into (n = 51; 57% female), transitioned out of (n = 50; 66% female), or maintained heavy drinking (n = 51; 53% female) during the initial transition from high school to the first semester of college. Most of the participants described their race/ethnicity as Non-Hispanic Caucasian (63%), 16% identified as Hispanic/Latino(a), 11% Asian-American/Pacific Islander, 3% African-American, 1% American Indian/Alaska Native, 5% endorsed multiple races and/or ethnicities, and 2% chose not to answer. The vast majority of participants stated that they lived in a university (67%) or private dormitory (22%) during their first year of college, 7% resided in an off-campus apartment or house, and 4% lived with parents or other family members. Estimated annual family income was greater than $50,000 for 76% of participants and higher than $100,000 for more than a third (36%) of the sample.

Recruitment and Selection

Incoming first-year college students were recruited for participation in a longitudinal research project during the summer prior to matriculating to The University of Texas at Austin (Fromme et al., in press). A total of 2,077 students completed web-based longitudinal assessments (1) during the summer between high school graduation and the start of their first semester in college, and (2) at

the end of the Fall semester of their freshman year of college. As part of these longitudinal assessments, these students provided drinking data at both time points that were used to determine eligibility for the current study.

Eligibility for the current study was established through the use of a heavy drinking composite score based on the combined frequency of binge drinking (defined as the consumption of 5 or more drinks in one sitting for men, 4 or more for women; Wechsler et al., 1995) and large effect drinking episodes (i.e., getting drunk; e.g., Midanik, 1999) participants reported over the last three months of their senior year in high school and first semester in college. Heavy drinking status for each assessment period was defined as a score of 4 or greater on this composite measure. Significant transitions in drinking were determined based on a change in heavy drinking status across the two assessments combined with a relative increase or decrease of at least three heavy drinking occasions (i.e., combined binge and large effect drinking episodes) to signify meaningful changes in patterns of drinking. Of the 2,077 participants in the larger project who completed both assessments, 238 (11.5%) did not meet heavy drinking criteria in high school but transitioned into heavy drinking in college (TI), 59 (2.8%) were classified as heavy drinkers in high school but transitioned out during the first semester of college (TO), and 386 (18.6%) maintained heavy drinking from high school to college (M). A total of 169 (57 TI, 56 TO, and 56 M) of these eligible students were subsequently randomly selected, contacted, and invited to participate in one 2-hour laboratory session comprising the current study. Of

those invited, 152 (90%) completed the protocol during the Spring semester of their first year in college, 10 (6%) missed an appointment and were unable to be rescheduled prior to the end of data collection, 5 (3%) expressed interest but were not scheduled due to time conflicts, and 2 (1%) declined the offer to participate. Participants received $40 in financial remuneration as compensation for completing Study 2.

Procedures

Participants in Study 2 completed the identical individual laboratory protocol described for Study 1. In brief, upon arrival to the laboratory participants provided photo identification, read and signed the informed consent form, and submitted to a breathalyzer test to ensure .00% BAC prior to being weighed by research assistants (to determine the number of standard drinks participants were asked to imagine consuming for the hypothetical measures of subjective response to alcohol). They then completed a packet of self-report questionnaires assessing typical alcohol consumption, effect drinking status, experience of alcohol-related problems during the past three months, family history of problem drinking, perceived subjective tolerance to alcohol, alcohol expectancies, distress tolerance, mindfulness, body vigilance, and anxiety sensitivity; followed by the measures of anticipated subjective response to alcohol based on the hypothetical drinking scenario. Next, they were administered each of the five neuropsychological tests (Visual Reproduction, Digit Symbol Coding,

Digit Span, Block Design, and Trail Making Parts A & B) followed by the 15-second spinning challenge protocol. As was the case in Study 1, all subsequent procedures were paired and counter-balanced so that participants completed one of two sets of physiological and perceptual challenge procedures [either (a) the CO_2 Challenge and Visual Perception tests, counter-balanced; or (b) the Cold Pressor and Auditory Perception tests, counter-balanced], followed by the two computer-administered procedures (the Go-Stop Paradigm and the Iowa Gambling Test, counter-balanced), and then the remaining set of physiological and perceptual challenge procedures, again counter-balanced to control for possible order effects. At the end of the laboratory session, Study 2 participants were fully debriefed and paid $40 as compensation for their participation.

Measures

Heavy Drinking Composite. In addition to the self-report measures common to both Study 1 and 2 previously described, a heavy drinking composite score was calculated by combining responses from two items measuring the frequency of (a) binge drinking ("During the last three months, how many times did you have 4 or more (for women, 5 for men) drinks in a sitting?"; Wechsler et al., 1995) and (b) large effect drinking ("During the past three months, how many times did you get drunk (not just a little high) after drinking alcohol?"; Jackson et al., 2001) episodes for the last three months of high school and the fall semester of freshman year.

Results

Preliminary Analyses

Family History of Problem Drinking. Similar to the rates observed in Study 1, 28% (n = 42) of Study 2 participants reported that at least one biologically-related family member (parents, paternal and maternal grandparents, or siblings) was a definite problem drinker. An additional 25% (n = 38) reported a suspected family history of problematic drinking when the identification criteria was relaxed from "definite" to "probable" problem drinker. Chi-square analyses revealed no significant gender differences in group composition of the three levels of family history of problematic drinking (none, probable, definite), χ^2 (2, N = 152) = 1.03, p = .60.

Past Three-Months Drinking and Experience of Alcohol-Related Problems. Participants in Study 2 reported drinking on average 2.05 days per week (SD = 1.26; range 0-6) and the typical consumption of 4.36 standard drinks per drinking occasion (SD = 2.07; range 1-12.3). The average number of drinking episodes reported in the three months prior to the laboratory study was 19.69 (SD = 16.74), with drinking to intoxication (i.e., large-effect drinking) occurring on approximately one-third of these occasions (M = 6.48; SD = 8.14). Eighty-three percent of the sample (n = 126) acknowledged experiencing at least one negative alcohol-related consequence in the preceding three months (M = 6.95, SD = 6.55).

A 2 (gender) x 3 (family history of problem drinking: none, probable, definite) MANOVA was conducted to examine group differences in number of drinking days per week, typical quantity of drinking, total number of drinking episodes, number of times drunk, and experience of alcohol-related problems during the three months prior to the laboratory assessment. There were no significant overall multivariate effects observed on these drinking variables: main effect of gender, $F(5, 142) = 1.99$, $p = .08$, main effect of family history, $F(5, 143) = 1.69$, $p = .14$, and gender x family history interaction, $F(5, 143) = 2.07$, $p = .07$.

Whereas the multivariate main effect of gender did not reach statistical significance, significant univariate findings suggested that women reported lower typical quantity of drinking ($M = 3.11$, $SD = 2. 62$), $F(1, 146) = 9.78$, $p < .01$, lower total number of drinking episodes ($M = 17.71$, $SD = 15.15$), $F(1, 146) = 4.07$, $p < .05$, and fewer large-effect drinking episodes ($M = 5.54$, $SD = 6.94$), $F(1, 146) = 3.93$, $p < .05$, compared to men ($M = 4.20$, $SD = 2.74$; $M = 22.49$, $SD = 18.52$; and $M = 7.80$, $SD = 9.48$, respectively). Other than a non-statistically significant trend towards heavier typical drinking in students who reported a definite family history of problematic drinking ($M = 4.31$, $SD = 3.22$), compared to participants with a probable ($M = 3.21$, $SD = 2.29$) or no family history ($M = 3.30$, $SD = 2.16$), $F(2, 146) = 2.80$, $p = .06$; there was no evidence to suggest that drinking differed by level of family history during the three months prior to the laboratory assessment.

There was also evidence of a significant univariate gender x family history interaction on typical quantity of alcohol consumed, $F(2, 146) = 4.10$, $p < .05$. Specifically, men who acknowledged a probable ($M = 4.14$, $SD = 2.62$) or definite ($M = 5.62$, $SD = 2.74$) family history of problematic drinking reported greater typical number of standard drinks/drinking episode than the women in these groups (probable $M = 2.67$, $SD = 1.93$; definite $M = 3.11$, $SD = 3.04$). This pattern was reversed for participants who reported no problematic drinking in their family, with men providing lower estimates of typical quantity ($M = 3.24$, $SD = 2.44$) than women ($M = 4.35$, $SD = 1.98$) in this group.

Perceived Tolerance and Estimated BAC to Feel "Drunk."

Participants in Study 2 reported an average score of 37.91 ($SD = 10.00$; observed range 10-64) on the Subjective Tolerance Index, suggesting that as a group these young adults rated their tolerance as slightly lower than their average peers' (scale score of 40 indicates same perceived tolerance as peers). The average estimated BAC needed to feel drunk for this group of participants was .132% ($SD = .056\%$), approximately 65% higher than the legal level of intoxication and the targeted BAC level in the drinking scenario for the hypothetical subjective response measures (.08%).

Group differences in two indices of subjective tolerance were examined with a 2 (gender) x 3 (family history of problematic drinking) MANOVA. The multivariate main effects of both gender, $F(2, 144) = 6.86$, $p < .01$, and family history of problematic drinking, $F(2, 145) = 4.45$, $p < .05$, were significant with

follow-up univariate analyses revealing that both men (M = 40.79, SD = 9.31), $F(1, 151) = 11.64$, $p < .01$, and participants with a definite family history of problematic drinking (M = 41.05, SD = 11.87), $F(2, 145) = 4.19$, $p < .05$, rated their subjective tolerance as higher relative to women (M = 35.73, SD = 10.00) and participants with no known family history of problematic drinking (M = 35.76, SD = 9.10, respectively. There were no differences in estimated BAC to feel drunk by gender (p = .36) or family history of problematic drinking (p = .96). The multivariate gender x family history of problematic drinking group interaction was not significant, $F(2, 145) = 1.34$, p = .26.

Familiarity with Drinking Scenario for the Hypothetical Subjective Response Measures. Eighty-eight percent of Study 2 participants (n = 134) reported that they had consumed the amount of alcohol within the time frame described in the hypothetical drinking scenario for the anticipated subjective response to alcohol measures at least once in the last three months, M = 6.54, SD = 7.00. Consistent with Study 1, this finding suggests that the majority of these emerging adults were able to rely on recollections of their recent drinking experiences when completing the hypothetical measures of subjective response to alcohol.

A 2 (gender) x 3 (family history of problematic drinking) ANOVA revealed a significant effect of gender, $F(1, 141) = 6.87$, $p < .05$, with men (M = 6.31, SD = 8.94) reporting drinking consistent with the hypothetical scenario more frequently than women (M = 3.79, SD = 4.30) in the three months prior to

the laboratory assessment. There was no significant effect of family history, $F(2, 141) = 1.41$, $p = .25$, or gender by family history interaction, $F(2, 141) = 1.70$, $p = .19$, on familiarity with the hypothetical drinking scenario.

Estimated BAC. Mean estimated peak BAC based on the drinking scenario described in the hypothetical subjective response measures was .081% ($SD = .006$) for Study 2 participants (Matthews & Miller, 1979). There were no differences in estimated BAC by gender, $p > .50$.

Measures of Anticipated Subjective Response to Alcohol.

Prior to examining differences between heavy drinking transition group, the factor structure, internal consistency, discriminant validity, and criterion validity of the measures of anticipated subjective response to alcohol based on the hypothetical drinking scenario were examined for Study 2 participants using similar statistical procedures as those used in Study 1 of this dissertation.

Given the uncertainty regarding the relative independence of the previously identified Impaired and Sedative factors, exploratory factor analyses were again conducted to determine whether a three-factor model would replicate (from Study 1) and parsimoniously account for the covariation between the variables comprising the hypothetical measures of subjective response. The forced three-factor model solution resulted in factor loadings identical to those observed in Study 1 with 9 items loading on the Positive factor, 7 items loading on the Stimulant factor, and all 16 items originally associated with the Impaired

and Sedative factors loading onto a single combined factor (see Table 6 for factor loadings from three-factor solutions of hypothetical subjective response to alcohol measures for Study 1 & Study 2). As was the case in Study 1, the Impaired and Sedative subscales identified in the preliminary study (Kruse et al., June 2004) were highly correlated (r = .83) providing further evidence of the shared variance between these two factors. The total variance accounted for by the three-factorial model was 70.2%. Consistent with Study 1, subsequent analyses in Study 2 were conducted using the subscales created by the three-factor model: Positive, Stimulant, and Impaired/Sedative.

The homogeneity of items within each of the three factors examined for the hypothetical subjective response to alcohol measures was again excellent: Positive (α = .94); Stimulant (α = .95); and the combined Impaired/Sedative factor (α = .96). In terms of discriminant validity, again only small-to-modest bivariate correlations were observed between the hypothetical subjective response to alcohol factor scores and the measures of alcohol expectancies. After accounting for the total number of independent correlations examined (n = 21; 7 for each of the three hypothetical SR factors), and increasing the threshold for statistical significance to $p < .002$ via Bonferroni correction to reduce the chance of Type I error, only one correlation remained statistically significant. Higher anticipated Positive factors scores were statistically associated with greater expectations for Liquid Courage (r = .31) as measured by the CEOA. The Stimulant and

combined Impaired/Sedative factor scores were not significantly correlated with any of the alcohol expectancy scales (see Table 7).

The criterion validity of each of the three factors was first evaluated with a series of linear regression analyses predicting five elements of drinking behavior in this sample of underage experienced drinkers: typical quantity of alcohol consumption, frequency of drinking episodes, frequency of large effect drinking (i.e., getting "drunk"), experience of alcohol-related problems, and estimated BAC to feel drunk. Greater anticipated Stimulant effects based on the hypothetical drinking scenario were associated with more frequent large effect drinking (i.e., number of times drunk), $\beta = .27$, $t = 2.65$, $p < .01$, and lower estimated BAC to feel drunk, $\beta = -.19$, $t = -2.31$, $p < .05$. Lower anticipated response to alcohol as measured by the combined Impaired/Sedative factor was significantly associated with each of the assessed drinking variables: greater typical quantity of alcohol consumed, $\beta = -.37$, $t = -3.65$, $p < .001$; more frequent drinking, $\beta = -.34$, $t = -3.81$, $p < .001$; more frequent drinking to intoxication, $\beta = -.27$, $t = -2.97$, $p < .01$; more alcohol-related problems, $\beta = -.20$, $t = -2.17$, $p < .05$; and higher estimated BAC to feel drunk, $\beta = -.54$, $t = -7.27$, $p < .001$. Anticipated Positive factor scores were not significantly associated with any of the five drinking outcome measures.

As was the case in Study 1, linear regression analyses demonstrated that lower Impaired/Sedative factor scores were significantly associated with higher ratings of subjective tolerance, $\beta = -.39$, $t = -4.42$, $p < .001$. Again, no effects

were seen for either Positive (p = .23) or Stimulant (p = .18) factor scores, suggesting that perceptions of subjective response are more closely tied to the individual's subjective experience of the "negative" (impairing and sedating) effects of alcohol.

Potential group differences in hypothetical subjective response to alcohol factor scores were examined with a 2 (gender) x 3 (family history of problematic drinking) MANOVA. The multivariate main effect of family history was significant, $F(3, 145) = 4.10$, $p < .01$, with follow-up univariate tests demonstrating that students who identified at least one family member as a definite problem drinker anticipated higher Stimulant effects from the hypothetical measure of subjective response to alcohol, $F(2, 146) = 3.31$, $p < .05$. The multivariate main effect of gender was not statistically significant, $F(3, 144) = 1.36$, $p = .26$, in spite of evidence that hypothetical Stimulant ratings were higher in women ($M = 52.52$, $SD = 20.43$) than men ($M = 47.94$, $SD = 20.64$), $F(1, 146) = 3.98$, $p < .05$. No significant gender x family history multivariate, $F(3, 145) = 2.49$, $p = .06$, or univariate interactions (all p's > .15) were observed.

Group Differences by Heavy Drinking Transition Status

Patterns of Drinking in High School and Fall. Differences in patterns of drinking between heavy drinking transition groups were examined with a 2 (gender) x 3 (transition group: TI, TO, M) x 2 (assessment: High School, Fall) mixed-model, repeated measures MANOVA for five drinking outcome variables:

frequency of drinking days per week, typical quantity of alcohol consumed per drinking occasion, total number of drinking episodes, total number of times drunk, and the experience of alcohol-related consequences in the three months preceding each assessment.

The multivariate main effect of heavy drinking transition group was significant, $F(5, 143) = 21.25$, $p < .001$, as were the follow-up univariate effects demonstrating that students who maintained heavy drinking from high school to college drank on more days/week, $F(2, 146) = 14.32$, consumed on average larger quantities of alcohol, $F(2, 146) = 33.78$, drank alcohol on more occasions, $F(2, 146) = 17.28$, and got drunk more frequently, $F(2, 146) = 25.12$ (all p's $< .001$) than students who transitioned into or out of heavy drinking (all post-hoc pair wise comparisons $p < .001$). The univariate main effect for alcohol-related problems was not statistically significant, $F(2, 146) = 2.49$, $p = .09$. No differences were observed in overall drinking between students who had transitioned into and transitioned out of heavy drinking (all pair wise comparisons $p > .73$), suggesting that the drinking patterns of those who transitioned into heavy drinking in college were similar to the high school drinking patterns of those who had transitioned out of heavy drinking. See Figures 2-6 for patterns of change in drinking variables between the High School and the Fall assessment by heavy drinking transition group.

The multivariate main effect of assessment was also statistically significant, $F(5, 142) = 4.60$, $p < .001$, with follow-up univariate analyses

demonstrating a significant overall increase in frequency of drinking days, $F(1, 146) = 11.45$, $p < .01$, and total number of drinking episodes, $F(1, 146) = 16.58$, $p < .001$, between senior year of high school and the Fall semester in college. The univariate effects of assessment were not significant for typical quantity of alcohol consumed ($p = .71$), frequency of getting drunk ($p = .14$), or experience of problems ($p = .68$).

The multivariate main effect of gender, $F(5, 142) = 0.97$, $p = .44$, as well as the multivariate gender x transition group x assessment, $F(5, 143) = 2.23$, $p = .06$, gender x transition group, $F(5, 143) = 1.61$, $p = .16$, and gender x assessment, $F(5, 142) = 1.77$, $p = .12$, interactions all failed to reach statistical significance on the drinking outcome variables suggesting that the overall pattern of drinking and changes in drinking patterns during the transition from high school to college were similar for women and men in this sample.

As anticipated, the multivariate transition group x assessment interaction was statistically significant, $F(5, 143) = 33.79$, $p < .001$, providing confirmation that there were differential changes in drinking patterns during the transition from high school to college by heavy drinking transition group. Follow-up univariate analyses revealed that this significant interaction existed for each of the drinking outcome variables evaluated: frequency of drinking days per week, $F(2, 146) = 46.07$; typical quantity of alcohol consumed per drinking occasion, $F(2, 146) = 51.91$; total number of drinking episodes, $F(2, 146) = 35.17$; frequency of getting

drunk, $F(2, 146) = 16.51$; and experience of alcohol-related problems, $F(2, 146) = 12.75$ (all p's < .001).

Family History of Problem Drinking. The proportion of participants who identified at least one family member (biological parents, grandparents, or siblings) as a definite problem drinker was slightly higher in the group of students who maintained heavy drinking (33%), than those who transitioned into (25%), or out of (24%) of heavy drinking during their freshman year of college. A similar pattern was observed when the classification criterion was based on the identification of at least one family member as either a "definite" or "probable" problem drinker (59%, 43%, and 46%, respectively). Neither of these differences, however, was statistically significant: χ^2 (2, $N = 152$) = 1.28, $p = .53$, for definite problem drinker analyses; χ^2 (2, $N = 152$) = 2.86, $p = .24$, for either definite or probable problem drinker.

Anticipated Subjective Response to Alcohol. Group differences in levels of anticipated subjective response to alcohol based on the hypothetical drinking scenario were examined with a 2 (gender) x 3 (heavy drinking transition group: TI, TO, M) MANOVA. Contrary to hypotheses, there were no significant multivariate, $F(3, 145) = 1.31$, $p = .27$, or univariate (all p's > .17) main effects of heavy drinking transition groups on the hypothetical subjective response to alcohol measures. Further, there were no significant findings observed for the multivariate main effect of gender, $F(3, 144) = 0.68$, $p = .56$, or multivariate gender x transition group interaction, $F(3, 145) = 1.23$, $p = .30$. See Table 8 for

means, standard deviations, and significance tests for univariate analyses subjective response to alcohol factors scores by heavy drinking transition groups.

Psychological Variables. Potential differences in anxiety sensitivity, mindfulness, body vigilance, and distress tolerance were evaluated for participants classified into the heavy drinking transition groups with a 2 (gender) x 3 (transition group: TI, TO, M) MANOVA. Significant multivariate main effects were observed for both gender, $F(8, 139) = 3.52$, $p < .01$, and heavy drinking transition groups, $F(8, 140) = 2.09$, $p < .05$. Follow-up univariate analyses documented that women endorsed higher levels of physical ($M = 18.91$, $SD = 6.82$ vs. $M = 15.65$, $SD = 5.40$), $F(1, 146) = 11.04$, $p < .01$, and total anxiety sensitivity ($M = 31.63$, $SD = 8.96$ vs. $M = 27.90$, $SD = 7.06$), $F(1, 146) = 8.29$, $p < .01$, than the men in this study. In addition, women also reported lower tolerance of physical ($M = 23.63$, $SD = 5.71$vs. $M = 25.95$, $SD = 4.75$), $F(1, 146) = 7.24$, $p < .01$, and emotional distress ($M = 37.15$, $SD = 7.01$ vs. $M = 40.71$, $SD = 6.74$), $F(1, 146) = 10.47$, $p < .01$, than those acknowledged by men in this sample.

Whereas the overall multivariate main effect of transition group was significant for these analyses, none of the univariate tests were statistically significant indicating that these variables did not discriminate between heavy drinking transition groups. The multivariate gender x transition group interaction failed to reach statistical significance, $F(8, 140) = 1.21$, $p = .30$. See Table 9 for means, standard deviations, and significance tests from univariate analyses.

Response to Physiological and Perceptual Challenge. Group differences in subjective response to each of the five physiological and perceptual challenges (Carbon Dioxide Challenge, Cold Pressor Test, Spinning Challenge, Auditory Perception Test, and Visual Perception Test) were examined by heavy drinking transition group status. Potential differences in continuous variables were examined with 2 (gender) x 3 (transition group) MANOVA and group differences in dichotomous variables (e.g., voluntary discontinuation of a procedure) were examined with the chi-square statistic.

Carbon-Dioxide Challenge (CO_2). The multivariate main effect for gender was statistically significant, $F(5, 139) = 2.29$, $p < .05$, with subsequent univariate analyses revealing that women experienced a greater reduction in positive mood ($M = -0.76$, $SD = 0.58$ vs. $M = -0.57$, $SD = 0.63$), $F(1, 143) = 3.94$, $p < .05$, and rated the overall intensity of the sensations induced by the CO_2 challenge as more intense than the men ($M = 3.23$, $SD = 1.54$ vs. $M = 2.59$, $SD = 1.44$), $F(1, 143) = 6.87$, $p < .05$. The main effect of transition group and multivariate gender x transition group interaction on the five continuous outcome variables obtained for the Carbon-Dioxide Challenge failed to reach statistical significance, $F(5, 140) = 1.66$, $p = .15$, and, $F(5, 140) = 0.61$, $p = .69$, respectively.

Pearson chi-square analyses revealed a non-significant trend for participants in the transitioned out of heavy drinking group to be more likely to voluntarily terminate the CO_2 challenge (10.0%), relative to students who had

transitioned into and maintained heavy drinking groups combined (2.9%); however, this difference failed to meet the threshold for statistical significance, χ^2 (1, N = 152) = 3.35, p = .07. See Table 10 for means, standard deviations, percentages, and significance tests.

Cold-Pressor Test (CPT). There were no significant main effects of transition group, $F(8, 138) = 1.38$, $p = .21$, or gender, $F(8, 138) = 1.33$, $p = .24$, or multivariate gender x transition group interaction, $F(8, 138) = 1.90$, $p = .06$, on response to the Cold Pressor Test as evaluated by the eight continuous outcome measures examined (change in positive mood states, change in negative mood states, change in BSQ score, change in API score, immediate SUDS rating, peak SUDS rating, final SUDS rating, or the single-item overall assessment of the intensity of the sensations induced by the CPT). Significant univariate effects of gender were observed with female participants providing higher immediate (M= 51.98, SD = 27.35 vs. M = 40.95, SD= 26.59), $F(1, 144) = 6.16$, $p < .05$, peak (M= 80.31, SD = 21.32 vs. M = 72.51, SD= 23.81), $F(1, 144) = 4.38$, $p < .05$, and final SUDS ratings (M= 67.29, SD = 28.85 vs. M = 56.35, SD= 31.49), $F(1, 144) = 4.44$, $p < .05$. As was the case for the CO_2 challenge, women also provided higher ratings of the overall intensity of the sensations induced by the CPT (M = 5.99, SD = 1.17 vs. M = 5.52, SD = 1.16), $F(1, 144) = 6.39$, $p < .05$.

Even though there were no differences in subjective ratings of the sensations induced by the CPT, participants who transitioned out of heavy drinking were significantly more likely to voluntarily terminate the CPT prior to

the end of the 5-minute protocol (58%), than students who had transitioned into (29%) or maintained heavy drinking from high school through the first year of college (37%), χ^2 (2, N = 152) = 9.06, $p < .01$. See Table 11 for means, standard deviations, percentages, and significance tests for the Cold Pressor Test by heavy drinking transition group.

15-Second Spinning Challenge. The 15-second Spinning Challenge yielded no significant main effects of transition group, $F(3, 145) = 1.39$, $p = .25$, or gender, $F(3, 144) = 0.37$, $p = .077$, or multivariate gender x transition group interaction, $F(3, 145) = 1.55$, $p = .16$, on the three continuous dependent variables (change in the four physiological sensations assessed, number of rotations completed prior to termination of the protocol, and the single-item intensity rating). Again, there was a trend for participants in the transitioned out of heavy drinking group to be more likely to voluntarily terminate the spinning challenge (14.0%) prior to the 15-second time limit (relative to only 5.9% in each of the other two groups); however, this difference failed to reach statistical significance, χ^2 (1; N = 152) = 2.83, $p = .09$ (see Table 12).

Auditory Perception Test. There were no significant main effects of transition group, $F(6, 142) = 0.85$, $p = .53$, or gender, $F(6, 142) = 1.45$, $p = .20$, or multivariate gender x transition group interaction, $F(6, 142) = 0.85$, $p = .54$, on the average ratings of the five auditory stimuli or in the overall rating of the intensity of the sensations induced by the Auditory Perception Test. See Table 13 for means, standard deviations, and significance tests.

Visual Perception Test. A significant multivariate main effect of gender was observed on ratings in response to the visual perception test, $F(5, 143) = 2.45$, $p < .05$, with subsequent univariate analyses demonstrating that women rated brighter visual stimuli (75-W and 100-W) as more intense than men, $F(1, 146) = 7.00$, $p < .01$ and $F(1, 146) = 7.74$, $p < .01$, respectively. Average ratings of the four visual perception stimuli and the overall rating of the intensity of the sensations induced by the Visual Perception Test, were unrelated to transitions in heavy drinking as demonstrated by a non-significant multivariate main effect for transition group, $F(5, 143) = 0.91$, $p = .48$, and non-significant multivariate gender x transition interaction, $F(5, 143) = 1.74$, $p = .13$ (see Table 14).

Neuropsychological Functioning. Potential differences in cognitive functioning between heavy drinking transition groups were examined based on performance on the Visual Reproduction Immediate and Delayed Memory Test, Digit Symbol Coding, Digit Span, and Block Design subtests of the WAIS-III, and Trail Making Test Parts A and B (see Table 15 for means, standard deviations, and significance tests). The multivariate main effect of gender was statistically significant, $F(8, 140) = 2.79$, $p < .01$. Follow-up univariate analyses revealed that women performed better than men on the Digit Symbol Coding test, a measure of processing speed, $F(1, 146) = 5.08$, $p < .05$. No significant main effect of transition group, $F(8, 140) = 1.43$, $p = .19$, or multivariate gender x transition group interaction, $F(8, 140) = 1.28$, $p = .26$, occurred on the neuropsychological measures. In addition, there were no significant univariate

effects on any of the neuropsychological measures (all *p*'s > .15), suggesting that these groups did not differ in terms of their cognitive functioning.

Behavioral Measures of Decision-Making. Separate analyses were conducted for the outcome variables derived from the two behavioral tests of decision-making.

Go-Stop Paradigm. As was the case in Study 1, preliminary analyses revealed that a significant portion of the Study 2 sample (25.7%; n = 39) responded in a manner on this behavioral measure to render their test results invalid and were subsequently excluded from further analyses based on this paradigm (see Study 1 results on p. 81 for description and significance of invalid profile). A slightly higher proportion of participants who transitioned out of heavy drinking (32.0%) provided an invalid response profile relative to those who transitioned into (25.5%) or maintained heavy drinking (19.6%), although this difference was not statistically significant, χ^2 (2, N = 152) = 2.03, p = .36. Subsequent multivariate analyses with the remaining participants identified no significant main effects of transition group, F(4, 105) = 1.42, p = .23, main effects of gender, F(4, 105) = 0.78, p = .54, or multivariate gender x transition group interactions, F(4, 105) = 0.49, p = .74, on differences in outcome variables (go reaction time, stop signal reaction time, number of correct go responses, and number of correct stop responses; see Table 16).

Iowa Gambling Test. There was a significant multivariate main effect of gender, F(3, 141) = 3.37, p < .05, with follow-up univariate analyses revealing a

significant effect of gender on Learning-Rate, $F(1, 143) = 8.94$, $p < .01$. Specifically, women ($M = 0.64$, $SD = 0.36$) scored higher on this measure than men ($M = 0.44$, $SD = 0.42$) indicating that the choices women made on this task were driven more strongly by the immediately preceding outcome of selections than the entire pattern of outcomes observed. Multivariate analyses revealed no significant main effect of transition group, $F(3, 142) = 1.99$, $p = .12$, or gender x transition group interaction, $F(3, 142) = 1.56$, $p = .20$, on performance outcomes on the Iowa Gambling Test (Motivation, Learning-Rate, & Choice-Consistency; see Table 17).

Post-Hoc Analyses.

Stability of Heavy Drinking Transition Groups. The stability of the initial transition in heavy drinking status groups (from senior year of high school to the Fall semester of the first year of college) was evaluated post-hoc through analysis of self-reported drinking in the three months preceding the laboratory assessment (conducted during the Spring semester of the first year of college). For nearly one-fourth of Study 2 participants (23%; n = 35), drinking patterns had changed to the extent that they no longer met criteria for the transition group from which they were recruited: nearly 20% (10 of 51) of students who had transitioned into heavy drinking had moderated their alcohol consumption; 40% (20 of 50) of participants recruited because they had transitioned out of heavy drinking during the Fall semester had reinitiated heavy drinking patterns; and

10% (5 of 51) of heavy drinking high school students who had continued this pattern throughout the Fall semester decreased their drinking to below the heavy drinking threshold in the Spring. As the factors examined in the current study were predicted to be more strongly related to stable changes in drinking initiated during the transition from high school to college, each of the analyses examining group differences by heavy drinking transition status were repeated post-hoc after removing the 35 participants for whom this transition was not stable to determine whether the overall pattern of findings were affected by their inclusion.

In general, these secondary analyses (N = 117; 59% female) revealed a similar pattern of findings to those obtained from the entire sample. There were, however, several significant differences observed which are briefly described below.

Anticipated Subjective Response to Alcohol. A significant multivariate main effect of transition group, $F(3, 110) = 4.76$, $p < .01$, was observed for the measures of anticipated subjective response to alcohol with the reduced sample. Follow-up univariate analyses revealed that participants who had transitioned out of heavy drinking and not reinitiated heavy drinking patterns reported significantly higher anticipated Impaired/Sedative effects ($M = 37.72$, $SD = 23.83$) from a moderate dose of alcohol than those who had maintained heavy drinking status through the laboratory assessment ($M = 25.25$, $SD = 18.00$), $F(2, 111) = 3.34$, $p < .05$. The univariate effects of transition group remained non-significant for the Positive ($p = .79$) and Stimulant ($p = .40$) factor scores.

Psychological Variables. The multivariate main effect of transition group on the psychological variables examined (e.g., anxiety sensitivity, distress tolerance) was no longer statistically significant, $F(8, 105) = 1.71$, $p = .10$, in this reduced sample of emerging adults. As was the case in the initial analyses with the complete sample, all univariate effects of transition group were also non-significant (p's > .11).

Carbon-Dioxide Challenge (CO_2). The multivariate main effect of transition group, $F(5, 106) = 1.93$, $p = .10$, and univariate effects of transition group on change in positive mood states, $F(2, 109) = 3.00$, $p = .05$, and intensity of the sensations induced by the CO_2 challenge, $F(2, 109) = 3.07$, $p = .05$, approached statistical significance with the restricted sample, albeit not in the hypothesized direction. On each measure, scores for those who transitioned out of heavy drinking and did not reinitiate heavy drinking patterns prior to the laboratory assessment (change in positive mood states $M = -0.47$, $SD = 0.47$; intensity of sensations $M = 2.48$, $SD = 1.40$) were suggestive of a reduced response to the effects of the CO_2 challenge relative to those who transitioned into and then maintained heavy drinking status through the laboratory assessment ($M = -0.82$, $SD = 0.63$ and $M = 3.22$, $SD = 1.67$; respectively; $p < .05$ for both pair-wise comparisons).

Spinning Challenge. The multivariate gender x transition group status interaction was statistically significant, $F(3, 110) = 3.39$, $p < .05$. The univariate gender x transition group interaction was significant for the composite score of

sensations induced by the spinning protocol, $F(2, 111) = 4.27$, $p < .05$. Men who had transitioned out of heavy drinking and not reinitiated heavy drinking patterns prior to the laboratory assessment ($M = 21.40$, $SD = 16.35$) provided a lower rating of the intensity of the sensations induced by the spinning challenge (e.g., dizzy, lightheaded) than did men who had transitioned into ($M = 46.61$, $SD = 20.19$) or maintained ($M = 33.67$, $SD = 18.13$) heavy drinking status ($p < .05$ for both pair-wise comparisons). As was the case for the post-hoc finding with the carbon dioxide challenge, the direction of this effect was opposite from what was predicted.

Discussion

Study 2 of this dissertation was a preliminary, cross-sectional study designed to identify factors which reliably differentiated emerging adults who transitioned out of heavy drinking from those who initiated or continued heavy drinking patterns during the initial transition from high school to college. To be clear, transitioning out of heavy drinking during the matriculation from high school to college was not presumed to be representative of the "maturing-out" of heavy drinking phenomenon frequently observed after emerging adults graduate from college (e.g., Bachman et al., 2002; Jochman & Fromme, in press). Rather, transitioning out of heavy drinking during a period of time in which a variety of social (e.g., peer influences, norms) and environmental (e.g., increased access to alcohol, decreased supervision) factors promote heavy drinking (e.g., Fromme &

Kruse, 2005) is considered to be relatively uncommon. Thus, it was hypothesized that emerging adults who transition out of heavy drinking during this developmental period would be distinguishable from those who transition into or maintain heavy drinking patterns based on differences in factors associated with a greater risk for persisting in problematic patterns of drinking. Further, it was presumed that the identification of factors associated with "early" moderation of heavy drinking could provide insight into the existence of individual difference variables which confer a protective effect by reducing the likelihood of continuing heavy drinking beyond the college years. Of particular interest was whether emerging adults who transition out of heavy drinking differ from their peers in anticipated subjective response to alcohol (based on a hypothetical drinking scenario), and whether other factors (e.g., subjective response to physiological and perceptual challenges; cognitive functioning) were differentially associated with transitions in heavy drinking.

In general, the findings failed to support the central study hypotheses that the putative risk factors examined – namely anticipated subjective response to alcohol, subjective response to other physiological and perceptual challenges, and cognitive abilities – significantly predicted transitions in heavy drinking between senior year in high school and the first semester in college. Indeed, only one statistically significant difference was observed between heavy drinking transition groups: those who transitioned out of heavy drinking (58%) were significantly more likely to voluntarily terminate a physically uncomfortable task (i.e., by

removing his/her arm from cold water) than students who had transitioned into or maintained their heavy drinking status (33%).

It is notable that the discrepancy in voluntarily terminating the Cold Pressor Test existed in spite of the fact that emerging adults who had transitioned out of heavy drinking did not rate their subjective experience of this task as more uncomfortable (i.e., painful), endorse higher levels of physiological sensations induced by the protocol, or report greater changes in positive or negative mood states after completing the challenge. In addition, there was no evidence to suggest that students who had transitioned out of heavy drinking differed on any of the psychological variables considered as potential moderators (e.g., physical and emotional distress tolerance, anxiety sensitivity, body vigilance). Whereas the specific mechanism underlying the greater likelihood of voluntarily terminating the Cold Pressor Test is not clear from the data collected in Study 2, it is notable that similar (though not statistically significant) patterns of behavior were also observed for voluntary termination of the Carbon Dioxide (10% vs. 3%) and Spinning (14% vs. 6%) challenges; again in spite of the absence of group differences in the subjective ratings of these procedures. Combined, these findings offer some tentative evidence for a potential behavioral correlate (i.e., voluntary termination of an uncomfortable experience) associated with a reduced risk for persisting in heavy drinking patterns that appears to be independent of both the subjective experience of the event and any baseline group differences in anxiety sensitivity or distress tolerance.

Just as the transitions in heavy drinking examined were not believed to be representative of the maturing-out phenomenon, they were also not presumed to be static. Although evaluations of these initial transitions are meaningful in that they provide a snapshot of factors associated with variable response to the matriculation into college, it is well known that there are enormous fluctuations in patterns of drinking as emerging adults navigate through college and into adulthood (e.g., Jackson, Sher, & Schulenberg, 2008; Windle, Mun, & Windle, 2005; Oesterle, Hill, Hawkins, Guo, Catalano, & Abbot, 2004; Schulenberg, O'Malley, Bachman, Wadsworth, & Joshnston, 1996). As such, it was not entirely surprising that for 23% (35 of 152) of the emerging adults who were recruited for Study 2 (based on data demonstrating that they had reliably transitioned into, transitioned out of, or maintained heavy drinking between their senior year of high school and the Fall semester) drinking patterns had continued to evolve such that they no longer met eligibility criteria for the group from which they were recruited by the time they participated in this laboratory study during the Spring semester. Whereas this was particularly true for the students who had transitioned out of heavy drinking (40% had reinitiated heavy drinking patterns by the time of their participation in Spring), a significant percentage of students who had transitioned into (20%) or maintained heavy drinking (10%) from high school to the Fall semester also had change their patterns of drinking and no longer met heavy drinking criteria in the Spring.

In addition to providing a clear exemplar of the tremendous volatility in drinking patterns of emerging adults during the first year of college, the instability of these heavy drinking transition groups also prompted a post-hoc analysis to determine whether the factors believed to be associated with long-term risk for problematic drinking (e.g., low response to alcohol; reduced behavioral inhibition) were more strongly related to transitions in heavy drinking within the subset of young adults for whom these initial transitions were stable through the Spring laboratory assessment.

Although the overall pattern of results were generally similar between the full sample and the subset of students for whom these initial transitions were stable through completion of the Spring laboratory assessment, there were a handful of notable differences. First, partial evidence was obtained in support of the hypotheses that heavy drinking transition groups would vary by differences in subjective response to alcohol. Specifically, students who had transitioned out of heavy drinking (and not reinitiated heavy drinking patterns in the Spring) reported significantly higher levels of anticipated impairment and sedation than those who had maintained heavy drinking from high school throughout their first year in college. This finding is consistent with several lines of research demonstrating that heavy drinkers are less sensitive to the sedating effects of alcohol (King et al., 2002) and lower impairment from alcohol is associated with an increased risk for patterns of problematic drinking (e.g., Viken et al, 2003). It is also congruent with general reinforcement models of alcohol abuse and dependence, which posit

that higher levels of the "punishing" effects of alcohol (e.g., impairing and sedating), particularly in the absence of comparably high levels of what are considered to be the "reinforcing" effects (e.g., positive and stimulant), will reduce the likelihood of persisting in heavy drinking patterns.

Second, there was evidence that men who had transitioned out of heavy drinking experienced less intense vestibular sensations (e.g., dizzy, light-headed) after completing a spinning challenge than men who had transitioned into or maintained heavy drinking. Further, there were trends suggestive that emerging adults who reliably transitioned out of heavy drinking also experienced less intense sensations from a carbon-dioxide challenge (e.g., lower overall rating of intensity; less of a decline in positive mood after completing the challenge) than those who had transitioned into heavy drinking and continued to drink heavily in the Spring semester of their first year in college. Both of these findings were opposite of what was predicted and are made more interesting in the context that the students who transitioned and remained out of heavy drinking still showed a higher proclivity (though not statistically significant) to voluntary terminate both the Spinning (13% vs. 5%) and Carbon Dioxide (10% vs. 2%) challenges in this restricted sample, in spite of partial evidence that they were less affected by these experiences. An alternative explanation worthy of consideration is that subjective ratings of the sensations induced by these two physiological challenges may have been lower because those who voluntarily terminated the protocols received a lower dose of the challenges. Whereas, there were no significant group

differences on any of the particular psychological constructs evaluated (e.g., anxiety sensitivity, distress tolerance) in either set of analyses, the significant multivariate effect observed for transition group in the full sample was not significant in analyses with the reduced sample, further suggesting that these heavy drinking transition groups did not differ on these constructs.

It was notable that absolutely no evidence was obtained to suggest (in either set of analyses) that the cognitive functioning of emerging adults varied as a function of changes in heavy drinking status during the initial transition from high school to college. Performance on the five neuropsychological tests administered was equivalent across groups in spite of evidence suggesting that these tests differentiate college student drinkers at greater risk for alcohol dependence (Sher et al., 1997). Similarly, there was no evidence to support the prediction that students who had transitioned out of heavy drinking were less likely to engage in a pattern of poor decision-making or display behavioral impulsivity, in spite of previous findings implicating these variables as risk factors for the development of alcohol dependence (e.g., Bechara et al., 2002; Rubio et al., 2008).

A secondary goal of Study 2 was to examine the psychometric properties of the factor structure of the measures of anticipated subjective response to alcohol used in Study 1 in a sample of experienced underage heavy drinkers. As was the case in Study 1, exploratory factor analyses revealed that a three-factor structure (Positive, Stimulant, and Impaired/Sedative) was able to parsimoniously

account for the covariation in these variables. The internal consistency and reliability estimates of these three measures were once again excellent (range in α = .94 to .96). Tests of discriminant validity reinforced the findings from Study 1 which suggested that anticipated subjective response to alcohol based on the hypothetical drinking scenario was relatively distinct from general alcohol expectancies with one exception: in the current study greater expectations for Liquid Courage (as measured by the CEOA) were associated with higher anticipated Positive effects from a moderate dose of alcohol.

In addition, partial evidence was obtained in further support of the construct validity of the subjective response factors. In particular, higher anticipated stimulation from a moderate dose of alcohol was associated with a family history of alcoholism consistent with findings from alcohol administration studies (e.g., King et al., 2002). Also, within the subset of participants for whom the initial transition in heavy drinking was stable through the Spring semester, those who transitioned out of heavy drinking reported significantly higher anticipated impairment and sedation from a moderate dose of alcohol than those who maintained in heavy drinking during this period. Again, this finding is consistent with data from alcohol administration studies (e.g., King et al., 2002; Schuckit, 1984) and suggests that students who reliably transition out of heavy drinking during the first year of college may be at a reduced risk for the persistence in heavy drinking patterns in part due to differences in their subjective response to alcohol.

In summary, the results of Study 2 provide further support for the utility of using a hypothetical drinking scenario to estimate individual differences in subjective response to alcohol in underage emerging adults. This study also identified a behavioral tendency to voluntarily terminate participation in an uncomfortable procedure (i.e., Cold Pressor Test) associated with a reduction in heavy drinking during the initial transition from high school to college. Although post-hoc, there was also evidence obtained that greater sensitivity to the impairing and sedating effects of alcohol is associated with stable reductions in heavy drinking over the course of the entire first year of college. In spite of the known volatility of heavy drinking patterns in emerging adults as they transition through college and into adulthood (e.g., Schulenberg et al., 1996), and the myriad of social and contextual factors which influence drinking behavior during this time (e.g., Fromme & Kruse, 2005) this finding offers preliminary evidence that heightened experience of the "punishing" (i.e., impairing and sedating) effects of alcohol may serve as a protective factor associated with a reduced risk of persisting in heavy drinking patterns and suggests that this association is worthy of further exploration in future research studies.

CHAPTER 5: DISCUSSION

Individual differences in the subjective experience of the pharmacological effects of alcohol have been identified as a genetically-driven robust predictor of increased risk for the development of alcohol use disorders (e.g., Viken et al., 2003; Schuckit & Smith, 2000; Heath et al., 1999; Munct et al., 1997; Schuckit, 1980; 1984; 1994). The extent to which this marker has been effectively utilized to identify those presumed to be at greater risk, however, has been significantly compromised by a variety of ethical, legal, and practical considerations (e.g., Schuckit et al., 2007). The two laboratory studies of this dissertation were designed to circumvent these limitations through the identification of valid and reliable correlates of individual differences in subjective response to alcohol which can be utilized as screening devices for detecting emerging adults believed to be at an increased risk. Three theoretically-derived and empirically-supported primary hypotheses provided the overall conceptual framework for this research and informed the selection of the measures and procedures used in these two studies.

First, it was predicted that emerging adults would be able to provide a valid and reliable estimation of their subjective response to alcohol based on a hypothetical drinking scenario standardized to target a .08% BAC. The most commonly used method for evaluating individual differences in subjective response to alcohol is through participant self-report, and there is evidence from

both alcohol outcome expectancy research (for review see Patel & Fromme, in press) as well as earlier efforts to measure anticipated subjective response to alcohol (e.g., Ray et al., 2007; Schuckit et al., 1997; Earleywine, 1994a; 1994b) to suggest that emerging adults are able to provide reliable estimates of the effects of alcohol they would anticipate experiencing when provided with a hypothetical drinking scenario. Thus far, however, attempts to evaluate individual differences in anticipated subjective response to alcohol have been critically flawed by their failure to statistically control (or otherwise account for) individual differences in estimated BAC based on the use of generic (i.e., non-individualized) hypothetical drinking scenarios (e.g., Ray et al., 2007; Earleywine, 1994a; 1994b). It was anticipated that by individualizing the number of standard drinks each participant would be asked to imagine consuming (based on his/her gender and weight to achieve a peak-BAC of .08%), emerging adults who were experienced drinkers would be able to rely on their previous drinking experiences to provide an accurate estimate of how they would feel at an actual BAC of .08%. Further, it was believed that individual differences in these anticipated measures of subjective response to alcohol would be relatively distinct from more global beliefs about the effects of alcohol (i.e., alcohol expectancies), would be associated with patterns of drinking, and would differentiate underage emerging adults who transitioned out of heavy drinking from those who transitioned into or maintained heavy drinking during the transition from high to college.

Second, it was hypothesized that individual differences in subjective response to alcohol are not unique to the pharmacological effects of ethanol, but rather are representative of a general pattern of sensitivity to a variety of physiological sensations. Individual differences in the perception of physiological sensations (e.g., tactile, visual, auditory) are ubiquitous and there is evidence that during the acute phases of intoxication alcohol affects our subjective experience (i.e., perception) of a variety of physiological/perceptual sensations [e.g., pain sensitivity (e.g., Perrino et al., 2008); vestibular sensitivity (e.g., Hafstrom et al., 2007); responsiveness to CO_2 (e.g., Johnston & Reiter, 1973); auditory sensitivity (e.g., Upile et al., 2007); and visual sensitivity (e.g., Johnston & Timney, 2008)]. Given the direct effect of alcohol on these perceptual systems, it was believed that individual differences in sensitivity to the effects of alcohol would be strongly correlated with variability in response to a variety of physiological and perceptual challenges (e.g., Carbon-Dioxide, Spinning, and Cold Pressor Test).

Third, individual differences in subjective response to alcohol were predicted to be associated with other patterns of cognitive impairment implicated as risk factors for the development of alcohol use disorders. In particular, we were interested in whether a "low" subjective response to alcohol may be usefully conceived of as a neurologically-based impairment in the ability to perceive physiological sensations that might be associated with other known cognitive risk factors for the development of alcohol use disorders. Whereas the long-term effects of alcohol on cognitive functioning are well known (for review see

Parsons & Nixon, 1998), less is known about potential baseline differences in cognitive functioning which may predispose emerging adults to a greater risk for alcohol dependence. It was hypothesized, that individual differences in subjective response to alcohol would be correlated with deficits in functioning associated with symptoms of alcohol dependence in high cognitive functioning adults (e.g., Sher et al., 1997) or implicated as potential risk factors for the development of alcohol use disorders (e.g., Rubio et al., 2008; Bechara et al., 2002), reflecting a common underlying risk factor associated with impairment in cognitive functioning.

To empirically evaluate these hypotheses, Study 1 combined questionnaire, laboratory, and standardized alcohol-administration (target BAC = .08%) methodologies in a sample of 21-23 year-old experienced drinkers to: (1) assess the factor structure, internal consistency, construct validity, discriminant validity, and criterion validity of a self-report measure of anticipated subjective response to alcohol based on an individualized hypothetical drinking scenario targeting a BAC of .08%; and (2) examine the associations between individual differences in the subjective experience of a moderate dose of alcohol and differences in response to a variety of physiological and perceptual challenge procedures as well as a number of indices of cognitive functioning. Study 2 served as a preliminary cross-sectional study designed to examine the criterion validity of each of these factors by evaluating the extent to which they differentiated emerging adults who had transitioned out of heavy drinking from

high school to the first semester of college (those presumed to be at lower-risk for the development of alcohol use disorders) from students who transitioned into or maintained heavy drinking patterns during this important developmental milestone.

Estimating Subjective Response to Alcohol based on a Hypothetical Drinking Scenario

The results of these two studies provide support for the validity and potential utility of estimating individual differences in subjective response to alcohol based on a hypothetical drinking scenario. In particular, the evidence suggests that experienced drinkers, on average, are quite capable of accurately estimating how they would feel if they consumed alcohol in accordance with a hypothetical drinking scenario targeting a BAC of .08%. Emerging adults demonstrated that they could reliably differentiate between three domains of subjective response to alcohol (Positive, Stimulant, and Impaired/Sedative), and that these anticipated effects were generally distinct from more global beliefs about the effects of alcohol on cognition and behavior (i.e., alcohol expectancies). Additionally, there was at least partial evidence obtained for the criterion validity of each of the factors evaluated. Among 21-23 year olds, for example, those who experienced more of the Positive effects from a moderate dose of example were also more likely to drink more frequently and experience more alcohol-related consequences. Within first-year college students, higher Stimulant ratings were

associated with a greater likelihood of having at least one "definite" problem drinker in the family, a lower estimated BAC to feel drunk, and getting drunk more frequently.

In terms of implications for the identification of emerging adults at greater risk for the persistence in heavy drinking patterns, the findings related to the anticipated Impaired/Sedative effects of a moderate dose of alcohol are likely of greater potential significance. The variables contained in this combined factor (a hybrid of the Impaired and Sedative subscales originally identified as distinct factors; Kruse et al., June 2004) most closely approximate the "negative" effects of alcohol upon which determinants of "low" subjective response have traditionally been made (e.g., dizzy, slurred speech, sleepy, confused, intoxicated; e.g., Schuckit, 1980). It is, therefore, noteworthy that of the three factors evaluated, the anticipated Impaired/Sedative factor scores were most closely aligned with ratings of the actual effects of alcohol (r = .67; 45% shared variance) and were better predictors of patterns of problematic drinking in both samples studied. Specifically, lower anticipated Impaired/Sedative effects were associated with both increased frequency of drinking as well as higher estimated BAC to feel "drunk" in 21-23 year olds. Within the sample of first-year college students, lower anticipated Impaired/Sedative effects were associated with each of the alcohol variables examined: greater typical quantity and frequency of drinking, getting drunk more frequently, more alcohol-related problems experienced, and higher estimated BAC to feel "drunk." In addition, the anticipated

Impaired/Sedative factor was the only measure of subjective response to differentiate the subset of emerging adults who transitioned out of heavy drinking during the initial transition from high school to the first semester of college (and then continued to refrain from drinking heavily in the Spring) from those who maintained in heavy drinking throughout the first year of college.

It is important to also keep in mind that lower anticipated (in both studies) and actual (Study 1) experience of the impairing and sedative effects of alcohol were related to higher estimates of subjective tolerance in these two samples of emerging adults. Whereas it is highly likely that perceptions of tolerance are driven in part by an evaluation of the subjective effects experienced from consumption of alcohol; it is also the case that tolerance from repeated drinking will reduce both the anticipated and actual experience of the pharmacological effects of a moderate dose of alcohol. Therefore the observed associations between lower anticipated impairment and sedation from a moderate dose of alcohol and an overall pattern of riskier drinking behavior should be interpreted with caution as the direction of the influence can not be determined based on the current research.

In spite of this limitation, the combined results of these two studies provide evidence in support of the measurement of individual differences in anticipated subjective response to alcohol in response to a hypothetical drinking scenario as a proxy for identifying those presumed to be at greater risk for the development of alcohol use disorders. Perhaps the most significant contribution

of this research is the introduction of a technique for controlling the significant variability in estimated peak BAC that is inherent in the use of generic hypothetical drinking scenarios (e.g., in which all participants are asked to imagine consuming the same amount of alcohol irrespective of gender or weight). By titrating the amount of alcohol each participant was asked to imagine consuming (through the use of standardized dosing calculations based on gender and weight to determine the amount of alcohol necessary to reach a peak BAC; Matthews & Miller, 1979), it is possible that greater confidence can be gained that observed differences in scores reflect variability in anticipated subjective response to a defined blood alcohol level, and are not reflective of grossly disproportionate estimated peak-BACs. The current studies did not explicitly examine the incremental validity of the individualized hypothetical drinking scenario relative to the more generic scenarios used in previous research. Whereas the concordance between the anticipated and actual subjective response to alcohol measures reported in Study 1 (*r*'s range from .53 to .67) are higher than those reported for the generic scenarios used in previous studies (e.g., $r = .41$; Ray et al., 2007), further experimental testing is necessary to document whether there is additional benefit from using the individualized scenarios in obtaining estimates of subjective response to alcohol.

Inconsistent findings were obtained relative to the prediction that greater experience/familiarity with the hypothetical drinking scenario used in these studies (conceptualized as the frequency of drinking in a pattern similar to what

was described in the previous three months) would be associated with increased accuracy of the anticipated subjective response measures. Specifically, whereas students who were "more" experienced with the scenario (determined by a median split) provided ratings of anticipated subjective response more concordant with the actual subjective response to alcohol measures, the overall frequency of drinking in a pattern similar to the scenarios had no impact. It should be noted, however, that both statistical techniques are limited due to the non-normality of the distribution of familiarity with the scenario (even after removing outliers) and the lack of conceptually distinct groups identified by the median split. Further, the exclusion of emerging adults from participation in this study because they had not reported getting drunk at least once in the past three months resulted in the virtual absence of participants who reported that they did not drink in a manner similar to the hypothetical drinking scenario (2.6%; 3 of 116 participants). As such, we were also unable to evaluate whether any drinking experience commensurate with the hypothetical drinking scenario was a necessary and/or sufficient condition in order to provide valid estimates of subjective response to alcohol.

Whereas most of the emerging adults evaluated in Studies 1 and 2 acknowledged drinking in a manner consistent with the hypothetical drinking scenario at least one time in the preceding three months, it is unclear what endorsement of this item may signify. Specifically, it may be the case that endorsement of that item does not necessarily indicate that the individual had

consumed the proscribed amount of alcohol within 30-minutes and then stopped (as is presumed in the hypothetical drinking scenario), but rather it may simply signify that the individual had consumed at least that amount of alcohol as part of a larger drinking experience.

An additional methodological issue is related to the ecological validity of the hypothetical drinking scenario relative to the typical drinking of college students. In the current studies the particulars of the hypothetical drinking scenario were derived to be indistinguishable from the alcohol administration protocol implemented in Study 1 in order to evaluate the construct validity of this assessment technique. It is likely, however, that the pattern of drinking described in these scenarios (i.e., consumption of enough alcohol within a 30-minute period to reach a peak-BAC of .08% followed by no additional drinking) does not accurately reflect the typical drinking experiences of emerging adults. Further refinement and modification of these assessment procedures, therefore, are necessary to determine whether hypothetical drinking scenarios with more ecological validity might provide even more useful information about the influence of individual differences in subjective response to alcohol on the risk for persistence in heavy drinking patterns.

As previously discussed, a significant limitation of this research is the modest sample size in these two studies. In addition to the resulting limited power to detect significant differences (exacerbated by the number of variables examined in each of the two studies), the modest sample sizes also reduce

confidence in the results of the factor analyses used to identify the latent structure of the measures of anticipated and actual subjective response to alcohol. A variety of factors (e.g., exploratory factor analyses, examination of the correlations between factor scores) generally suggested that a 3-factor model, in which items from the Impaired and Sedative subscales were combined into a single factor, best accounted for the variability in the subjective response to alcohol measures. Given the variability in factor loadings and related concerns about the relative independence of the Impaired and Sedative subscales originally identified as distinct factors, further evaluation of the factor structure of this measure is warranted within a larger and more diverse (in terms of drinking history) sample.

Subjective Response to Alcohol: Unique versus General Pattern of Sensitivity

The results of Study 1 failed to provide any evidence to support the hypothesis that individual differences in subjective response to alcohol were representative of a general pattern of responsiveness to physiological sensations. In fact, individual differences in subjective response to alcohol were not in any way associated with pain, vestibular, auditory, or visual sensitivity or to the sensations induced by a carbon-dioxide challenge. This absence of findings occurs in spite of evidence suggesting that each of these response systems are significantly impacted by the acute effects of alcohol intoxication [e.g., pain

sensitivity (e.g., Perrino et al., 2008); vestibular sensitivity (e.g., Hafstrom et al., 2007); responsiveness to CO_2 (e.g., Johnston & Reiter, 1973); auditory sensitivity (e.g., Upile et al., 2007); and visual sensitivity (e.g., Johnston & Timney, 2008)]. Although not exhaustive, the range of physiological and perceptual challenges used in these two studies was diverse, including tests of the perception of both external (i.e., tactile sensitivity) and internal sensations (i.e., vestibular sensitivity), perception of audio and visual cues, as well as sensations induced by the inhalation of carbon-dioxide. Thus, results provide compelling evidence that individual differences in subjective response to alcohol may be uniquely associated with the pharmacological properties of ethanol.

It was predicted that those who transitioned out of heavy drinking would endorse more extreme responses to the physiological challenges administered (e.g., Carbon-Dioxide challenge, Cold Pressor Test). In fact, analyses based on the entire sample of participants in Study 2, revealed that those who had transitioned out of heavy drinking were significantly more likely to voluntarily terminate the Cold Pressor Test, and showed non-significant trends towards being more likely to voluntarily terminate both the Carbon-Dioxide and Spinning challenges than those who had transitioned into or maintained heavy drinking. This discrepancy was observed in spite of the fact that there were no differences in ratings of the subjective experience of these physiological challenges by heavy drinking transition groups. Further, when only the subset of participants for whom the initial transitions in heavy drinking from high school to the Fall

semester were maintained through the Spring laboratory assessment, the data suggested that those who transitioned out of heavy drinking actually reported modestly lower subjective response to the Spinning (men only) and Carbon-Dioxide challenges. Combined these findings offer tentative evidence of a behavioral correlate between the cessation of heavy drinking during the initial transition from high school to college and an increased likelihood of voluntarily terminating an uncomfortable experience.

Differences in Subjective Response to Alcohol as Cognitive Impairment

There was very little evidence to suggest that individual differences in subjective response to alcohol were associated with patterns of neuropsychological functioning save for one finding: Impaired/Sedative factor scores were positively associated with the ratio of time required to complete a processing speed task made more difficult by the inclusion of a working memory component (Trails B) relative to the time required to complete a similar though conceptually similar processing speed task (Trails A). This finding has already been discussed in depth (p. 87), so it will suffice to repeat here that this association does offer tentative evidence that heightened sensitivity to the impairing and sedative effects of alcohol may be associated with a rather subtle cognitive inefficiency which results in a relatively greater level of impairment triggered by an increase in cognitive demand. Future efforts to further explore this association, in addition to replicating the observed finding from the Trails A

and Trails B Making Tests of the Halstead-Reitan Battery (Reitan, 1969) may benefit from the inclusion of other tasks related to this construct (e.g., the Stroop Test; Stroop, 1935; Paced Auditory Serial Addition Test).

In addition, there was no evidence obtained that a low level of subjective response to alcohol, a known risk-factor for the development of alcohol use disorders, was associated with two patterns of cognitive impairment which have also been implicated as risk factors for alcohol dependence: impaired behavioral control as measured by the Go-Stop Paradigm (i.e., slower stop reaction times; e.g., Rubio et al., 2008) or hyper-vigilance to reward (i.e., higher motivation scores indicating choices are driven by possible gains to the exclusion of consideration of potential losses; e.g., Bechara et al., 2002). The absence of significant associations generally suggests that these factors likely exert their respective influences on risk for alcohol use disorders independent of one another and are, therefore, not indicative of a common underlying cognitive risk factor.

Fluctuations and Instability in Patterns of Heavy Drinking

The instability of heavy drinking transition groups clearly limits confidence in the findings from Study 2. Given the relatively uncommon occurrence of transitioning out of heavy drinking during the initial transition from high school to college (59 of 2,077 eligible students met criteria; 2.8%), and the high proportion of these individuals who subsequently transitioned back into heavy drinking during the second semester of their freshman year (40% of 50

participants), it is possible that this small subset of students may differ from other students in a manner that was not evaluated in the current study. As such, caution should be exercised in interpreting the findings from Study 2 and future efforts to evaluate factors associated with significant transitions out of heavy drinking during this time of fluctuating drinking patterns (e.g., Schulenberg et al., 1996) may be better served by the requirement of longer periods of stable change.

Further, the cross-sectional design of Study 2 precludes an examination of the potential predictive validity of the measures of anticipated subjective response to alcohol relative to changes in patterns of heavy drinking in emerging adults. This study was an important first-step in evaluating whether those who transitioned out of heavy drinking differ meaningfully from those who initiated or maintained heavy drinking patterns during the initial transition from high school to college. The next critical step will be to implement prospective, longitudinal studies to evaluate whether individual differences in anticipated subjective response predict trajectories of heavy drinking in emerging adults.

Future Directions

In summary, the overall results of these two studies suggest that valid and reliable estimates of individual differences in subjective response to alcohol may be obtained through the measurement of anticipated subjective response to alcohol based on a hypothetical drinking scenario targeting a standardized BAC. Future research studies with larger and more diverse (in terms of drinking history)

samples is necessary in order to further examine the psychometric properties (e.g., solidify the facture structure of different domains; examine test-retest reliability; investigate the incremental validity of the hypothetical drinking scenarios) of the anticipated measures of subjective response to alcohol, and to determine whether the overall validity of this assessment technique can be enhanced through the development of more ecologically valid drinking scenarios comparable to the typical drinking patterns of heavy college student drinkers. In addition, longitudinal designs in which individual differences in subjective response to alcohol are identified prior to the development of patterns of heavy drinking may help elucidate the relative role of tolerance in the observed associations between low response to the impairing and sedating effects of alcohol and problematic drinking behaviors. Similarly, there is a need to replicate this research with less experienced drinkers to further differentiate the overall effect of drinking history on the accuracy of the hypothetical drinking measures. This intervention technique may ultimately prove to be useful in the identification of emerging adults at greater risk for the development of alcohol use disorders, and provide an opportunity for these individuals to be educated on the relative risks associated with this phenotype.

Table 1. Factor Loadings for Exploratory Factor Analyses for Hypothetical and Actual Measures of Subjective Response to Alcohol in Study 1 (N = 116) compared to Factor Loadings obtained in Preliminary Study (N = 119; Kruse et al., June 2004).

Measure:	HYPOTHETICAL				HYPOTHETICAL				ACTUAL			
Source:	Kruse et al., June 2004				Study 1				Study 1			
Variance:	58%				70%				69%			
Item:	F1: Pos	F2: Stim	F3: Imp	F4: Sed	F1: Pos	F2: Stim	F3: Imp	F4: Sed	F1: Pos	F2: Stim	F3: Imp	F4: Sed
Relaxed	.89	-	-	-	.81	-	-	-	.65	-	-	-
Top of World	.89	-	-	-	.87	-	-	-	.69	-	-	-
Great	.73	-	-	-	.87	-	-	-	.82	-	-	-
Charming	.73	-	-	-	.72	-	-	-	.78	-	-	-
Free	.71	-	-	-	.69	-	-	-	.73	-	-	-
Joyful	.65	-	-	-	.89	-	-	-	.78	-	-	-
Sexy	.62	-	-	-	.86	-	-	-	.93	-	-	-
Enjoy Self	.51	-	-	-	.88	-	-	-	.82	-	-	-
Ideas Flow Easily	.47	-	-	-	.69	-	-	-	.82	-	-	-
Energized	-	.89	-	-	-	.91	-	-	-	.85	-	-
Stimulated	-	.88	-	-	-	.86	-	-	-	.86	-	-
Up	-	.87	-	-	-	.81	-	-	-	.87	-	-
Vigorous	-	.86	-	-	-	.84	-	-	-	.86	-	-
Excited	-	.85	-	-	-	.89	-	-	-	.85	-	-
Talkative	-	.74	-	-	-	.81	-	-	-	.78	-	-
Elated	-	.62	-	-	-	.73	-	-	-	.81	-	-

Table 1 (continued)

Table 1 (continued). Factor Loadings for Exploratory Factor Analyses for Hypothetical and Actual Measures of Subjective Response to Alcohol in Study 1 (N = 116) compared to Factor Loadings obtained in Preliminary Study (N = 119; Kruse et al., June 2004).

Measure:	HYPOTHETICAL				HYPOTHETICAL				ACTUAL			
Source:	Kruse et al., June 2004				Study 1				Study 1			
Variance:	58%				70%				69%			
Item:	F1: Pos	F2: Stim	F3: Imp	F4: Sed	F1: Pos	F2: Stim	F3: Imp	F4: Sed	F1: Pos	F2: Stim	F3: Imp	F4: Sed
High	-	-	.90	-	-	-	.78	-	-	-	.69	-
Drunk	-	-	.88	-	-	-	1.00	-	-	-	.66	-
Intoxicated	-	-	.83	-	-	-	.86	-	-	-	.78	-
Dizzy	-	-	.66	-	-	-	.41	-	-	-	.89	-
Slurred Speech	-	-	.64	-	-	-	.47	-	-	-	.73	-
Uncomfortable	-	-	.62	-	-	-	-	-	-	-	.72	-
Muddled/Confused	-	-	.57	-	-	-	-	.51	-	-	.82	-
Clumsy	-	-	.57	-	-	-	.52	-	-	-	.90	-
Dif. Concentrating	-	-	.55	-	-	-	.52	-	-	-	.66	-
Inactive	-	-	-	.86	-	-	-	.87	-	-	-	.64
Sedated	-	-	-	.83	-	-	-	.85	-	-	-	.60
Sluggish	-	-	-	.82	-	-	-	.91	-	-	.48	-
Down	-	-	-	.71	-	-	-	.96	-	-	-	.90
Lonely	-	-	-	.67	-	-	-	.75	-	-	.51	-
Slow Thoughts	-	-	-	.57	-	-	-	.70	-	-	.57	-
Sleepy	-	-	-	.55	-	-	-	.67	-	-	.76	-

Notes. Factor loadings below .30 not displayed.

Table 2. Factor Loadings for Forced-Three Factorial Model Exploratory Factor Analyses for Hypothetical and Actual Measures of Subjective Response in Study 1 (N = 116).

Measure:	Hypothetical Subjective Response			Actual Subjective Response		
Variance:	65.1%			64.3%		
	Positive	Stimulant	Impaired/ Sedative	Positive	Stimulant	Impaired/ Sedative
Joyful	.87	-	-	.75	-	-
Enjoy Self	.86	-	-	.81	-	-
On Top of World	.85	-	-	.65	-	-
Sexy	.84	-	-	.88	-	-
Great	.84	-	-	.77	-	-
Relaxed	.80	-	-	.60	-	-
Charming	.73	-	-	.80	-	-
Ideas Flow Easily	.69	-	-	.80	-	-
Free	.67	-	-	.72	-	-
Energized	-	.91	-	-	.85	-
Stimulated	-	.87	-	-	.76	-
Excited	-	.87	-	-	.88	-
Vigorous	-	.81	-	-	.75	-
Talkative	-	.81	-	-	.81	-
Up	-	.80	-	-	.82	-
Elated	-	.76	-	-	.83	-

Table 2 (continued)

Table 2 (continued). Factor Loadings for Forced-Three Factorial Model Exploratory Factor Analyses for Hypothetical and Actual Measures of Subjective Response in Study 1 (N = 116).

Measure:	Hypothetical Subjective Response			Actual Subjective Response		
Variance:	65.1%			64.3%		
	Positive	Stimulant	Impaired/ Sedative	Positive	Stimulant	Impaired/ Sedative
Sluggish	-	-	.91	-	-	.76
Inactive	-	-	.84	-	-	.63
Slow Thoughts	-	-	.82	-	-	.75
Sleepy	-	-	.81	-	-	.78
Dif. Concentrating	-	-	.77	-	-	.70
Sedated	-	-	.77	-	-	.71
Down	-	-	.72	-	-	.40
Dizzy	-	-	.71	-	-	.77
Intoxicated	-	-	.71	-	-	.73
Slurred Speech	-	-	.70	-	-	.64
Drunk	-	-	.70	-	-	.71
High	-	-	.67	-	-	.67
Clumsy	-	-	.66	-	-	.77
Muddled/Confused	-	-	.66	-	-	.73
Lonely	-	-	.47	-	-	.58
Uncomfortable	-	-	.42	-	-	.76

Note. Factor loadings below .30 not displayed.

Table 3. Bivariate Correlations between Measures of Subjective Response based on Hypothetical Drinking Scenario and CEOA Subscales.

	Hypothetical Subjective Response Factors		
CEOA Subscales	Positive	Stimulant	Impaired/ Sedative
Sociability	.30*	.40*	.02
Liquid Courage	.34*	.37*	.05
Sexual Enhancement	.33*	.23	.14
Tension Reduction	.04	-.01	-.16
Negative Self-Perception	-.03	-.11	.16
Cognitive-Behavioral Impairment	.07	-.04	.17
Risk & Aggression	.30*	.33*	.12

Note. * Significant at Bonferroni-adjusted $p < .002$ to control for Type I errors.

Table 4. Bivariate Correlations between Psychological Variables and Measures of Subjective Response to Alcohol based on Hypothetical Drinking Scenario (Hyp) and After Consuming Alcohol (Act).

	Subjective Response to Alcohol Factors					
	Positive		Stimulant		Impaired/ Sedative	
Psychological Variables:	Hyp.	Act.	Hyp.	Act.	Hyp.	Act.
ASI – Physical	.11	-.03	.15	.00	.13	.12
ASI – Mental Incapacitation	.27	.08	.29	.05	.20	.14
ASI – Social	.00	-.06	.02	-.03	-.15	.02
ASI – Total	.17	-.01	.17	-.02	.13	.14
Mindfulness (MAAS)	-.28	-.03	-.17	-.02	-.23	-.19
Body Vigilance Scale	.02	.00	.04	.05	-.03	.16
DTS - Physical	-.14	-.08	.06	.09	-.28	-.26
DTS - Emotional	-.26	-.07	-.11	.12	-.15	-.18

Notes. No correlation was statistically significant at Bonferroni-adjusted $p <$ .002; ASI = Anxiety Sensitivity Index; MAAS = Mindful Attention Awareness Scale; DTS = Distress Tolerance Scale.

Table 5. Means (Standard Deviations) and Significance Tests for Actual Subjective Response to Alcohol Factor Scores by Completion Status of Cold Pressor Test (CPT).

	Voluntarily Terminated CPT Protocol (n = 51)	Completed CPT Protocol (n = 65)	*t* (114)
Positive	42.49 (22.22)	34.80 (24.57)	1.76[#]
Stimulant	49.52 (21.49)	47.05 (21.38)	0.61
Impaired/Sedative	28.94 (15.35)	24.63 (14.79)	1.53

Note. [#] Indicates non-significant trend, $p < .10$.

Table 6. Factor Loadings for Anticipated Subjective Response to Alcohol (Forced-Three Factor Model) in Study 1 (N = 116) and Study 2 (N = 152).

Source:	Study 1			Study 2		
Variance:	65.1%			70.2%		
	Positive	Stimulant	Impaired/ Sedative	Positive	Stimulant	Impaired/ Sedative
Joyful	.87	-	-	.68	-	-
Enjoy Self	.86	-	-	.81	-	-
On Top of World	.85	-	-	.72	-	-
Sexy	.84	-	-	.82	-	-
Great	.84	-	-	.87	-	-
Relaxed	.80	-	-	.89	-	-
Charming	.73	-	-	.77	-	-
Ideas Flow Easily	.69	-	-	.73	-	-
Free	.67	-	-	.64	-	-
Energized	-	.91	-	-	.94	-
Stimulated	-	.87	-	-	.78	-
Excited	-	.87	-	-	.91	-
Vigorous	-	.81	-	-	.79	-
Talkative	-	.81	-	-	.85	-
Up	-	.80	-	-	.83	-
Elated	-	.76	-	-	.77	-

Table 6 (continued)

Table 6 (continued). Factor Loadings for Anticipated Subjective Response to Alcohol (Forced-Three Factor Model) in Study 1 (N = 116) and Study 2 (N = 152).

Source:	Study 1			Study 2		
Variance:	65.1%			70.2%		
	Positive	Stimulant	Impaired/ Sedative	Positive	Stimulant	Impaired/ Sedative
Sluggish	-	-	.91	-	-	.94
Inactive	-	-	.84	-	-	.80
Slow Thoughts	-	-	.82	-	-	.84
Sleepy	-	-	.81	-	-	.79
Dif. Concentrating	-	-	.77	-	-	.73
Sedated	-	-	.77	-	-	.86
Down	-	-	.72	-	-	.77
Dizzy	-	-	.71	-	-	.79
Intoxicated	-	-	.71	-	-	.76
Slurred Speech	-	-	.70	-	-	.78
Drunk	-	-	.70	-	-	.74
High	-	-	.67	-	-	.70
Clumsy	-	-	.66	-	-	.83
Muddled/Confused	-	-	.66	-	-	.84
Lonely	-	-	.47	-	-	.45
Uncomfortable	-	-	.42	-	-	.85

Note. Factor loadings below .30 not displayed.

Table 7. Bivariate Correlations between Measures of Subjective Response based on Hypothetical Drinking Scenario and CEOA Subscales for Study 2 Participants.

CEOA Subscales	Hypothetical Subjective Response Factors		
	Positive	Stimulant	Impaired/ Sedative
Sociability	.26	.25	-.15
Liquid Courage	.31*	.10	-.07
Sexual Enhancement	.24	.11	-.02
Tension Reduction	.17	-.01	-.01
Negative Self-Perception	.05	-.03	.13
Cognitive-Behavioral Impairment	-.02	-.12	.01
Risk & Aggression	.25	.09	-.01

Note. * Significant at Bonferroni-adjusted $p < .002$ to control for Type I errors.

Table 8. Differences in Anticipated Subjective Response to Hypothetical Drinking Scenario by Study 2 Heavy Drinking Transition Groups.

	Heavy Drinking Transition Groups			
	Transitioned In	Transitioned Out	Maintained	
Factor Scores	(n = 51)	(n = 50)	(n = 51)	F(2, 146)
Positive	39.39	39.61	37.30	0.20
	(19.03)	(22.08)	(20.57)	
Stimulant	53.05	48.63	50.14	0.56
	(19.38)	(23.35)	(18.95)	
Impaired/Sedative	34.32	32.51	27.08	1.82
	(20.15)	(23.13)	(18.20)	

Notes. No statistical differences observed between heavy drinking transition groups.

Table 9. Differences in Psychological Factors identified as Potential Moderators by Study 2 Heavy Drinking Transition Groups.

	Heavy Drinking Transition Groups			
Psychological Factors:	Transitioned In (n = 51)	Transitioned Out (n = 50)	Maintained (n = 51)	F (2, 146)
ASI – Physical	18.78 (6.44)	16.52 (6.00)	17.35 (6.83)	2.42#
ASI – Mental Incapacitation	6.27 (2.29)	6.18 (2.34)	7.31 (3.24)	2.96#
ASI – Social	8.71 (2.14)	8.92 (1.85)	8.86 (2.30)	0.13
ASI – Total	30.98 (8.30)	28.94 (7.19)	30.31 (9.58)	1.23
Mindfulness (MAAS)	58.59 (9.25)	57.36 (11.24)	60.14 (10.50)	0.87
Body Vigilance Scale	20.10 (6.61)	18.53 (6.46)	18.54 (7.55)	0.65
DTS - Physical	24.43 (4.79)	24.98 (5.79)	24.37 (5.76)	0.33
DTS - Emotional	39.12 (6.69)	38.14 (8.12)	38.61 (6.49)	0.07

Note. # Denotes non-significant trend ($p < .10$); ASI = Anxiety Sensitivity Index; MAAS = Mindful Attention Awareness Scale; DTS = Distress Tolerance Scale.

Table 10. Differences in Response to Carbon-Dioxide Challenge by Study 2 Heavy Drinking Transition Groups.

	Heavy Drinking Transition Groups			
CO_2 Outcome Variables	Transitioned In (n = 51)	Transitioned Out (n = 49)	Maintained (n = 49)	F (2, 143)
Positive POMS Change	-0.80 (0.63)	-0.54 (0.57)	-0.71 (0.61)	2.73 #
Negative POMS Change	0.19 (0.39)	0.11 (0.25)	0.17 (0.47)	0.93
BSQ Change	3.73 (6.16)	3.56 (5.86)	3.77 (6.03)	0.14
API Change	4.60 (8.44)	3.23 (4.77)	4.31 (6.72)	0.90
Overall Intensity	3.16 (1.65)	2.88 (1.48)	2.86 (1.44)	0.87
Voluntary Termination	2.0%	10.0%	3.9%	$\chi^2 = 3.56$

Notes. # Denotes non-significant trend ($p < .10$); POMS = Profile of Mood States; BSQ = Body Sensations Questionnaire; API = Acute Panic Inventory.

Table 11. Differences in Response to Cold Pressor Test by Study 2 Heavy Drinking Transition Groups.

	Heavy Drinking Transition Groups			
CPT Outcome Variables	Transitioned In (n = 50)	Transitioned Out (n = 49)	Maintained (n = 51)	*F* (2, 144)
Positive POMS Change	-0.67	-0.54	-0.74	1.40
	(0.56)	(0.72)	(0.76)	
Negative POMS Change	0.29	0.17	0.31	1.17
	(0.52)	(0.29)	(0.41)	
BSQ Change	8.51	6.51	9.86	2.49#
	(6.22)	(4.92)	(9.69)	
API Change	2.47	2.38	3.43	0.60
	(5.59)	(4.14)	(6.17)	
Immediate SUDS	50.08	45.98	45.98	0.60
	(24.88)	(30.23)	(27.53)	
Peak/Highest SUDS	80.20	74.78	76.10	0.61
	(18.94)	(27.67)	(20.67)	
Final SUDS	64.36	62.88	60.88	0.22
	(27.37)	(33.37)	(30.65)	
Overall Intensity	5.88	5.59	5.90	1.14
	(1.08)	(1.34)	(1.12)	
Voluntary Termination	29.4% [b]	58.0% [a]	37.3% [b]	$\chi^2 = 9.06$*

Notes. * $p < .05$; Lower-case letters indicate significant differences between groups ($p < .05$); # Denotes non-significant trend ($p < .10$).

Table 12. Differences in Response to 15-Second Spinning Challenge by Study 2 Heavy Drinking Transition Groups.

	Heavy Drinking Transition Groups			
Spinning Outcome Variables:	Transitioned In (n = 51)	Transitioned Out (n = 50)	Maintained (n = 51)	*F* (2, 146)
Change in Sensations	40.30	35.31	40.49	1.36
	(18.40)	(19.54)	(23.71)	
Rotations Completed	9.46	9.03	8.81	0.91
	(2.83)	(2.76)	(2.71)	
Overall Intensity	4.75	4.60	4.94	0.75
	(1.38)	(1.39)	(1.27)	
Voluntary Termination	5.9%	14.0%	5.9%	$\chi^2 = 2.83$

Note. No significant group differences observed.

Table 13. Differences in Response to Auditory Perception Test by Study 2 Heavy Drinking Transition Groups.

	Heavy Drinking Transition Groups			
Auditory Perception Outcome Variables:	Transitioned In (n = 51)	Transitioned Out (n = 50)	Maintained (n = 51)	*F* (2, 146)
Average 20 db Intensity	9.35 (10.08)	6.89 (9.30)	7.78 (5.89)	0.74
Average 40 db Intensity	14.24 (11.81)	10.78 (9.27)	12.27 (9.25)	1.39
Average 60 db Intensity	25.49 (16.86)	19.21 (12.79)	22.50 (14.19)	2.05
Average 80 db Intensity	36.47 (20.23)	30.99 (14.92)	32.54 (18.27)	1.40
Average 100 db Intensity	58.26 (24.77)	52.84 (23.08)	51.07 (22.19)	1.45
Overall Intensity	3.25 (1.20)	3.26 (1.38)	3.31 (1.36)	0.13

Note. No significant group differences observed.

Table 14. Differences in Response to Visual Perception Test by Study 2 Heavy Drinking Transition Groups.

	Heavy Drinking Transition Groups			
Visual Perception Outcome Variables:	Transitioned In (n = 51)	Transitioned Out (n = 50)	Maintained (n = 51)	*F* (2, 146)
Average 25 W Intensity	30.18 (15.18)	31.57 (17.14)	33.53 (13.40)	0.87
Average 40 W Intensity	38.41 (17.12)	40.35 (17.31)	40.29 (15.67)	0.95
Average 75 W Intensity	63.19 (19.40)	61.66 (18.44)	65.09 (18.73)	0.68
Average 100 W Intensity	69.50 (18.61)	68.50 (18.05)	72.00 (17.56)	0.84
Overall Intensity	4.14 (1.23)	3.78 (1.64)	3.98 (1.35)	0.82

Note. No significant group differences observed.

Table 15. Differences in Neuropsychological Functioning by Study 2 Heavy Drinking Transition Groups.

Neuropsychological Functioning Outcomes:	Heavy Drinking Transition Groups			
	Transitioned In (n = 51)	Transitioned Out (n = 50)	Maintained (n = 51)	*F* (2, 146)
Visual Reproduction Immediate (raw score)	94.16 (8.73)	95.82 (6.57)	93.67 (8.59)	0.81
Visual Reproduction Delayed (raw score)	80.65 (15.32)	78.34 (16.97)	76.69 (15.84)	0.76
Digit Symbol Coding (Total Correct)	87.06 (13.36)	87.56 (11.49)	91.08 (12.70)	1.93
Digit Span (raw score)	18.86 (3.58)	18.92 (3.72)	20.08 (3.53)	1.75
Block Design (raw score)	52.59 (10.02)	49.43 (10.26)	50.65 (9.75)	0.21
Trail Making A (time in seconds)	21.92 (6.51)	23.38 (7.32)	21.99 (7.93)	0.19
Trail Making B (time in seconds)	46.07 (13.18)	48.37 (16.45)	45.85 (13.23)	0.06
Trail B/Trail A Completion Time Ratio	2.17 (0.57)	2.14 (0.56)	2.14 (0.60)	0.25

Note. No significant group differences observed.

Table 16. Differences in Performance on Go-Stop Paradigm by Study 2 Heavy Drinking Transition Groups.

	Heavy Drinking Transition Groups			
Go-Stop Paradigm Outcome Variables:	Transitioned In (n = 38)	Transitioned Out (n = 34)	Maintained (n = 41)	*F* (2, 107)
Mean "Go" Reaction Time (ms)	529.05 (93.71)	503.67 (68.50)	493.68 (74.86)	1.74
Estimated "Stop" Signal Reaction Time (ms)	241.48 (26.88)	239.64 (22.28)	243.58 (24.97)	0.14
Correct Number of "Go" Responses	133.39 (6.04)	133.29 (5.13)	133.07 (6.06)	0.05
Correct Number of "Stop" Responses	24.37 (2.02)	25.35 (2.71)	25.46 (2.69)	2.31

Note. No significant group differences observed.

Table 17. Differences in Performance on Iowa Gambling Test by Study 2 Heavy Drinking Transition Groups.

	Heavy Drinking Transition Groups			
Iowa Gambling Test Outcome Variables:	Transitioned In (n = 51)	Transitioned Out (n = 49)	Maintained (n = 49)	*F* (2, 111)
Motivation (High = Greater Attention to Gains vs. Losses)	0.47 (0.41)	0.65 (0.38)	0.56 (0.41)	1.47
Learning-Rate (High = Greater Attention to Recent vs. Remote)	0.53 (0.35)	0.75 (0.33)	0.63 (0.39)	1.33
Choice Consistency (High = More Consistent w/ Expectations vs. Random)	-0.14 (1.92)	-0.08 (1.82)	-0.03 (2.07)	0.19

Note. No significant group differences observed.

Figure 1. Means and Correlations between Hypothetical and Actual Subjective Response to Alcohol Factor Scores.

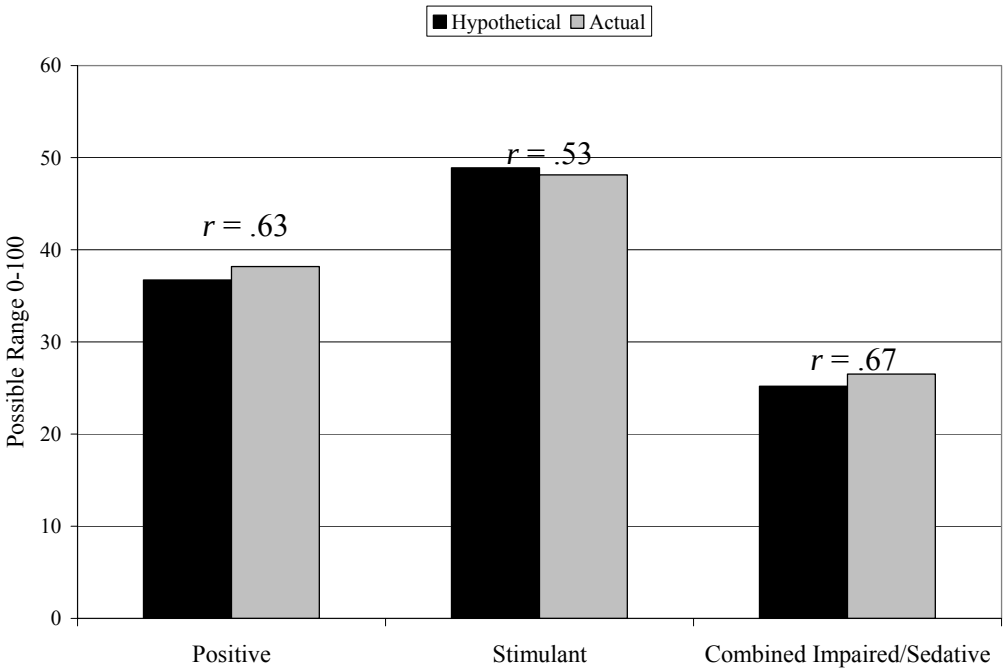


Figure 2. Changes in Typical Quantity of Alcohol Consumed by Heavy Drinking Transition Groups (Study 2).

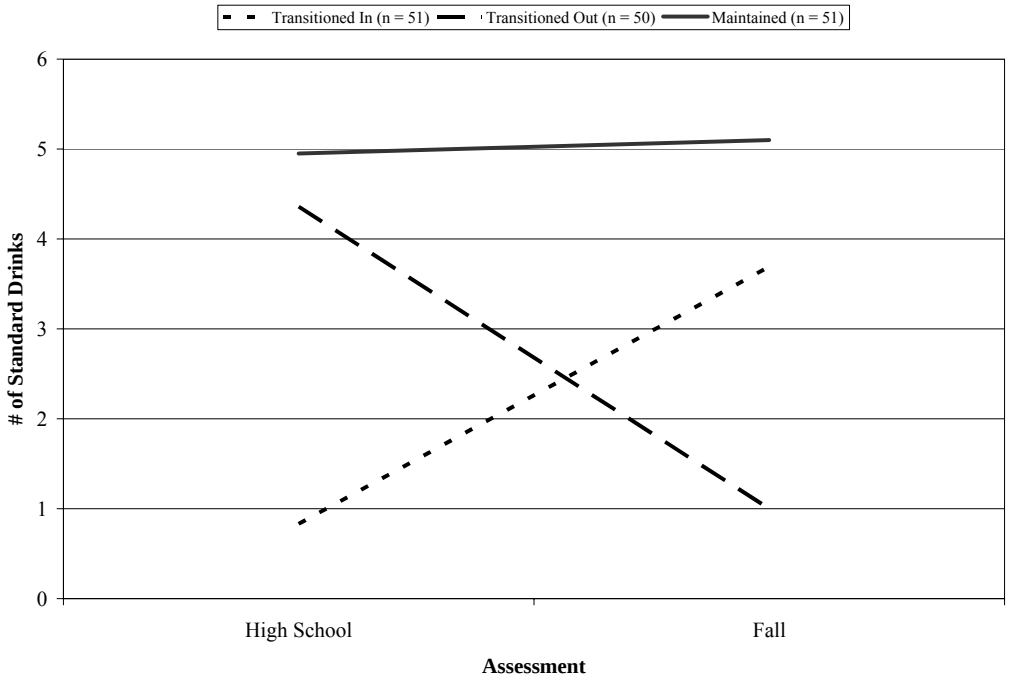


Figure 3. Changes in Frequency of Drinking by Heavy Drinking Transition Groups (Study 2).

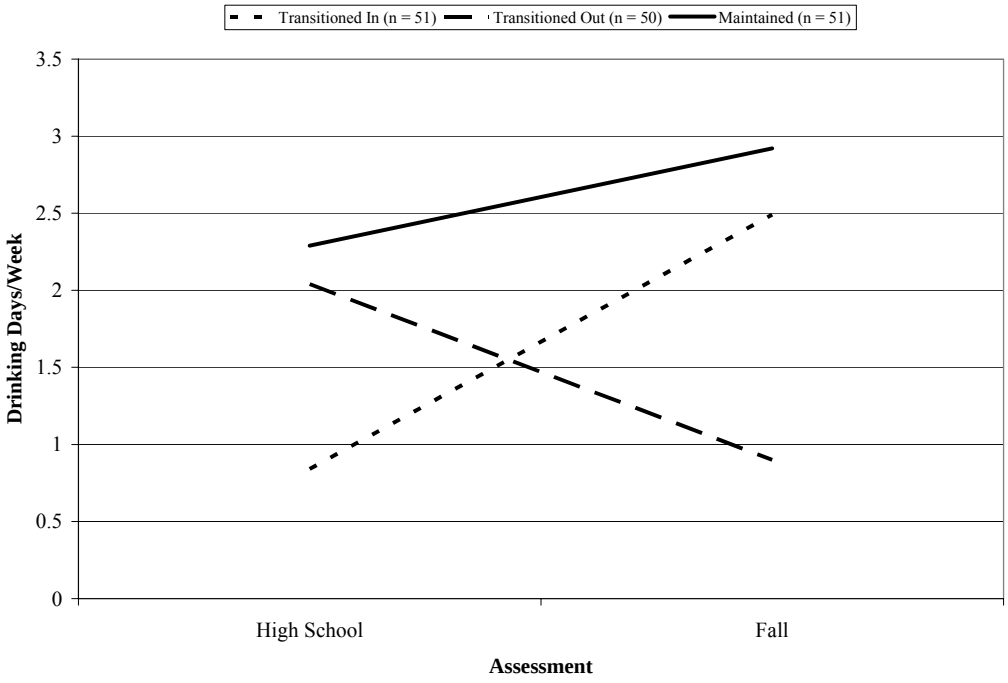


Figure 4. Changes in Total Number of Drinking Episodes in Past 3 Months by Heavy Drinking Transition Groups (Study 2).

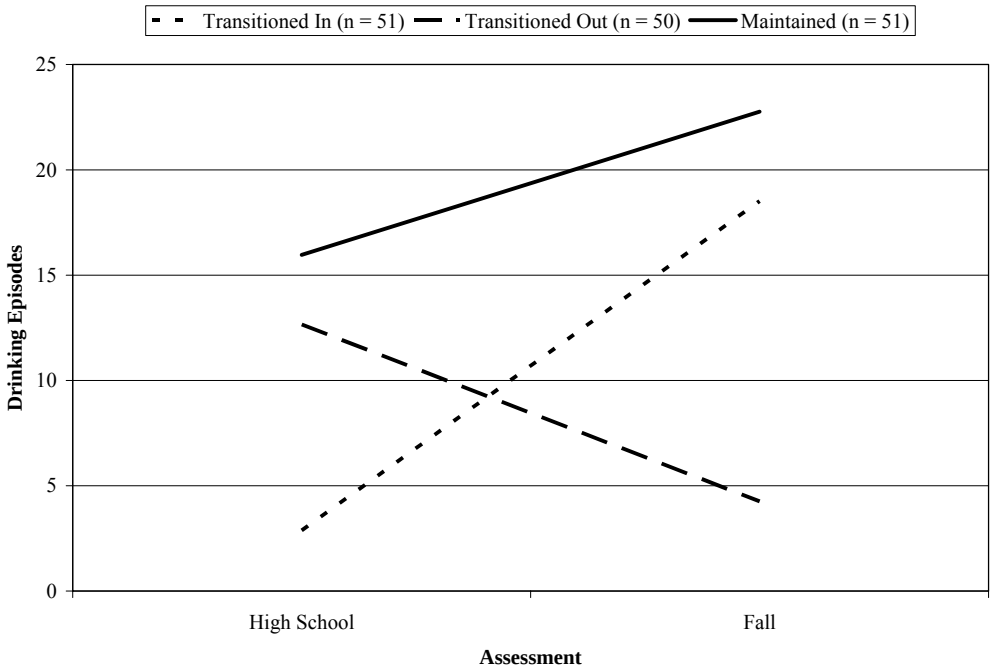


Figure 5. Changes in Frequency of Large Effect Drinking Episodes (Getting "Drunk") by Heavy Drinking Transition Groups (Study 2).

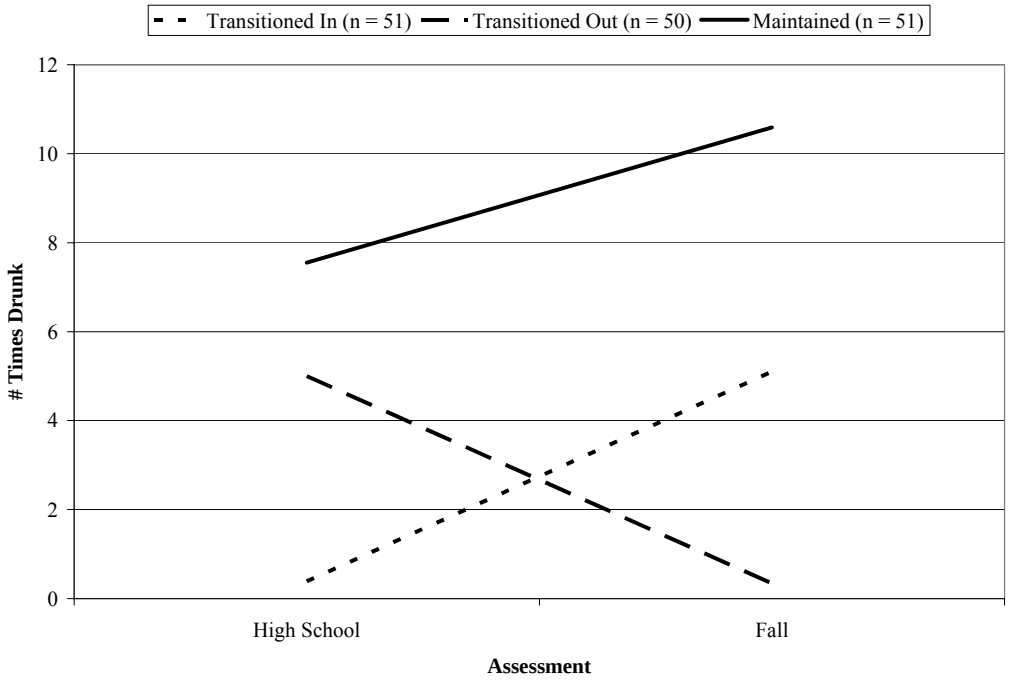
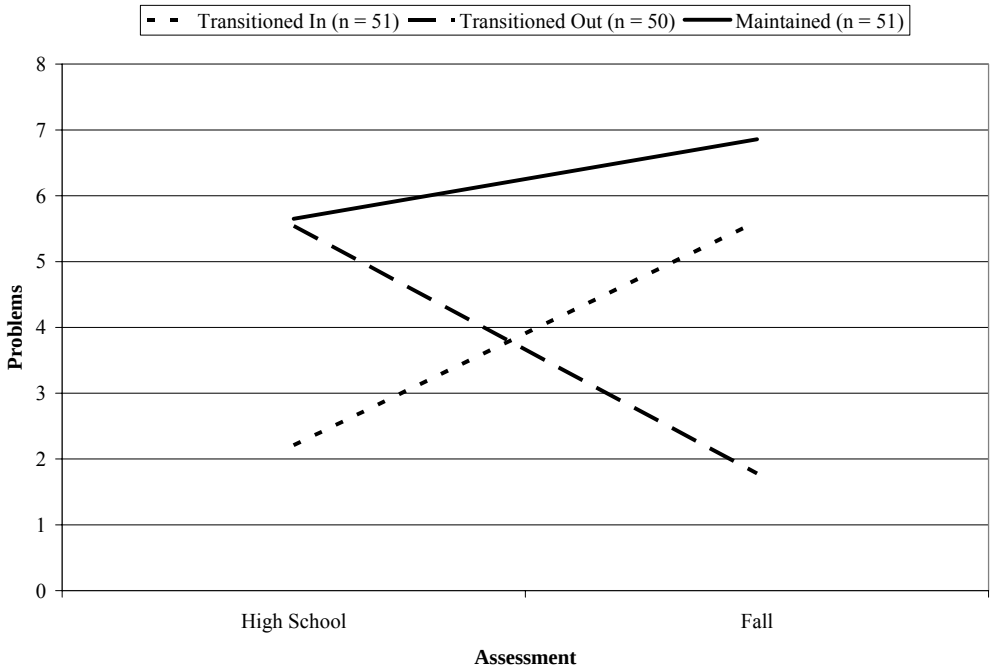


Figure 6. Changes in Experience of Alcohol-Related Problems by Heavy Drinking Transition Groups (Study 2).



APPENDIX A: Self-Report Measures

A-1. **Demographics**

1. What is your age? a. 21 b. 22 c. 23

2. What is your biological sex? a. female b. male

3. What is your height? _____ feet _____ inches

4. What is your weight? _____ pounds

5. What is your race/ethnicity?

   a. African American or Black
   b. American Indian/Alaskan Native
   c. Asian
   d. Hispanic or Latino/a
   e. Native Hawaiian or Pacific Islander
   f. White or Caucasian

6. What is your family's estimated annual income?

   a. under $20,000 b. $20,000-$29,999 c. $30,000-$39,999

   d. $40,000-$49,999 e. $50,000-$59,999 f. $60,000-$69,999

   g. $70,000-$99,999 h. over $100,000

A-2. **Daily Drinking Questionnaire (DDQ)**

For the following questions, please think about your drinking behavior DURING THE LAST 3 MONTHS.

1 Standard Drink = 12 ounces of beer, 1 shot of liquor (straight or in mixed drink), or 5 ounces of wine

For a TYPICAL WEEK, please indicate the number of standard drinks you consumed each day:

Monday	_____	Tuesday	_____
Wednesday	_____	Thursday	_____
Friday	_____	Saturday	_____
Sunday	_____		

If you marked zero for all seven days in a TYPICAL week above, was it because:

_____ a. You never drink alcohol.
_____ b. You rarely drink alcohol (i.e. drinking is not typical for you).
_____ c. You typically drink alcohol, but did not drink during the last 3 months.
_____ d. Not applicable (you reported that you typically consume alcohol).

A-3. Rutgers Alcohol Problem Index (RAPI)

During the last 3 months, how many times did the following things happen to you while you were drinking alcohol or because of your alcohol use?

1.	Not able to do your homework or study for a test.	0	1 -2	3-5	6-10	>10
2.	Got into fights, acted badly, or did mean things.	0	1 - 2	3-5	6-10	>10
3.	Missed out in other things because you spent too much money on alcohol.	0	1 - 2	3-5	6-10	>10
4.	Went to work or school high or drunk.	0	1 - 2	3-5	6-10	>10
5.	Caused shame or embarrassment to someone.	0	1 - 2	3-5	6-10	>10
6.	Neglected your responsibilities.	0	1 - 2	3-5	6-10	>10
7.	Relatives avoided you.	0	1 - 2	3-5	6-10	>10
8.	Felt that you needed more alcohol than you used to use in order to get the same effect.	0	1 - 2	3-5	6-10	>10
9.	Tried to control your drinking by trying to drink only at certain times of the day or in certain places.	0	1 - 2	3-5	6-10	>10
10.	Had withdrawal symptoms (i.e. felt sick because you stopped or cut down on drinking).	0	1 - 2	3-5	6-10	>10
11.	Noticed a change in your personality.	0	1 - 2	3-5	6-10	>10
12.	Felt that you had a problem with alcohol.	0	1 - 2	3-5	6-10	>10
13.	Missed a day (or part of a day) of school or work.	0	1 - 2	3-5	6-10	>10
14.	Tried to cut down or quit drinking.	0	1 - 2	3-5	6-10	>10
15.	Suddenly found yourself in a place that you could not remember getting to.	0	1 - 2	3-5	6-10	>10
16.	Passed out or fainted suddenly.	0	1 - 2	3-5	6-10	>10
17.	Had a fight, argument, or bad feelings with a friend.	0	1 - 2	3-5	6-10	>10
18.	Had a fight, argument, or bad feelings with a family member.	0	1 - 2	3-5	6-10	>10
19.	Kept drinking when you promised yourself not to.	0	1 - 2	3-5	6-10	>10
20.	Felt you were going crazy.	0	1 - 2	3-5	6-10	>10
21.	Had a bad time.	0	1 - 2	3-5	6-10	>10
22.	Felt psychologically or physiologically dependent on alcohol.	0	1 - 2	3-5	6-10	>10
23.	Was told by a friend or neighbor to stop or cut down drinking.	0	1 - 2	3-5	6-10	>10

A-4. Family Tree Questionnaire (FTQ)

INSTRUCTIONS: For each relative listed below, we want to know your impressions of their drinking behavior. Please categorize each relative into the category you think best describes their drinking behavior. Only include blood relatives; that is, relatives by birth. Do not include relatives who are adopted, half-siblings, or step-relatives. In addition, please provide the age for any brothers and/or sisters you have in the last column of items 7-14. If you have less than 4 brothers and/or 4 sisters, please select "N/A" on any remaining lines for brothers (7-10) and sisters (11-14).

CODE EACH RELATIVE USING ONE OF THE FOLLOWING 5 CATEGORIES:

1. ABSTAINER: A person who has never consumed alcoholic beverages (i.e., a lifelong abstainer or teetotaler).
2. SOCIAL DRINKER: A person who you think drinks moderately and is not known to have a drinking problem.
3. POSSIBLE PROBLEM DRINKER: A person whom you or others believe may have a past or current drinking problem, but you are not actually certain whether they ever had a drinking problem.
4. DEFINITE PROBLEM DRINKER: Only include persons who you think either have received treatment for a drinking problem (i.e., Alcoholics Anonymous), or who have experienced several negative consequences from their drinking.
5. DON'T KNOW/DON'T REMEMBER: Please indicate only if you do not know the relative, or have no memory of their drinking behavior.

	Family Member	[redacted]	1	2	3	4	5	Age
01.	Maternal Grandmother (Mom's Mom)	[redacted]	1	2	3	4	5	[redacted]
02.	Maternal Grandfather (Mom's Dad)	[redacted]	1	2	3	4	5	[redacted]
03.	Paternal Grandmother (Dad's Mom)	[redacted]	1	2	3	4	5	[redacted]
04.	Paternal Grandfather (Dad's Dad)	[redacted]	1	2	3	4	5	[redacted]
05.	Mother	[redacted]	1	2	3	4	5	[redacted]
06.	Father	[redacted]	1	2	3	4	5	[redacted]
07.	Brother	N/A	1	2	3	4	5	_____
08.	Brother	N/A	1	2	3	4	5	_____
09.	Brother	N/A	1	2	3	4	5	_____
10.	Brother	N/A	1	2	3	4	5	_____
11.	Sister	N/A	1	2	3	4	5	_____
12.	Sister	N/A	1	2	3	4	5	_____
13.	Sister	N/A	1	2	3	4	5	_____
14.	Sister	N/A	1	2	3	4	5	_____

For the following questions, only include blood siblings; that is, relatives by birth. Do not include siblings who are adopted, half-siblings, or step-relatives.

15. How many brothers do you have? _____
16. How many sisters do you have _____

A-5. Subjective Response to Alcohol Measures – Hypothetical (1)

The following questions ask you to imagine how you would feel if you drank a certain number of standard drinks over a 30-minute period. Even if you have never consumed that many beverages in that amount of time, please give us your best estimate of how you think you would feel if you did.

1 Standard Drink = 12 ounces of beer, 1 shot of liquor (straight or in a mixed drink), or 5 ounces of wine

1. Have you ever consumed _____ standard drinks in 30 minutes?

   (please circle) YES NO

2. How many times have you consumed _____ standard drinks in 30 minutes
   during the past 3 months?

   _____ times

If you consumed _____ standard drinks in 30 minutes, please rate how **HIGH** or **LIGHTHEADED** you would feel by placing an "X" anywhere on this line:

0 | | | | | | | | | | | 25 | | | | | | | | | | | 50 | | | | | | | | | | | 75 | | | | | | | | | | | 100

Not at all High	Slightly High	Moderately High	Very High	Extremely High

If you consumed _____ standard drinks in 30 minutes, please rate how **DRUNK** you would feel by placing an "X" anywhere on this line:

0 | | | | | | | | | | | 25 | | | | | | | | | | | 50 | | | | | | | | | | | 75 | | | | | | | | | | | 100

Not at all Drunk	Slightly Drunk	Moderately Drunk	Very Drunk	Extremely Drunk

A-6. Subjective Response to Alcohol Measures – Hypothetical (2)

Biphasic Alcohol Effects Scale (BAES)

The following questions ask you to imagine how you would feel if you drank a certain number of standard drinks over a 30-minute period. Even if you have never consumed that many beverages in that amount of time, please give us your best estimate of how you think you would feel if you did.

1 Standard Drink = 12 ounces of beer, 1 shot of liquor (straight or in a mixed drink), or 5 ounces of wine

INSTRUCTIONS: The following adjectives describe feelings that are sometimes produced by drinking alcohol. Please rate the extent to which you believe drinking _____ standard drinks in 30 minutes would produce these feelings in you.

		Not at All					**Moderately**					**Extremely**
1.	Difficulty Concentrating	0	1	2	3	4	5	6	7	8	9	10
2.	Down	0	1	2	3	4	5	6	7	8	9	10
3.	Elated	0	1	2	3	4	5	6	7	8	9	10
4.	Energized	0	1	2	3	4	5	6	7	8	9	10
5.	Excited	0	1	2	3	4	5	6	7	8	9	10
6.	Heavy Head	0	1	2	3	4	5	6	7	8	9	10
7.	Inactive	0	1	2	3	4	5	6	7	8	9	10
8.	Sedated	0	1	2	3	4	5	6	7	8	9	10
9.	Slow Thoughts	0	1	2	3	4	5	6	7	8	9	10
10.	Sluggish	0	1	2	3	4	5	6	7	8	9	10
11.	Stimulated	0	1	2	3	4	5	6	7	8	9	10
12.	Talkative	0	1	2	3	4	5	6	7	8	9	10
13.	Up	0	1	2	3	4	5	6	7	8	9	10
14.	Vigorous	0	1	2	3	4	5	6	7	8	9	10

A-7. Subjective Response to Alcohol Measures – Hypothetical (3)

Subjective High Assessment Scale (SHAS)

The following questions ask you to imagine how you would feel if you drank a certain number of standard drinks over a 30-minute period.

The extreme left-hand side of each line, **0** or **NORMAL**, indicates that you would experience **NO CHANGE** after drinking. In other words, you would feel exactly the same. The extreme right-hand side of the line, **36**, is meant to indicate the **MOST EXTREME** state you would possibly feel related to alcohol. For example, if you place an "X" at the extreme right-hand side of the first item, "uncomfortable", this tells us that you can hardly picture feeling more uncomfortable than you would if you drank _________ standard drinks in 30 minutes.

Please place an "X" on each line which you feel best estimates how you would feel after drinking _________ standard drinks in 30 minutes.

NO CHANGE **MOST EXTREME**

01. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Uncomfortable**

02. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Clumsy**

03. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Free**

04. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Charming**

05. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Enjoy Self**

06. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Slurred Speech**

07. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Joyful**

08. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Ideas Flow Easily**

09. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Muddled or Confused**

10. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Dizzy**

11. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Intoxicated**

12. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Sleepy**

13. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Great**

14. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Relaxed**

15. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **On Top of World**

16. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Sexy**

17. Normal **0** |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-| **36** **Lonely**

A-8. Subjective Tolerance Index (STI)

-3 = Strongly Disagree
-2 = Moderately Disagree
-1 = Slightly Disagree
0 = Neither Disagree nor Agree
+ 1 = Slightly Agree
+ 2 = Moderately Agree
+ 3 = Strongly Agree

"In general…"	Disagree ← ← ←			Neither	Agree → → →		
1. I can drink more than the average drinker before feeling the effects of alcohol.	-3	-2	-1	0	+1	+2	+3
2. I can drink more than others without experiencing a hangover.	-3	-2	-1	0	+1	+2	+3
3. I don't get drunk as quickly as the average drinker.	-3	-2	-1	0	+1	+2	+3
4. I can drink most of my friends "under the table".	-3	-2	-1	0	+1	+2	+3
5. I usually win drinking contest.	-3	-2	-1	0	+1	+2	+3
6. Others are impressed with how much alcohol I can drink.	-3	-2	-1	0	+1	+2	+3
7. Others think I can hold my alcohol well.	-3	-2	-1	0	+1	+2	+3
8. I decide if I am drunk based on physical sensations I experience (e.g., dizziness, difficulty walking).	-3	-2	-1	0	+1	+2	+3
9. I decide if I am drunk by counting how many drinks I consumed during a given time frame.	-3	-2	-1	0	+1	+2	+3
10. In general, when I drink, I intend to get drunk.	-3	-2	-1	0	+1	+2	+3

A-9. Effect Drinking Items

1. During the past three months, how many times did you have some kind of beverage containing alcohol? _____

2. During the past three months, how many times did you get a little high or lightheaded on alcohol? _____

3. During the past three months, how many times did you get drunk (not just a little high) on alcohol? _____

1 Standard Drink = 12 ounces of beer, 1 shot of liquor (straight or in a mixed drink), or 5 ounces of wine

4. How many standard drinks would you need to consume over a 30 minute period to feel a little high or lightheaded? _____

5. How many standard drinks would you need to consume over a 30 minute period to feel drunk? _____

A-10 Comprehensive Effects of Alcohol Questionnaire (CEOA)

This questionnaire assesses what you would expect to happen if you were under the influence of alcohol. Circle a number from (1) for disagree to (4) for agree, depending on whether or not you would expect the effect to happen to you if you were under the influence of alcohol. These effects will vary, depending upon the amount of alcohol you typically consume.

This is not a personality assessment. We want to know what you would expect to happen if you were to drink alcohol, not how you are when you are sober. Example: If you are always emotional, you would not check agree as your answer for the statement "I would be emotional" unless you expected to become MORE EMOTIONAL if you drank.

This questionnaire assesses whether you think each effect, which may result from drinking alcohol, is bad or good. Circle a number from 1, for bad, to 5, for good-- depending on whether you think this particular effect is bad, neutral, or good, etc.

We want to know if you think a particular effect is bad or good, REGARDLESS of whether you expect it to happen to YOU personally when you drink alcohol.

If I were under the influence of alcohol:	This effect of alcohol would happen to me…				If this effect of alcohol did happen to me, it would be…				
	Disagree	Slightly Disagree	Slightly Agree	Agree	Bad	Slightly Bad	Neutral	Slightly Good	Good
01. I would be outgoing.	D	SD	SA	A	B	SB	N	SG	G
02. My senses would be dulled.	D	SD	SA	A	B	SB	N	SG	G
03. I would be humorous.	D	SD	SA	A	B	SB	N	SG	G
04. My problems would seem worse.	D	SD	SA	A	B	SB	N	SG	G
05. It would be easier to express my feelings.	D	SD	SA	A	B	SB	N	SG	G
06. My writing would be impaired.	D	SD	SA	A	B	SB	N	SG	G
07. I would feel sexy.	D	SD	SA	A	B	SB	N	SG	G
08. I would have difficulty thinking.	D	SD	SA	A	B	SB	N	SG	G
09. I would neglect my obligations.	D	SD	SA	A	B	SB	N	SG	G
10. I would be dominant.	D	SD	SA	A	B	SB	N	SG	G

A-10 Comprehensive Effects of Alcohol Questionnaire (CEOA; continued)

If I were under the influence of alcohol:	This effect of alcohol would happen to me…				If this effect of alcohol did happen to me, it would be…				
	Disagree	Slightly Disagree	Slightly Agree	Agree	Bad	Slightly Bad	Neutral	Slightly Good	Good
11. My head would feel fuzzy.	D	SD	SA	A	B	SB	N	SG	G
12. I would enjoy sex more.	D	SD	SA	A	B	SB	N	SG	G
13. I would feel dizzy.	D	SD	SA	A	B	SB	N	SG	G
14. I would be friendly.	D	SD	SA	A	B	SB	N	SG	G
15. I would be clumsy.	D	SD	SA	A	B	SB	N	SG	G
16. It would be easier to act out my fantasies.	D	SD	SA	A	B	SB	N	SG	G
17. I would be loud, boisterous, or noisy.	D	SD	SA	A	B	SB	N	SG	G
18. I would feel peaceful.	D	SD	SA	A	B	SB	N	SG	G
19. I would be brave and daring.	D	SD	SA	A	B	SB	N	SG	G
20. I would feel unafraid.	D	SD	SA	A	B	SB	N	SG	G
21. I would feel creative.	D	SD	SA	A	B	SB	N	SG	G
22. I would be courageous.	D	SD	SA	A	B	SB	N	SG	G
23. I would feel shaky or jittery the next day.	D	SD	SA	A	B	SB	N	SG	G
24. I would feel energetic.	D	SD	SA	A	B	SB	N	SG	G
25. I would act aggressively.	D	SD	SA	A	B	SB	N	SG	G
26. My responses would be slow.	D	SD	SA	A	B	SB	N	SG	G
27. My body would be relaxed.	D	SD	SA	A	B	SB	N	SG	G
28. I would feel guilty.	D	SD	SA	A	B	SB	N	SG	G
29. I would feel calm.	D	SD	SA	A	B	SB	N	SG	G
30. I would feel moody.	D	SD	SA	A	B	SB	N	SG	G
31. It would be easier to talk to people.	D	SD	SA	A	B	SB	N	SG	G
32. I would be a better lover.	D	SD	SA	A	B	SB	N	SG	G
33. I would feel self-critical.	D	SD	SA	A	B	SB	N	SG	G
34. I would be talkative.	D	SD	SA	A	B	SB	N	SG	G
35. I would act tough.	D	SD	SA	A	B	SB	N	SG	G
36. I would take risks.	D	SD	SA	A	B	SB	N	SG	G
37. I would feel powerful.	D	SD	SA	A	B	SB	N	SG	G
38. I would act sociable.	D	SD	SA	A	B	SB	N	SG	G

A-11. Profile of Mood States (POMS)

Below is a list of words that describe feelings people have. Please read each one carefully. Then circle the number of the answer to the right which best describes **HOW YOU FEEL RIGHT NOW**.

		Not at all	A little	Moderately	Quite a bit	A lot
01.	Lively	1	2	3	4	5
02.	energetic	1	2	3	4	5
03.	worthless	1	2	3	4	5
04.	cheerful	1	2	3	4	5
05.	discouraged	1	2	3	4	5
06.	grouchy	1	2	3	4	5
07.	good-natured	1	2	3	4	5
08.	exhausted	1	2	3	4	5
09.	nervous	1	2	3	4	5
10.	Tired	1	2	3	4	5
11.	helpless	1	2	3	4	5
12.	unhappy	1	2	3	4	5
13.	on edge	1	2	3	4	5
14.	Furious	1	2	3	4	5
15.	ready to fight	1	2	3	4	5
16.	cooperative	1	2	3	4	5
17.	friendly	1	2	3	4	5
18.	Tense	1	2	3	4	5
19.	Angry	1	2	3	4	5
20.	Shaky	1	2	3	4	5

A-12 Modified Body Sensations Questionnaire/Acute Panic Inventory (BSQ/API)

Using a scale from 0 (not at all) to 100 (most extreme sensation possible), please rate how strongly you feel each of the sensations listed below **RIGHT NOW** by placing an "X" anywhere on each line.

		0 25 50 75 100
01.	Butterflies in stomach	**Not at all** **Extreme**
02.	Feeling like you are floating	**Not at all** **Extreme**
03.	Tingling in fingers	**Not at all** **Extreme**
04.	Feeling short of breath	**Not at all** **Extreme**
05.	Feeling cool	**Not at all** **Extreme**
06.	Numbness in arms or legs	**Not at all** **Extreme**
07.	Dizziness	**Not at all** **Extreme**
08.	Blurred or distorted vision	**Not at all** **Extreme**
09.	Nausea	**Not at all** **Extreme**
10.	Numbness in another part of your body	**Not at all** **Extreme**
11.	Feeling heavy	**Not at all** **Extreme**
12.	Lump in throat	**Not at all** **Extreme**
13.	Wobbly or rubber legs	**Not at all** **Extreme**
14.	Sweating	**Not at all** **Extreme**
15.	Dry throat	**Not at all** **Extreme**
16.	Heart palpitations	**Not at all** **Extreme**
17.	Pressure in chest	**Not at all** **Extreme**
18	Feeling warm	**Not at all** **Extreme**
19.	Knots in stomach	**Not at all** **Extreme**
20.	Feeling disconnected or your body only partly present	**Not at all** **Extreme**
21.	Feeling faint	**Not at all** **Extreme**
22.	Afraid of dying	**Not at all** **Extreme**
23.	Afraid in general	**Not at all** **Extreme**
24.	Hard to breathe or catch your breath	**Not at all** **Extreme**
25.	Lightheaded	**Not at all** **Extreme**
26.	Things and people seem unreal	**Not at all** **Extreme**

A-12 Modified Body Sensations Questionnaire/Acute Panic Inventory (BSQ/API)

Using a scale from 0 (not at all) to 100 (most extreme sensation possible), please rate how strongly you feel each of the sensations listed below **RIGHT NOW** by placing an "X" anywhere on each line.

27.	Difficulty speaking	0 | 25 | 50 | 75 | 100 **Not at all** **Extreme**
28.	Inner shakiness, trembling	0 | 25 | 50 | 75 | 100 **Not at all** **Extreme**
29.	Afraid of going crazy	0 | 25 | 50 | 75 | 100 **Not at all** **Extreme**
30.	Afraid of losing control	0 | 25 | 50 | 75 | 100 **Not at all** **Extreme**
31.	Chest pain or discomfort	0 | 25 | 50 | 75 | 100 **Not at all** **Extreme**
32.	Difficulty swallowing	0 | 25 | 50 | 75 | 100 **Not at all** **Extreme**
33.	Feeling like choking or suffocating	0 | 25 | 50 | 75 | 100 **Not at all** **Extreme**
34.	Feeling weak	0 | 25 | 50 | 75 | 100 **Not at all** **Extreme**
35.	Desire to flee	0 | 25 | 50 | 75 | 100 **Not at all** **Extreme**
36.	Feeling depressed	0 | 25 | 50 | 75 | 100 **Not at all** **Extreme**
37.	Feeling embarrassed or humiliated	0 | 25 | 50 | 75 | 100 **Not at all** **Extreme**

A-13. Anxiety Sensitivity Index (ASI)

INSTRUCTIONS: Rate each of the 16 items by circling the answer that most applies to you.

		Very Little	A Little	Some	Much	Very Much
01.	It is important to me not to appear nervous.	1	2	3	4	5
02.	When I cannot keep my mind on a task, I worry that I might be going crazy.	1	2	3	4	5
03.	It scares me when I feel "shaky" (trembling).	1	2	3	4	5
04.	It scares me when I feel faint.	1	2	3	4	5
05.	It is important for me to stay in control of my emotions.	1	2	3	4	5
06.	It scares me when my heart beats rapidly.	1	2	3	4	5
07.	It embarrasses me when my stomach growls.	1	2	3	4	5
08.	It scares me when I am nauseous.	1	2	3	4	5
09.	When I notice that my heart is beating rapidly, I worry that I might have a heart attack.	1	2	3	4	5
10.	It scares me when I become short of breath.	1	2	3	4	5
11.	When my stomach is upset, I worry that I might be seriously ill.	1	2	3	4	5
12.	It scares me when I am unable to keep my mind on a task.	1	2	3	4	5
13.	Other people notice when I feel shaky.	1	2	3	4	5
14.	Unusual body sensations scare me.	1	2	3	4	5
15.	When I am nervous, I worry that I might be mentally ill.	1	2	3	4	5
16.	It scares me when I am nervous.	1	2	3	4	5

A-14. Mindful Attention Awareness Scale (MAAS)

INSTRUCTIONS: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be.

		Almost always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never
01.	I could be experiencing some emotion and not be conscious of it until some time later.	1	2	3	4	5	6
02.	I break or spill things because of carelessness, not paying attention, or thinking of something else.	1	2	3	4	5	6
03.	I find it difficult to stay focused on what's happening in the present.	1	2	3	4	5	6
04.	I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	1	2	3	4	5	6
05.	I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	1	2	3	4	5	6
06.	I forget a person's name almost as soon as I've been told it for the first time.	1	2	3	4	5	6
07.	It seems I am "running on automatic" without much awareness of what I'm doing.	1	2	3	4	5	6
08.	I rush through activities without being really attentive to them.	1	2	3	4	5	6
09.	I get so focused on the goal I want to achieve that I lose touch with what I am doing right now to get there.	1	2	3	4	5	6
10.	I do jobs or tasks automatically, without being aware of what I'm doing.	1	2	3	4	5	6
11.	I find myself listening to someone with one ear, and doing something else at the same time.	1	2	3	4	5	6
12.	I drive places on "automatic pilot" and then wonder why I went there.	1	2	3	4	5	6
13.	I find myself preoccupied with the future or the past.	1	2	3	4	5	6
14.	I find myself doing things without paying attention.	1	2	3	4	5	6
15.	I snack without being aware that I'm eating.	1	2	3	4	5	6

A-15. Body Vigilance Scale (BVS)

Instructions: This measure is designed to index how sensitive you are to internal bodily sensations such as heart palpitations or dizziness. Fill it out according to how you have felt for the past week.

		Not at all like me				Moderately like me						Extremely like me
01.	I am the kind of person who pays close attention to internal bodily sensations.	0	1	2	3	4	5	6	7	8	9	10
02.	I am very sensitive to changes in my internal bodily sensations.	0	1	2	3	4	5	6	7	8	9	10
03.	On average, how much time do you spend each day "scanning" your body for sensations (e.g., sweating, heart palpitations, dizziness)?	No time 0	1	2	3	Half of the time 4	5	6	7	8	9	All of the time 10
04.	Rate how much attention you pay to each of the following sensations:	None		Slight		Moderate			Substantial			Extreme
	a. Heart palpitations	0	1	2	3	4	5	6	7	8	9	10
	b. Chest pain/discomfort	0	1	2	3	4	5	6	7	8	9	10
	c. Numbness	0	1	2	3	4	5	6	7	8	9	10
	d. Tingling	0	1	2	3	4	5	6	7	8	9	10
	e. Short of breath/smothering	0	1	2	3	4	5	6	7	8	9	10
	f. Faintness	0	1	2	3	4	5	6	7	8	9	10
	g. Vision changes	0	1	2	3	4	5	6	7	8	9	10
	h. Feelings of unreality	0	1	2	3	4	5	6	7	8	9	10
	i. Feeling detached from self	0	1	2	3	4	5	6	7	8	9	10
	j. Dizziness	0	1	2	3	4	5	6	7	8	9	10
	k. Hot flash	0	1	2	3	4	5	6	7	8	9	10
	l. Sweating/clammy hands	0	1	2	3	4	5	6	7	8	9	10
	m. Stomach upset	0	1	2	3	4	5	6	7	8	9	10
	n. Nausea	0	1	2	3	4	5	6	7	8	9	10
	o. Choking/throat closing	0	1	2	3	4	5	6	7	8	9	10

A-16. Distress Tolerance Scale (DTS)

<u>INSTRUCTIONS</u>: For each of the statements listed below, please select the response that *best* describes how much you agree or disagree with the statement as it applies to how you are normally. Please read each statement carefully before responding and keep in mind that there are no *right* or *wrong* answers.

		Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
01.	I often <u>avoid</u> situations that are likely to produce feelings of emotional upset such as sadness, fear or anger.	1	2	3	4	5	6
02.	I can usually handle feelings of emotional upset quite well.	1	2	3	4	5	6
03.	When I'm having feelings of emotional upset, I'll do just about anything to make them stop.	1	2	3	4	5	6
04.	I usually face emotionally upsetting situations head on.	1	2	3	4	5	6
05.	I usually follow through with tasks that are emotionally upsetting.	1	2	3	4	5	6
06.	It is important for me to avoid situations that might upset me.	1	2	3	4	5	6
07.	I am able to handle feelings of emotional upset as well as most people.	1	2	3	4	5	6
08.	When I'm emotionally upset, I'll do almost anything to escape from the feelings.	1	2	3	4	5	6
09.	I cannot tolerate feeling emotionally upset even for a short time.	1	2	3	4	5	6
10.	When faced with the choice of either facing an upsetting situation or avoiding it, I usually avoid it even if facing the situation is in my best interest.	1	2	3	4	5	6
11.	I tend to avoid situations that make me physically uncomfortable (e.g., dentists, intense exercise, working outdoors in the heat).	1	2	3	4	5	6
12.	I'll take fairly extreme measures to stop physical pain or other unpleasant physical feelings.	1	2	3	4	5	6
13.	I am a real wimp when it comes to handling any kind of physical discomfort or pain.	1	2	3	4	5	6
14.	I have a high threshold for pain and other forms of physical discomfort.	1	2	3	4	5	6
15.	I can handle quite a bit of physical pain or physical discomfort.	1	2	3	4	5	6
16.	Pain and other forms of physical distress do not bother me much.	1	2	3	4	5	6

Appendix B

Table for determining the number of standard drinks (based on gender and weight) necessary to achieve a target BAC of .08% for the hypothetical drinking scenario.

Gender	**Weight (in pounds)**												
Females	< 86	86-109	110-133	134-157	158-181	182-205	206-229	230-253	254-277	278-301	302-325	326-349	> 350
Males	< 78	78-99	100-121	122-143	144-165	166-187	188-209	210-231	232-253	254-275	276-297	298-319	> 320
# of Standard Drinks	**1 ½**	**2**	**2 ½**	**3**	**3 ½**	**4**	**4 ½**	**5**	**5 ½**	**6**	**6 ½**	**7**	**7 ½**

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