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Exploring the Decisional Process behind Alcohol Use: Converging Evidence Across Multiple Theories

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by

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ABSTRACT

Understanding the etiological and maintaining processes of problematic drinking continues to be a challenge. There has been a growing amount of research focusing on the decisional processes that act to maintain addictive behaviors. Elucidating this underlying process is key to understanding the range of drinking behavior observed among individuals. Rather than relying on one theory, examining overlap between multiple theories of alcohol use may lead to a better understanding of such a process. Using a construct validation approach, this study utilized motivational (Ambivalence Model of Craving), cognitive (Alcohol Outcome Expectancy Theory), and behavioral theories (Behavioral Economics) of alcohol use to examine the extent to which they tap into a common underlying decisional process of alcohol use behaviors. Two methods were used including establishing motivational profiles using latent profile analysis and an experimental manipulation of situational context to examine the effect of setting on constructs of interest. Results from the two studies provided partial support for the overlap between these theories as it pertains to a common underlying process.

INTRODUCTION

Problematic alcohol use among college students continues to be a major public health concern, with approximately 60% of students consuming alcohol in the past month and 2 out of 3 of this group engaging in binge drinking (SAMHSA, 2014). Alcohol consumption on college campuses is associated with negative consequences including death, injury, physical assault, sexual assault, unsafe sex, health problems, suicide attempts and drunk driving (White & Hingson, 2014). In addition, in any given year approximately 20% of college students meet diagnostic criteria for an alcohol use disorder (Blanco et al., 2008). As such, there has been a greater push within the field to better understand the etiological and maintaining processes of problematic drinking.

Although numerous theories covering a vast array of biological, cognitive, motivational and behavioral mechanisms are proposed, they often narrowly focus on their "unique" constructs of interest to explain what drives problematic drinking among individuals. Though some theories pertaining to addiction and alcohol have characterized it as a biological predisposition or brain disease (Dick & Agrawal, 2008; Leshner, 1997), a growing literature has focused on decisional processes that act to maintain addictive behaviors (Heather, 1998). In as much as consuming alcohol is an observable behavior, the decision to engage in alcohol use is most proximal to the behavior itself. Therefore, elucidating this underlying process is key to understanding the range of drinking behavior observed among individuals. Importantly, examining overlap between multiple theories of alcohol use may lead to a better understanding of such a process. Therefore, the current project will utilize motivational (Ambivalence Model of Craving), cognitive (Alcohol

Outcome Expectancy Theory), and behavioral theories (Behavioral Economics) of alcohol use to examine the extent to which they tap into a common underlying decisional process of alcohol use behaviors.

Theories of Alcohol Use and Problematic Drinking

Theories such as Alcohol Outcome Expectancy Theory, Behavioral Economics, and the Ambivalence Model of Craving have been established as useful theories in the prediction of alcohol use; however, research often fails to consider the similarities between theories. Rather than demonstration of the "unique" predictive utility, greater attention should be paid on how these theories converge to influence the decision to drink. Part of the difficulty lies in the nature of psychological research, which relies on the development of methods and measures to infer constructs of interest. In doing so, Cronbach and Meehl (1955) emphasized the need for extensive theory testing, including the ways in which constructs within and across theories relate to one another. Although the general principles underlying construct validity are generally agreed upon, there remains a vast degree of uncertainty involved in theory building and establishing construct validity (Smith, 2005). Complicating the issue is the method of measurement, such that variance accounted for by any given measure may very well be due to the method of assessment and not the construct of interest (Reich & Goldman, 2015; G. T. Smith, 2005). Although advances in statistics (e.g., SEM) have aided in addressing this issue by attempting to parse out non-shared method variance, few studies evaluate multiple theories simultaneously. Therefore, it remains largely unknown if related theories are measuring the same underlying construct, and just capturing it in a different way. As such, the current study will explore the foundations of the Ambivalence Model of Craving, Alcohol Outcome Expectancy

Theory, and Behavioral Economics as well as similarities between the theories that suggest a common underlying process.

Ambivalence Model of Craving

The Ambivalence Model of Craving (AMC; Breiner, Stritzke, & Lang, 1999) is a departure from the traditional viewpoint of craving as solely a unidimensional construct of urge intensity (Kozlowski & Wilkinson, 1987). Rather, the AMC stems from motivational models of alcohol use (Cox & Klinger, 1988) that focuses on the choice to use alcohol. The AMC conceptualizes craving in terms of approach and avoidance inclinations (Stritzke, McEvoy, Wheat, Dyer, & French, 2007), two motivational pathways influencing an individual's choice to either consume or not consume alcohol. These pathways operate in an 'evaluative space' to determine an individual's motivation to use alcohol. Approach inclinations refer to how much an individual desires to use a substance, while avoidance inclinations refer to how much they want to avoid using a substance. Combining these inclinations results in four distinct motivational profiles: predominately approach (high approach, low avoidance), predominately avoidance (low approach, high avoidance), indifference (low approach, low avoidance), and ambivalence (high approach, high avoidance). The ambivalence quadrant effectively captures the common motivational conflict substance users feel when experiencing simultaneous desires to use and to not use a substance. As such, ambivalence is an important feature because when faced with the possibility of an immediate reward (alcohol), individuals are likely to feel the "push and pull" of whether to approach or avoid drinking.

The AMC posits that approach and avoidance inclinations are proximal to the decision to engage in alcohol use and are influenced by a host of other factors. First and foremost, the AMC posits that both approach and avoidance inclinations develop as the result of the positive and negative consequences of use. Interestingly, negative consequences associated with alcohol use

are often delayed. These temporal differences in reward and punishment likely result in impaired decision making and the maintenance of problematic drinking behavior (Breiner et al., 1999), especially until the accumulation of negative consequences over time strengthen avoidance inclinations. As such, these inclinations are influenced differentially for different types of drinkers (i.e., young adult drinkers versus a clinical sample). For example, young adults may desire to avoid alcohol due to legal restrictions while clinical samples wish to avoid drinking to improve their daily functioning. Further, approach and avoidance are also influenced by historical factors including biochemical reactivity, personality, environment and past reinforcement as well as contextual factors that include quantity and quality of positive and negative incentives and access to alternative activities. Finally, positive and negative alcohol expectancies are believed to significantly influence these inclinations such that positive expectancies promote approach inclinations, and negative expectancies promote avoidance inclinations. As such, the AMC offers a comprehensive explanation, pulling together a vast array of literatures.

Cue reactivity studies have consistently demonstrated the distinction between approach and avoidance, as well as the independent predictive value of avoidance in substance-related behaviors among non-clinical and clinical samples (Curtin, Barnett, Colby, Rohsenow, & Monti, 2005; Klein, Stasiewicz, Koutsky, Bradizza, & Coffey, 2007; McEvoy, Stritzke, French, Lang, & Ketterman, 2004; Schlauch, Breiner, Stasiewicz, Christensen, & Lang, 2013; Schlauch, Gwynn-Shapiro, Stasiewicz, Molnar, & Lang, 2013; Schlauch, Rice, Connors, & Lang, 2015; Stritzke, Breiner, Curtin, & Lang, 2004). For example, approach and avoidance inclinations have demonstrated unique predictive relationships with several alcohol use related variables, including quantity and frequency of use, alcohol-related consequences, and stages of readiness to change

(Schlauch, Breiner, et al., 2013; Schlauch et al., 2015; Stritzke et al., 2004). In addition, avoidance inclinations have been associated with treatment-seeking behaviors and treatment retention (Klein et al., 2007; Schlauch et al., 2012) and moderate the effect of approach inclinations on drinking, such that those concurrently high on approach and avoidance drink significantly less than those high on approach only (Schlauch, Crane, Connors, Maisto, & Dearing, under review; Schlauch, Levitt, et al., 2013; Schlauch et al., 2015). Further, consistent with theory, approach and avoidance have been shown to vary as a function of contextual factors, namely affect. Specifically, in an inpatient clinical sample, negative affect was shown to be associated with higher approach inclinations in response to both cigarette and alcohol cues while positive affect was associated with higher avoidance inclinations (Schlauch, Gwynn-Shapiro, et al., 2013).

Taken together, the Ambivalence Model of Craving offers a useful conceptualization of the motivational pathways to alcohol use by distinguishing between the desire to use alcohol and the desire not to use alcohol, providing a framework for understanding under what conditions and for whom alcohol consumption is likely to occur.

Alcohol Outcome Expectancy Theory

Alcohol outcome expectancy theory is rooted in concepts of learning such that expectancies are generally defined as a learned relationship among a stimulus, a response, and the outcome of that response. This information is then stored in memory and processed to influence behaviors (M. S. Goldman, Del Boca, & Darkes, 1999). Expectancies are theorized to extend to all kinds of behavior, allowing organisms to form memory networks to anticipate appropriate responses to a stimulus. With regard to alcohol use, expectancies are thought of as "information that reflects the reinforcement value of alcohol use" (M. S. Goldman et al., 1999, p.

216). This information lies in long-term memory and impact an individual's cognitive processes, including the decision to engage in alcohol use. Alcohol expectancies are also theorized to partly represent an individual's incentive to drink such that positive expectancies are an important component of motivation to drink while negative expectancies are a component of motivation to restrain (Cox & Klinger, 1988; Jones, Corbin, & Fromme, 2001).

Indeed, many studies have found a clear association between alcohol expectancies and alcohol use. For example, positive expectancies have been found to be positively associated with drinking behavior and negative expectancies have been found to be negatively associated with drinking behavior (Christiansen & Goldman, 1983; Fromme, Stroot, & Kaplan, 1993; Leigh & Stacy, 2004). Importantly, expectancies have been shown to differ among non-problem and problem drinkers (S. A. Brown, Goldman, & Christiansen, 1985; Connors, O'Farrell, Cutter, & Thompson, 1986; Lewis & O'Neill, 2000). Of note, children develop expectations about alcohol as early as third grade (Miller, Smith, & Goldman, 1990). While some research suggests that alcohol expectancies in children tend to shift from predominately negative to more positive expectancies (Dunn & Goldman, 1996; Dunn & Goldman, 1998; Miller et al., 1990), others have noted the shift is toward the simultaneous presence of both positive and negative expectancies (Cameron, Stritzke, & Durkin, 2003), suggestive that effects of expectancies may involve the evaluation of competing cognitions. Nevertheless, positive expectancies among adolescents have also been shown to largely predict drinking levels and the development of problematic drinking later in adolescence and can possibly be used to identify high-risk adolescents (Christiansen, Smith, Roehling, & Goldman, 1989). Christiansen and colleagues (1989) followed a sample of seventh and eighth grade students for a year and showed that positive expectancies, namely social facilitation and cognitive and motor functioning enhancement, discriminated between

those that remained non-problematic drinkers and the initiation of problematic drinking over the course of the year. Moreover, the social facilitation subscale proved to be the most powerful predictor of the initiation of problematic drinking as well as identifying problematic drinkers among the expectancy subscales.

Historically, greater attention has been paid to the role of positive expectancies in drinking behavior than negative expectancies. In part this was due to previous research with both positive and negative expectancies suggesting that immediate reinforcement (i.e., positive expectancies) is more influential of behavior than delayed consequences (i.e., negative expectancies) on drinking behavior (Rohsenow, 1983). However, given that the decision to engage in alcohol use is the result of an evaluative process, the role of negative expectancies remains important to understanding drinking behavior. For example, in a sample of young adult social drinkers, negative expectancies accounted for greater variance in frequency of drinking days than positive expectancies while positive expectancies was a better predictor for quantity of alcohol consumption (Lee, Greely, & Oei, 1999). This points to the possibility that positive expectancies account for why individuals initiate a drinking episode while negative expectancies may serve to moderate the amount consumed. Further, these results highlight the importance of considering both positive and negative expectancies and how they may simply influence different aspects of drinking behavior.

Alcohol outcome expectancy theory has evolved since its introduction in the 1970s, and today focuses on and incorporates cognitive neuroscience perspectives. As such, research has shifted from simply studying the connection between positive and negative alcohol expectancies and drinking behaviors to furthering the understanding of expectancies using information-processing models. One advancement involves mapping alcohol-related memory network

models. These models allow for understanding individual differences in drinking behavior (Reich, Ariel, Darkes, & Goldman, 2012; Reich & Goldman, 2005), and thus may aid in understanding individual differences in decision ma king and motivational systems. These memory networks hold and organize an individual's outcome expectancies, and as such reflect learned reinforcement. For example, Reich et al. (2012) found that among 18 to 19 year olds, differences in expectancies associated with the word "drunk" were observed among light and heavy drinkers. Specifically, among those who exhibited binge drinking, being "drunk" was associated with more positive and arousing affects (e.g., "happy"). Conversely, among lighter drinkers, the word drunk was associated with more negative and sedating effects (e.g., "dizzy"). Overall, this perspective seeks to understand differences in memory networks organizing alcohol cognitions and what influences the retrieval of such cognitions. However, what is lacking in the research is the extent to which both positive and negative expectancies interact to predict drinking behavior and related cognitions.

Although traditionally alcohol expectancies have been examined as a static or trait-like process, research also demonstrates these processes to be dynamic and influenced by historical factors and contextual factors. For example, individual differences arise throughout development based on direct and indirect experiences with alcohol related stimuli (e.g. parents' consumption of alcohol). Further, research supports the notion that alcohol expectancies are modifiable and can result in changes in drinking behavior. Specifically, expectancy challenge approaches have been supported as an intervention method to reduce alcohol use in college students (Darkes & Goldman, 1993; Dunn, Lau, & Cruz, 2000; Lau-Barraco & Dunn, 2008). Alcohol expectancies have also been shown to be sensitive to environmental cues and other contextual factors. A modified Stroop task containing alcohol expectancies has been used to illustrate the different

effects of priming with an alcohol beverage word between light and heavy drinkers (Kramer & Goldman, 2003). A primed recall task has also been used to show that heavier young adult drinkers more easily recalled expectancy words when "beer" was presented as a first word (Reich, Noll, & Goldman, 2005). Mood has also been established to influence expectancies. Among college students, inducing negative affect has been shown to be associated with higher endorsement of positive alcohol expectancies compared to inducement of positive affect (Hufford, 2001) supporting a motivational perspective where drinking is largely based on anticipated effects on mood. Overall, this research shows how expectancies are not necessarily static characteristics and can be influenced by context.

In sum, alcohol expectancy theory emphasizes the role of information processing in maintaining problematic use, specifically how alcohol expectations are stored in an individual's memory and are activated in response to environmental contexts. This theory recognizes the importance of learning in the development of expectancies, as well as the array of individual differences that can result. Though positive expectancies have greatly dominated the research with this theory, the current study will also include negative expectancies for a more comprehensive understanding into the decisional process behind drinking behavior.

Behavioral Economics

Behavioral economics is a theoretical discipline that applies economic concepts to the understanding of decision making and behavior. This perspective focuses on "environmental conditions" that contribute to the choice to engage in substance abuse. Specifically, this approach stems from basic principles of learning, focusing on reinforcement pathologies as the mechanism for problematic substance use. Reinforcement pathologies are defined as consisting of the effects of a high valuation of a reinforcer as well as favoring immediate acquisition of a commodity over

larger delayed rewards (Bickel, Jarmolowicz, Mueller, & Gatchalian, 2011). Over time, this reinforcement has an additive effect on an individual's decisions (Bickel, Johnson, Koffarnus, MacKillop, & Murphy, 2014). Specifically, demand and discounting, two concepts rooted in economics, are constructs theorized to largely drive the decision making process. For example, demand represents how much an individual values a commodity. Those with substance use problems are theorized to value a substance more than other commodities. Higher value can manifest both in the total amount of the substance consumed and in the subjective level of enjoyment (Bickel et al., 2014). Demonstrating higher demand translates to allocating more resources to obtaining the substance. As such, an individual dependent on a substance would be willing to pay money for a substance than someone with non-problematic use, illustrating higher demand.

From this perspective, it is also important to consider what an individual is giving up when exhibiting high demand for a substance. This is referred to as opportunity cost, in which making the decision to engage in substance use is mutually exclusive from other choices (i.e., alternative reinforcers) an individual may have. Alternative reinforcers have an imperative role in maintaining problematic substance use as individuals may largely discount the reward they associate with substance-free alternatives since they tend to be associated with long term rewards. This phenomenon, called delayed discounting, refers to the idea that the value of a reinforcer decreases as its perceived temporal distance increases (Rachlin, Raineri, & Cross, 1991). More generally, delayed discounting can be thought of as a behavioral economic construct of impulsivity (Ainslie, 1975).

Research has shown that both demand and delay discounting are associated with problematic alcohol use. Research has consistently demonstrated that variables related to

substance use, including quantity and frequency of alcohol consumption, attentional bias and craving, are associated with higher levels of delay discounting among clinical samples as well as nonclinical samples (Bickel & Marsch, 2001; Field, Christiansen, Cole, & Goudie, 2007; MacKillop, Miranda, et al., 2010; Petry, 2001; Vuchinich & Simpson, 1998). Greater delay discounting of money rewards and greater demand for alcohol has been shown to be associated with greater severity of alcohol use disorder among heavy drinkers in a community sample (MacKillop, Miranda, et al., 2010). In the same study, higher demand was associated with higher reported craving (desire to use) for alcohol. Among young adult samples, heavy drinkers, defined as having at least one heavy drinking occasion (four drinks for women and five for men per episode) in the past week, exhibited greater demand than light drinkers (Murphy & MacKillop, 2006).

More specifically, demand has been widely studied utilizing the Alcohol Purchase Task (Murphy & MacKillop, 2006), which generates multiple indices: intensity (i.e. consumption at zero cost), O_{max} (i.e., the maximum alcohol expenditure), P_{max} (i.e. price at which consumption starts to be affected in proportion to the change in unit price), and Breakpoint (i.e., the first price that seizes consumption). Subsequently, a demand curve can also be used to determine elasticity of demand (i.e. how much demand declines with increasing price). Research has illustrated that these indices discriminate between light and heavy drinkers. In a young adult sample, Breakpoint, Intensity, O_{max} have been shown to be significantly higher in heavy drinkers than light drinkers (Murphy & MacKillop, 2006). Additionally, a recent meta-analysis of studies utilizing the APT showed that while all indices (intensity, breakpoint, O_{max}, P_{max} and elasticity) were correlated and illustrated expected relationships with drinking outcomes (alcohol consumption, heavy drinking, alcohol problems, AUD symptoms), intensity had the largest

effect sizes and was the only indicator that added to the prediction of AUD symptoms above and beyond reported drinking levels (Kiselica, Webber, & Bornovalova, 2016). Though these indices are posited to be relatively distinct, the high correlations between indices led researchers to identify two distinct factors that underlie demand. Using a sample of young adult drinkers, an Exploratory Factor Analysis revealed two-factors. The first factor labeled Persistence, which reflected sensitivity to escalating price, was composed of elasticity, P_{max}, breakpoint and to a lesser extent Omax. The second was called Amplitude, which reflects the amount consumed and spent, was composed of predominately intensity, but also O_{max} (MacKillop et al., 2009). Amplitude proved to be more strongly correlated with both quantity and frequency of drinking, as well as alcohol-related problems. This further supports the result of Kiselica et al., (2016), in which intensity had the strongest relationship with these outcomes. Taken together, these results suggest that individual differences in consumption are reflective of volumetric differences in demand and current use of alcohol (i.e., Amplitude) as opposed to differences in sensitivity to changing prices. As such, MacKillop et al. (2009) also suggested that indices related to price sensitivity (i.e., Persistence) may relate more to the likelihood of changing consumption patterns and may have implications for treatment as supported by previous research (MacKillop & Murphy, 2007).

Further, research has examined factors that modify demand indices. Among heavy drinkers, alcohol cues significantly increased craving and three indices of alcohol demand including intensity, O_{max} and breakpoint (MacKillop, O'Hagen, et al., 2010). The effects of induced stress and alcohol cues has also been examined in relation to alcohol demand and craving. In a sample of heavy drinkers, stress increased craving for alcohol as well as increased Intensity, O_{max} and Breakpoint (Amlung & MacKillop, 2014). In college students, both

depressive and PTSD symptoms have been linked to elevated levels of demand (Murphy et al., 2013).

In sum, research supports that the reward value for alcohol is influenced by contextual factors (i.e., mood, environmental cues). Furthermore, it is possible that alcohol demand represents a net sum of an individual's alcohol expectancies and approach and avoidance inclinations. For example, those high on positive expectancies, low on negative expectancies, and high on approach and low on avoidance likely will exhibit high demand. Those high on both positive and negative expectancies and high on both approach and avoidance may exhibit a more moderate demand due to the effect of negative expectancies and avoidance. The similarities between these constructs addressed in the following section will aid in understanding the relationships among these constructs.

Similarities Across Theories

Although the Ambivalence Model of Craving, Alcohol Expectancy Theory, and Behavioral Economics vary in their approach in the study of alcohol use behaviors, including their underlying perspective (i.e., motivational, cognitive, behavioral), there are a number of similarities between the theories which suggests a unifying underlying process. In fact, the differences between them largely point to measurement and the extent to which they are proximal or distal in the chain of events to the decision to engage in use. Further, all of these theories similarly explain the maladaptive decision making process that acts to maintain problematic use. For example, the AMC addresses the importance of alcohol expectancies as a contributory factor to both approach (positive expectancies) and avoidance (negative expectancies) inclinations (see Breiner et al., 1999). The AMC also addresses how these inclinations are influenced by the reinforcement value of alcohol over other alternatives and

negative consequences that may be experienced, reflecting an underlying learning process, as well as how temporal discrepancies in the immediate reward of alcohol and delayed consequences as a maintaining factor for problematic drinking. Similarly, Alcohol Outcome Expectancy Theory discusses the importance of motivations to consume and to avoid, as well as emphasizing that positive expectancies reflect learned reinforcement from alcohol. In addition, expectancy theory has posited that negative expectancies have less immediate effect on behavior because they are associated with delayed rewards and consequences. Whereas, Behavioral Economics largely focusses on the immediate reinforcement value of alcohol (i.e. demand) and considers delayed discounting of rewards to be the issue underlying maladaptive decision making, quantifying these ideas using economic concepts.

Arguably, the main commonality surrounding these theories is related to reinforcement and an underlying anticipatory process. Though addressed and captured using different methods of assessment, all three of these theories advocate that differentiating levels of reinforcement influence the constructs of interest (i.e., approach/avoidance inclinations, expectancies, demand). More broadly, measuring reinforcement reflects an anticipatory process as put forth by Reich and Goldman (2015) in which organisms anticipate the effects of a behavior and act according to their environmental context. These theories also address why problematic use is maintained despite negative consequences due to anticipation of the immediate rewarding effect from consuming alcohol. Therefore, anticipatory processes may be the unifying process behind these theories as well as a key component in the decision making process behind substance abuse.

A few direct parallels between theoretical perspectives have been identified by researchers. First, the key component in the AMC is addressing the conflicting nature of substance abuse (i.e. both wanting to use and wanting to abstain from use) by measuring

approach and avoidance inclinations. Alcohol expectancy theory has been recognized as a way to measure these dual motivations as well due to the possibility of holding both positive and negative expectancies (Jones et al., 2001). As such, Jones et al. (2001) posited that alcohol expectancy theory can be fit into a broader motivational framework. Vuchinich and Tucker (1988), in describing what developed into behavioral economics, address the complementary theories to the behavioral approach including alcohol expectancy theory as well as motivational perspectives. Specifically, they hypothesize that alcohol expectancies contribute to the individual differences in response to the reinforcement value of alcohol. They also address how motivational states likely influence reinforcement value of alcohol such that consumption and environmental cues activate incentive systems that initiate and maintain problematic substance use. More recently, behavior economics has begun to explicitly identify predictors of demand. In a sample of young adult drinkers, approach inclinations and drinking identity exhibited positive associations with alcohol demand (Persistence and Amplitude; Ramirez, Dennhardt, Baldwin, Murphy, & Lindgren, 2016). In addition to their results, these researchers stated that "alcohol-approach inclinations represent a point of convergence between models and may be a construct that not only underlies alcohol consumption, but also underlies alcohol demand" (Ramirez et al., 2016, p. 357). As such, the conceptual overlap between these constructs was identified. However, approach inclinations were not discussed in regards to the AMC and avoidance, and were only referenced as representing appetitive influences. Rather, the Inclined/Indulgent subscale alone from the Approach and Avoidance to Alcohol Questionnaire (AAAQ; McEvoy et al., 2004) was used to assess approach-inclinations. Additionally, though proven to be associated with one another, no causal inferences can be made. As such, it is unclear which constructs influence one another, or if they all operate in the same evaluative space.

Lastly, similar neurobiological mechanisms have been proposed to be associated with these constructs. The AMC suggests that appetitive and aversive brain systems are activated in response to substance-related stimuli and provide the neural basis for ambivalence. The appetitive system involves reward pathways resulting in reinforcement while the aversive system responds to negative stimuli. These systems are subcortically based, but interact with complex cognitive processes such as memory and attention (Breiner et al., 1999). Alcohol expectancy research takes an information-processing perspective, and as such addresses the neural processes in the brain involved in managing information and storage into memory. Additionally, motivational pathways associated with reward and punishment are implicated in storage of information, as behaviors that are reinforced or punished are made more salient (M. S. Goldman, Reich, & Darkes, 2006). Behavioral economics posits that higher demand and discounting is associated with weakened executive functioning due to changes in the prefrontal cortex and subcortical motivational circuits resulting from the additive effect of reinforcement from substance use (Bickel et al., 2014). Though a simple and brief overview of these proposed mechanisms, all theories point out the role of motivational pathways in decision making processes and the development of problematic use.

The parallels outlined here give reason to believe that anticipatory processes underlie all three of these theories. Anticipation involves both seeking reward and avoiding adversity (Reich & Goldman, 2015), which perfectly captures these three theories. The Ambivalence Model of Craving operates solely based on the assumption that there are two motivational pathways (i.e. one to approach rewarding stimuli, one to avoid negative stimuli). Alcohol Expectancy Theory emphasizes that individuals respond to stimuli based on stored memory about anticipated outcomes. Behavioral economics captures individual differences in anticipated outcome in the

form of alcohol demand. Therefore, elucidating the relationship between differing theories of alcohol behavior, including identification of similar underlying processes, has the potential to advance our understanding of when problematic drinking may occur.

Notably, all three theories have established how context can largely influence their construct of interest. First, the accessibility of positive and negative alcohol expectancies is theorized to change according to context. For example, environmental context (a laboratory setting versus a naturalistic bar) has a significant effect on endorsement and accessibility of expectancies in a sample of college students, such that students reported more positive alcohol expectancies and had quicker reaction times when in a naturalistic bar setting than in a laboratory setting (Wall, Hinson, McKee, & Goldstein, 2001). Studies utilizing simulated bar settings have also been shown to have an effect on alcohol-related cognitions. In one study, participants in the simulated bar setting exhibited more alcohol-related cognitions and subsequently consumed significantly more alcohol in a taste-rating task than the control condition after controlling for typical weekly alcohol use (Lau-Barraco & Dunn, 2009). Further, in a study utilizing a false-memory paradigm, participants in a simulated bar setting had a higher false memory for alcohol expectancy words than those in the neutral setting (Reich, Goldman, & Noll, 2004). In sum, these studies illustrate the activation of alcohol expectancies in response to priming in an environmental context.

Approach and avoidance inclinations are postulated to behave in a similar way such that exposure to alcohol-related stimuli can activate and show individual differences in these inclinations. For example, cue reactivity paradigms have consistently demonstrated that alcohol cues elicit both approach and avoidance inclinations specific to alcohol that vary based on history of use (Curtin et al., 2005; Schlauch, Breiner, et al., 2013; Schlauch et al., 2015; Stritzke

et al., 2004). In a sample of adolescents, heavier drinkers exhibited more approach inclinations in response to alcohol-related cues than light drinkers whereas heavier drinkers had lower avoidance inclinations in response to alcohol-related cues than light drinkers (Curtin et al., 2005). In an inpatient clinical sample, a latent profile analysis established the four motivational profiles of the AMC (i.e., approach, avoidance, indifference, ambivalence) and showed that approach and ambivalence classes were associated with more drinking and negative consequences (Schlauch et al., 2015). The assumption underlying cue reactivity paradigms is that individuals will react to each cue with differing responses based on their histories with the substance. As such, research has established the validity and specificity of these paradigms to ensure they function in this manner. Stritzke et al. (2004) demonstrated high internal consistency for the set of cues as well as the specificity across cue types and across status of substance use in a sample of young adult drinkers. This study also utilized an arousal control analysis to demonstrate that observed differences were not due to differences in reported arousal in response to each cue. Taken together, this research supports the individual differences in approach and avoidance inclinations in response to substance cues.

Alcohol demand has also been demonstrated to be influenced by the presence of alcohol-related stimuli. Among a sample of heavy college student drinkers, alcohol cues significantly increased the three main indices of alcohol demand compared to neutral cues (intensity, Omax and breakpoint) (MacKillop, O'Hagen, et al., 2010). In addition, the instrument used to measure alcohol demand instructs individuals to picture themselves in a club on the weekend to prime respondents of alcohol-related cognitions. Thus, the established influence context has on approach and avoidance inclinations, positive and negative expectancies, and alcohol demand provides further support of the similarity of these three theories.

Proposed Study

The current study was designed to examine the extent to which the Ambivalence Model of Craving, Alcohol Outcome Expectancy Theory, and Behavioral Economics are tapping into the same underlying construct (i.e. anticipatory processes). To our knowledge, this was the first study to simultaneously assess constructs of interest relevant to each theory. Specifically, data were collected across two studies with undergraduate college students: a) Study 1 –utilized correlational methods to examine the relationships among the constructs of interest and b) Study 2 –utilized experimental methods to examine the effect of context on each construct. Notably, the study utilized a college student sample as all methods of measurement have been extensively validated in college student samples. Three aims were proposed:

Aim 1. To investigate the relationships between the primary constructs within each theory, including their relationships with alcohol use behavior.

Hypothesis 1a: We predicted that positive alcohol expectancies would be associated with higher approach inclinations and higher demand, as well as heavier drinking. In contrast, we predicted that negative expectancies would be associated with avoidance inclinations and low demand and lower levels of alcohol use.

Hypothesis 1b: Utilizing a latent profile analysis, we predicted that four motivational profiles would emerge in which to classify individuals based on approach and avoidance inclinations, positive and negative expectancies, and alcohol demand. Specifically, we expected individuals to place into 1 of 4 profiles similar to what has been established with the Ambivalence Model of Craving: highly appetitive (high approach, high positive expectancies, high demand), highly aversive (high avoidance, negative expectancies, low demand), ambivalent (high on approach and avoidance, positive and negative expectancies, moderate demand) and

indifferent (low on all indices). Table 1 below illustrates the expected levels within class of each indicator/construct. We hypothesized that these profiles would have differentiating associations with drinking behaviors and alcohol-related consequences.

Table 1. Hypothesized motivational profiles

	Positive Expectancies	**Negative Expectancies**	**Approach**	**Avoidance**	**Demand**
Approach	High	Low	High	Low	High
Avoidance	Low	High	Low	High	Low
Ambivalence	High	High	High	High	Moderate
Indifference	Low	Low	Low	Low	Low

Aim 2. To examine if a common predictor, namely situational context, modifies the hypothesized constructs of interest in similar ways.

Hypothesis 2a: We predicted that those in the bar lab setting will score significantly higher on positive expectancies, approach inclinations and demand indices when compared to those in a neutral laboratory setting. We chose to focus on positive expectancies and approach inclinations based on previous research illustrating heavy drinking college students generally hold higher positive expectancies and approach inclinations and as such the bar lab should prime further motivation to consume.

Hypothesis 2b: We predicted the bar setting will result in stronger convergence of these constructs due to the situational context that would inherently activate motivational pathways to drink, whereas the neutral laboratory setting would measure more trait specific levels of these constructs. Specifically, stronger correlations among the constructs of interest were expected for individuals in the bar lab condition when compared to those in the neutral laboratory setting.

Exploratory Aim 3: **To explore the extent to which drinker status impacts these relationships as well as the convergence of these constructs.**

Theoretical considerations of these constructs suggests that the drinking history, specifically the experience of alcohol-related consequences, may increase avoidance inclinations and negative expectancies. This was explored within both settings to determine if these constructs converge differentially when considering the experience of consequences.

STUDY 1 METHODS

Participants

Undergraduate students with a full range of drinking behaviors were recruited to participate in an online survey study. Specifically, students enrolled in psychology courses at the University of South Florida were recruited from a psychology research pool (SONA Systems). Eligible individuals must have consumed alcohol on at least one occasion in their lifetime, be native English speaking and be at least 18 years of age to participate.

A total of 347 participants participated in the study. Of the 347 participants, 29 failed to accurately complete the 3 validity checks, resulting in a final sample of 318 participants. The mean age of the sample was 21.31 (SD = 3.58). The sample consisted of 40.3% males and was predominately Caucasian (65.6%; 7.6% African American, 9.8% Asian, 9.8% Multiracial, 7.2% Other). With regard to drinking behaviors, on average participants reported consuming alcohol once per week (M= 1.02, SD = 1.63) and an average of 3.74 drinks per occasion (SD = 2.20). See table 2 for additional demographic information of the sample.

Table 2. Demographic characteristics of study 1 sample

Characteristic	Mean (SD) or percentage of sample
Age	21.31 (3.58)
Sex	
Male	40.3%
Female	59.7
Ethnicity	
Caucasian	65.6
African-American	7.6
Asian	9.8
Mixed/Multiracial	9.8
Other	7.2

Table 2 (Continued)

Year of education	
Freshman	21.1
Sophomore	16.4
Junior	33.0
Senior	28.6
Other	0.9
Residence	
On-campus	26.1
Off-campus	73.9
Employed	
Part-time	51.3
Full-time	12.6
Not employed	36.2

Procedure

Eligible participants were recruited for the study through SONA. Participants viewing studies listed on SONA saw a brief description of the study as follows "Answer online survey questions about your alcohol-related attitudes and behavior". Participants clicked on a link to a full description of the study, including estimated time, points (credit) awarded, and eligibility requirements. The Qualtrics study link was delivered where they provided informed consent. Participants then completed a series of surveys assessing demographics, personality and drinking behavior.

All measures were presented with their full instructions. Instructions for the cue-reactivity task were presented prior to two practice trials and presentation of the images. Participants then rated their approach and avoidance to 30 images. For each trial a preparatory screen was presented for 4 seconds, followed by the substance image for 6 seconds. Participants then provided both their approach and avoidance ratings. After providing ratings, participants received a 10 second break prior to the presentation of the next image.

Three attention check questions were included. Online measures took approximately 90 minutes to complete. Participants received class credit for their participation (90 minutes = 1.5 points), awarded to them through SONA.

Measures

Approach and Avoidance Inclinations

Cue-reactivity – Approach and Avoidance inclinations were measured using a cue reactivity paradigm. Following each cue, participants answered "How much do you want to consume the item right now?" to assess approach inclinations and "How much do you want to avoid consuming the item right now?" to assess avoidance inclinations. Responses range from 0 ("Not at all") to 8 ("Very much"). Each cue had a separate page for the rating scale. The order of approach and avoidance rating scales was counterbalanced across slides. Similar methods have been used to assess approach and avoidance in young adult samples (Curtin et al., 2005; Stritzke et al., 2004).

Thirty cue slides were presented to participants including alcoholic beverages (n = 18, 6 slides each for beer, wine and hard liquor) and nonalcoholic beverages (n = 12) taken from the Normative Appetitive Picture System (NAPS; Stritzke et al., 2004), which has been standardized in adolescent and young adult samples (Curtin et al., 2005; Stritzke et al., 2004). Individual slides varied by setting (e.g., bar, restaurant, home, neutral background), and activity state (e.g., substance held in hand, actively consumed, or sitting untouched on table). Brand names and identifying symbols were excluded to the extent possible to minimize potential biases from brand preferences. To avoid reactivity to affective information conveyed by people depicted with the substance, cues were shown without human involvement when possible. Additionally, when

people were depicted along with a substance, their facial expressions and body posture were kept neutral.

Self- Report – The Approach and Avoidance of Alcohol Questionnaire (AAAQ; McEvoy et al., 2004) is a 14-item self-report measure which was also used to assess approach inclinations and avoidance inclinations. Participants are asked to rate how much they agree with each item on a scale of 0 (Not at All) to 8 (Very Strongly). Items assessing approach inclinations include statements such as "I would like to have a drink or two" and "I am planning to drink alcohol." Items assessing avoidance inclinations include statements such as "I am avoiding people who are likely to offer me a drink" and "I am deliberately occupying myself so I will not drink alcohol". The AAAQ has demonstrated strong psychometric properties in a range of samples, including college students, and has demonstrated predictive validity by distinguishing between light and heavy drinkers (McEvoy et al., 2004).

Although the cue-reactivity was originally was going to be used for the primary aim of the study, as the cue-reactivity paradigm has previously captured a greater range of avoidance inclinations among college samples (see Stritzke et al., 2004), in the current sample the cue-reactivity resulted in low levels of approach relative to avoidance. Indeed, there was a good amount of variation in the avoidance ratings in the current sample (M = 4.12, *SD* = 2.16). However, there were low levels of approach relative to mean levels of avoidance (M = 2.61, SD = 1.83) which would hinder the differentiation of motivational profiles. Conversely, while mean values were overall lower, approach was higher relative to avoidance when assessed with the AAAQ. Specifically the mean for approach was 1.69 (SD = 1.35) and the mean for avoidance was .97 (SD = 1.13). These mean values are comparable with previous literature on the AAAQ

in college samples (McEvoy, 2004). As such, approach and avoidance obtained in the AAAQ will be used in the current study.

Alcohol Expectancies

Self-report – The 40-item Alcohol Expectancy Questionnaire (AEQ-2; Rohsenow, 1983) assessed positive and negative alcohol expectancies. The AEQ-2 is a revised version of the original AEQ (S. A. Brown, Goldman, Inn, & Anderson, 1980). Respondents rate 0 (Disagree) or 1 (Agree) to items such as "Alcohol allows me to be more assertive" and "Drinking makes the future seem brighter". Items assess alcohol expectancies across a total of eight subscales: Global Positive, Social and Physical Pleasure, Sexual Enhancement, Power and Aggression, Social Expressiveness, Relaxation and Tension Reduction, Cognitive and Physical Impairment, and Careless Unconcern. The first 6 subscales reflect positive expectancies while the latter 2 subscales reflect negative expectancies. As such, for the purposes of this study, the first 6 subscales were combined to form an overall expectancy composite score and the latter 2 were combined to form a negative expectancy composite score.

Free Associates – A Free Associates task was used to assess alcohol expectancies. Participants were provided with the prompt "Alcohol makes me _____" and were asked to write up to 5 responses to the prompt. Participants then rated each of their responses on valence (pleasantness) and arousal on a scale of 1-7. Higher values are indicative of more pleasantness and arousal while low values are indicative of unpleasantness and sedation. This method has been used to assess alcohol expectancies in numerous populations including college students (Reich & Goldman, 2005). Responses from the Free Associates task are posited to represent an individual's most readily activated expectancies in their memory network (Nelson, Mcevoy, & Dennis, 2000).

Alcohol Demand

The *Alcohol Purchase Task* was used to (APT; Murphy & MacKillop, 2006) measure an individual's demand for alcohol by assessing how many standard drinks they would consume in a variety of drinking situations across a range of 14 different prices ($0 to $9). The instructions of the questionnaire prompt respondents to imagine that they are with their friends in a bar from 9 p.m. to 2 a.m. to see a band. Respondents are provided with single standard size measurements of beer (12 oz), wine (5 oz), shots of hard liquor (1.5 oz), and mixed drinks containing one shot of liquor. The APT has demonstrated test-retest reliability and validity in college students (Murphy, MacKillop, Skidmore, & Pederson, 2009). Calculated using the APT, demand intensity and O_{max} have exhibited larger effect sizes and more consistent relationships with drinking behavior than Breakpoint, $P_{max,}$ and elasticity (Kiselica et al., 2016; MacKillop et al., 2009). As such, these two indices were included in the main analyses.

Additional Measures

Alcohol-Related Consequences – The 18-item Rutgers Alcohol Problem Index (Neal, Corbin, & Fromme, 2006) is a revised measure of the original RAPI (White & Labouvie, 1989) that was used to assess alcohol-related problems across academic, social, and physical domains. Participants are instructed to respond with how much each consequence has occurred to them because of drinking on a scale of 0 (none) to 3 (more than 5 times). Consequences include things like "Neglected your responsibilities" and "Missed a day (or part of a day) of school or work". The 18-item RAPI has been validated with college students and has demonstrated clinical utility (Neal et al., 2006). For the purposes of the current study, the RAPI was used in an auxiliary analysis to determine if latent profiles are associated with alcohol-related consequences.

Alcohol Use Severity – The Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, De La Fuente, & Grant, 1993) was administered to determine severity of alcohol problems. The AUDIT is a widely used screening tool that assesses alcohol consumption, drinking behaviors, and alcohol-related consequences across diverse populations. In young adult samples, the AUDIT has demonstrated strong psychometric properties, including identification of an optimal cutoff of 6 points or more in identifying high-risk drinkers (Kokotailo et al., 2004).

Drinking History – Alcohol use will be assessed using the 10-item Drinking History Questionnaire (DHQ). Based on the work of (Cahalan, Cisin, & Crossley, 1969), this instrument assessed both quantity and frequency of drinking. Frequency is assessed using a 10-point scale ranging from once a month or less to 21 or more times a week. The number of standard drinks they typically consume per drinking occasion will indicate quantity. This questionnaire was used to categorize general drinking behavior of participants based on quantity and frequency and to examine the relationships between alcohol use behavior and latent profiles.

Standard questions were used to collect demographic information including gender, age, education, and race. Additional measures administered included the Big Five Inventory (BFI-10; Rammstedt & John, 2007), Substance Use Risk Profile Scale (SURPS; Woicik, Stewart, Pihl, & Conrod, 2009), and the Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988).

Data Analytic Strategy

First, possible outliers (median + or – 2 interquartile ranges) and normality of variables were examined prior to all analyses. Descriptive statistics were computed for variables of interest to characterize the sample.

Hypothesis 1a. We predicted that positive alcohol expectancies would be associated with higher approach inclinations and higher demand, as well as heavier drinking. In contrast, negative expectancies would be associated with avoidance inclinations and low demand, as well as lower levels of alcohol use. To examine these hypotheses we conducted a series of bivariate correlations examining the relationships between the constructs of interest.

Hypothesis 1b. Consistent with theory, we predicted that four motivational profiles would emerge in which to classify individuals based on approach and avoidance inclinations, positive and negative expectancies, and alcohol demand. These profiles would have differentiating associations with drinking behaviors and alcohol-related consequences. To examine this hypothesis, a latent profile analysis was conducted with approach and avoidance inclinations, positive and negative expectancies, and alcohol demand (Intensity and O_{max}) as indicators. Latent profile analysis is a technique used to group individuals (i.e., latent classes) based on similar patterns of responding. First, a step-wise approach was used to enumerate the number of classes based on the work of Masyn (2017). This approach is useful because it allows for incremental adjustments in the variance covariance structure in each model. This structure ultimately influences conclusions about the best fitting model, which is often overlooked and held to be invariant across classes when fitting these models. Importantly, this approach allows for relaxing the conditional independence assumption that is enforced in traditional LPA models (i.e., latent class membership explains observed covariation). Fit indices and theoretical considerations were used to determine the number of resulting latent classes. Specifically, the Baysesian Information Criterion (BIC), sample size-adjusted Bayesian Information Criterion (aBIC), Akaike Information Criterion (AIC), entropy, and the Lo-Mendell-Rubin Likelihood Ratio Test and the BLRT were examined to determine the best fitting model. Though there is

little agreement on which indicator provides the best information regarding fit, simulation studies have demonstrated that of the Information Criterion (ICs) used, the BIC tends to perform the best (Nylund-Gibson, Asaprouhov, & Muthén, 2007). This simulation also suggested that the BLRT outperforms the other indicators, though should be considered in light of the LRT which is more robust and valid under a variety of distributional and model assumptions. However, this research also demonstrated that LRT tends to show fluctuation (significant to nonsignificant to significant again) from class to class. Given there is high variability in recommendations and practice for which fit indices to rely on, the current study considered all the above indices simultaneously to inform the decision on number of classes. The interpretability of the extracted classes will also be considered. Once the number of classes was identified, we examined relationships between class membership and auxiliary variables of interest to further establish differences between motivational profiles. Specifically, a three-step approach will be used to minimize the potential for biased estimates due to class uncertainty (Asparouhov & Muthén, 2013).

STUDY 1 RESULTS

Descriptive Statistics

All variables were first examined for normality. Assessment of alcohol-related consequences, as measured by the RAPI, was significantly positively skewed. Square-root transformations were performed which improved normality. Consistent with previous research, outliers for O_{max} and Intensity were recoded and square root transformed. More detailed information on the evaluation of demand indices is reported below. Means, standard deviations, and correlations for the constructs of interest are presented in table 3.

Demand Indices and Demand Curve Evaluation

Intensity and O_{max}, were determined using observed values. Literature on the Alcohol Purchase Task suggests examined the indices for outliers greater than 3.29 standard deviations from the means and recoding these scores as one value greater than the next highest nonoutlier value (Murphy & MacKillop, 2006; Tabachnick & Fidell, 2001). A total of 8 values were recoded in this manner. Further, demand indices were positively skewed and square root mean transformations were conducted to improve normality. To examine the performance of the APT in the sample, data were examined with Hursh and Silberberg's demand equation. Results suggested exceptional fit ($R^2 = .98$). This suggests that the data are consistent with the expected pattern of a decrease in alcohol as price increases.

Bivariate Correlations

Pearson's correlations were used to analyze the associations between approach, avoidance, Intensity, O_{max}, positive expectancies, negative expectancies, and drinking variables

(i.e., quantity, frequency, and consequences). Positive expectancies were positively associated with approach, Intensity, O_{max}, frequency, and quantity. Negative expectancies were negatively associated with Intensity and positively associated with avoidance inclinations as expected. In contrast, negative expectancies were positively associated with quantity and alcohol-related consequences. Additionally, approach inclinations were positive associated Intensity, O_{max}, frequency, quantity and alcohol-related consequences. Avoidance inclinations were positively associated with RAPI scores. Intensity was positive associated with frequency, quantity and alcohol-related consequences. O_{max} was also positive associated with frequency, quantity and alcohol-related consequences.

Table 3. Summary of study 1 means, standard deviations, and correlations

	M	*SD*	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Approach	1.70	1.35	-								
2. Avoidance	0.98	1.13	.16**	-							
3. Intensity	2.29	0.78	.49***	.002	-						
4. O_{max}	3.52	1.42	.26***	-.11	.58***	-					
5. AEQ Total Positive	15.19	5.10	.47***	.05	.40***	.21***	-				
6. AEQ Total Negative	5.14	2.09	.32***	.11*	-.23***	.07	.64***	-			
7. Frequency	1.02	1.63	.30***	.03	.24***	.21***	.21***	.11	-		
8. Quantity	3.74	2.20	.40***	.05	.68***	.37***	.32***	.24***	.16**	-	
9. RAPI	1.49	1.41	.44***	.28***	.39***	.14*	.37***	.37***	.28***	.35***	-

Note: Frequency = number of drinking occasions per week; quantity = number of drinks per occasion; RAPI = Rutgers adolescent problem index. Intensity, Omax and RAPI scores reported are square root transformed.
*p < .05, ** p < .01, *** p < .001.

Latent Profile Analysis: Model Fit

To examine motivational profiles, a latent profile analysis was conducted with approach and avoidance inclinations, positive and negative expectancies, and alcohol demand (Intensity and O_{max}) as indicators. We used the AEQ and AAAQ to examine expectancies and approach and avoidance over the Free Associates task and cue-reactivity to consistently probe more trait-like levels of these constructs to establish motivational profiles. A total score for positive expectancies and negative expectancies was drawn from the AEQ by combining corresponding factors scores. Approach and avoidance inclinations were assessed using the AAAQ scale.

First, a step-wise approach was attempted to enumerate the number of classes based on the work of Masyn (2017). Because each step in this approach calls for the estimation of more parameters (variances and covariances) than the initial, most-restrictive model, these models were underpowered and did not converge beyond the two-class models. As such, for the purposes of the current study, we report the results of a latent profile analysis using the traditional constraints of an invariant variance covariance structure and assuming conditional independence. Appendix A includes a more detailed discussion of Masyn's approach and model results that were obtained.

Results from the latent profile analysis demonstrated that a four-class solution best fit the data (see table 4 for a summary of fit indices). Examination of the fit indices demonstrated that changes in the Bayesian Information Criterion began to slow at the four-class model. Though the sample size-adjusted Bayesian information Criterion and the Akaike Information Criterion continue to decrease beyond the four-class solution, these reductions also slowed. Further, the Lo-Mendell-Rubin Likelihood Ratio Test was nonsignificant at the three-class solution and marginally significant at the four-class solution. Next, random start values were then increased

from 1000 to 10000 in order to ensure that the model would hold. Model results were unchanged. Further, the posterior probabilities that individuals belong to their assigned class was high (See table 5; ranging from .85- .93). Given that the BIC continued to drop beyond the four-class solution, we examined the five-class solution closely. Upon inspection of the values, it appeared that the solution further differentiated individuals in the developing approach class. The other 3 classes (approach, indifferent, avoidant profiles) remained clearly established. Further, the posterior probabilities of being assigned to the newly extracted class was relatively low (.77), suggesting more uncertainty in being assigned to this class which was also reflected in a lower entropy value for the five-class model. We also examined the five-class solution in regard to drinking variables to determine if the differentiation was practically meaningful. Importantly, the additional class did not differ significantly on frequency or alcohol-related consequences, though it did significantly differ on quantity. Finally, we also examined the six-class solution as it resulted in a decrease in BIC and an increase in entropy, however, the additional extracted class had 2 individuals in it which would greatly hinder interpretability. As such, we returned to the results of the five-class solution. However, given the low posterior probability, interpretability of the classes, the relatively small decrease in BIC within the five-class solution, we decided on the four-class solution.

To temper the concern about violating the conditional independence assumption, we examined the standardized residuals for covariances (Muthén, 2009). Significant standardized residuals (greater than 1.96) indicate that the assumption of conditional independence is not met. Upon inspection of these residuals, all values were relatively small (ranging from .01- .48). No significant residuals were evident, providing support that this assumption was not violated.

Next, qualitative inspection of the 4-class solution was done to determine if the class separations were theoretically meaningful. We predicted 4 classes would emerge in accordance with AMC profiles: approach-oriented, avoidant, indifferent and an ambivalent group. Class 2 (*n* = 62), was relatively low across all six variables, which corresponded to our predicted indifferent profile. Class 3 (*n* = 15) stood apart as the group highest on avoidance inclinations and lowest on Intensity, O_{max}, approach, and positive expectancies, reflecting an avoidant group. Class 4 (*n* = 59) was highest on approach, Intensity, $O_{max,}$ and positive and negative expectancies. We labeled this the approach class. The first class (*n* = 182) was not as clear as the other 3 classes and it was our largest resulting class. Inspection of the means demonstrated that they were largely at the mean level across all constructs (higher than the indifferent group but lower than the approach group). We hypothesized that this may be reflective of the developmental period of drinking that many young adults experience while in college. In other words, these constructs may still be in the process of developing as individuals begin to have more experiences with alcohol. Further, the lack of ambivalent group may be reflected by low levels of problematic drinking observed in our sample. Indeed, the average RAPI scores were also low (M = 4.17, SD = 5.99), compared to previous research suggesting a cut off of 8 to be used as a measure of clinical relevant levels of consequences (Neal et al., 2006). See table 6 for estimated means of LPA variables in each class. Figure 1 plots the means (standardized values) for each of the 4 latent profiles along with their corresponding labels.

Table 4. Latent profile analysis: summary of fit indices

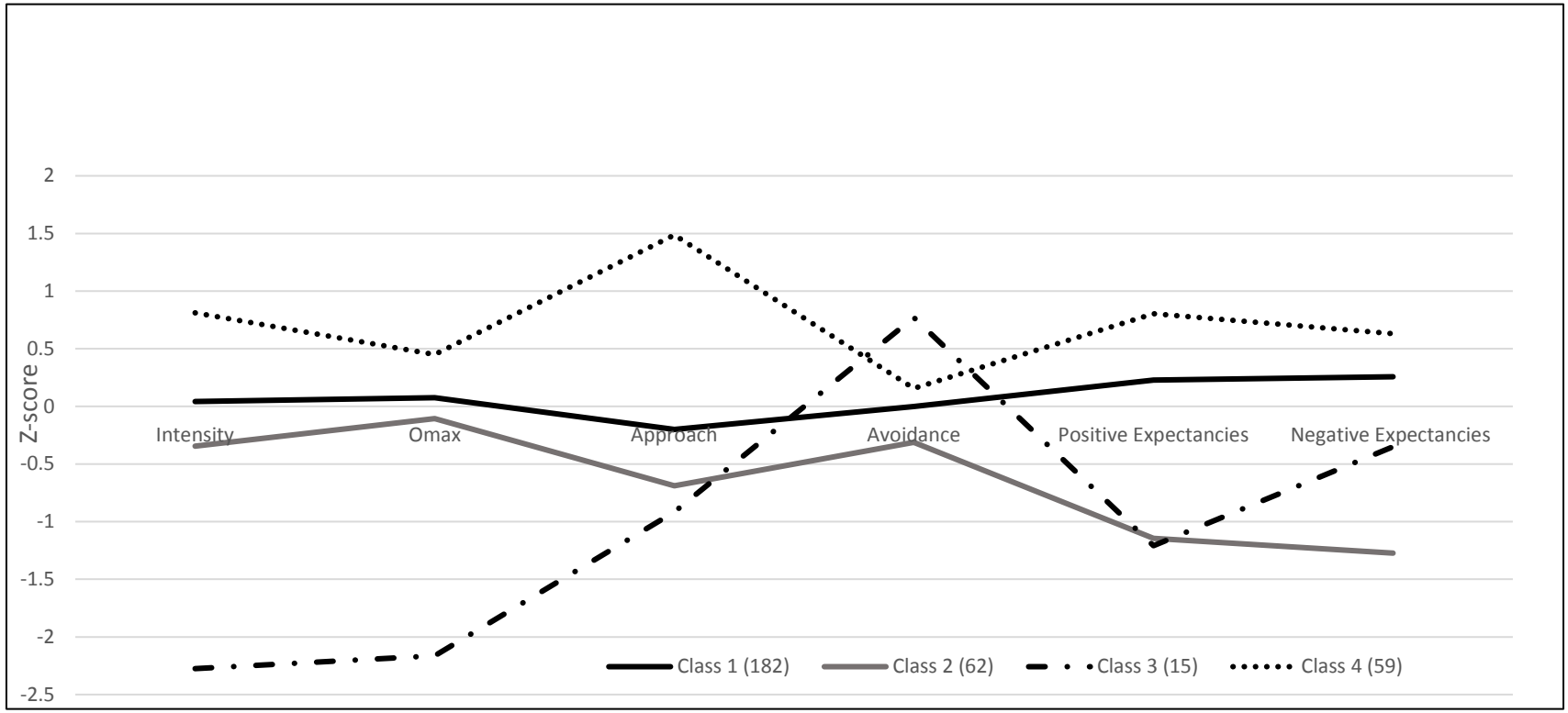
Variable	Log-Likelihood	AIC	Parameters	BIC	Difference in BIC	aBIC	Difference in aBIC	Entropy	LMR LRT	BLRT
1 class	-2704.33	432.66	12	5477.805	-	5439.73	-	-	-	-
2 class	-2580.79	5199.59	19	5271.066	206.74	5210.80	228.93	.725	.0069	<.001
3 class	-2529.60	5111.19	26	5209.006	62.06	5126.54	84.26	.798	.1400	<.001
4 class	**-2487.54**	**5041.09**	**33**	**5165.235**	**43.77**	**5060.57**	**65.97**	**.814**	**.0654**	**<.001**
5 class	-2455.30	4900.61	40	5141.091	24.14	5014.22	46.35	.811	.6828	<.001
6 class	-2422.42	4938.85	47	5115.664	25.43	4966.59	47.63	.818	.274	<.001
7 class	-2402.01	4912.02	54	5115.170	0.49	4943.89	22.70	.845	.7417	<.001

Notes: AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; aBIC = sample size–adjusted Bayesian Information Criterion; Entropy = measure of the accuracy of classification in latent classes and of class differentiation, higher values indicate better classification; LMR LRT = Lo–Mendell–Rubin Likelihood Ratio Test *p* value for (K-1) classes. A significant *p* value indicates that the K-1 class model should be rejected in favor of a model with at least K classes; BLRT = Bootstrap likelihood ratio test, a test of the significance of difference in model fit with the addition of one more latent class. A significant *p* values indicates a significant change in model fit with a change in the number of classes. **Bold** indicates best fitting model.

Table 5. Average posterior probabilities associated with the 4-class model

Class	n	1	2	3	4
1	182	**0.93**	0.15	0.02	0.13
2	62	0.04	**0.85**	0.07	0.00
3	15	0.00	0.00	**0.91**	0.00
4	59	0.03	0.00	0.00	**0.87**

Note. Posterior probabilities are the probability that an individual belongs to the assigned to class. Bolded values are the average posterior probabilities associated with the class to which individuals were assigned.



Note. The results were standardized to aid in interpretation.

Figure 1. Results of LPA: four motivational profiles

Table 6. Estimated means of latent profile analysis variables

	Approach		Avoidance		Intensity		O_{max}		Positive Expectancies		Negative Expectancies	
Variable	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*
Class 1 (n= 182) Developing approach	-0.20	0.09	-0.02	0.10	0.04	0.10	0.08	0.09	0.23	0.09	0.26	0.11
	(1.43)		(0.96)		(2.32)		(3.62)		(16.36)		(5.68)	
Class 2 (n = 62) Indifferent	-0.69	0.14	-0.31	0.14	-0.35	0.18	-0.11	0.20	-1.14	0.23	-1.27	0.20
	(0.77)		(0.62)		(2.02)		(3.37)		(9.35)		(2.48)	
Class 3 (n=15) Avoidant	-0.92	0.13	0.77	0.30	-2.28	0.27	-2.17	0.15	-1.21	0.34	-0.35	0.36
	(0.46)		(1.85)		(0.51)		(0.45)		(9.02)		(4.41)	
Class 4 (n= 59) Approach	1.49	0.17	0.16	0.16	0.81	0.13	0.45	0.14	0.80	0.11	0.63	0.11
	(3.71)		(1.15)		(2.92)		(4.16)		(19.29)		(6.46)	

Note: Z-score standardized means reported (converted means in parentheses below).

Latent Profile Analysis: Auxiliary Variable Analysis

An auxiliary variable analysis was conducted to examine the class differences in the constructs of interest. Specifically, the relationship between the four classes and frequency (i.e., average number of occasions per week), quantity, and alcohol-related consequences. See table 7 for a summary of these results.

A three-step approach was used to examine mean differences between classes for frequency, quantity, alcohol-related consequences and age. Overall mean differences were observed for frequency ($\chi^2_{(3)} = 82.6$, $p < .001$). Follow-up comparisons revealed significant differences between the developing approach class ($M = 0.84$, $SE = 0.06$) and avoidant class ($M = 0.34$, SE = 0.05; $\chi^2_{(1)} = 38.64$, $p < .001$), developing approach and approach class ($M = 2.07$, $SE = 0.33$; $\chi^2_{(1)} = 13.23$, $p < .001$), avoidant and approach classes ($\chi^2_{(1)} = 29.35$, $p < .001$), and indifferent ($M = 0.77$, $SE = 0.26$) and approach class ($\chi^2_{(1)} = 9.16$, $p < .01$). The approach class was associated with the highest frequency of alcohol use per week, while the avoidant class was associated with the lowest frequency of alcohol use.

Overall mean differences between classes were also observed for quantity ($\chi^2_{(3)} = 96.88$, $p < .001$). Follow-up comparisons revealed significant differences between all classes: developing approach ($M = 3.61$, $SE = 0.19$) and avoidant classes ($M = 1.59$, $SE = .44$; $\chi^2_{(1)} = 17.26$, $p < .001$), developing approach and indifferent classes ($M = 2.85$, $SE = 0.20$; $\chi^2_{(1)} = 7.63$, $p < .01$), indifferent and avoidant classes ($\chi^2_{(1)=} 4.86$, $p < .05$), developing approach and approach classes ($M = 5.83$, $SE = 0.37$; $\chi^2_{(1)} = 24.38$, $p < .001$), avoidant and approach classes ($\chi^2_{(1)} = 54.51$, $p < .001$) and indifferent and approach classes ($\chi^2_{(1)} = 51.38$, $p < .001$).

Overall mean differences were also observed for alcohol-related consequences ($\chi^2_{(3)} = 85.79$, $p < .001$). Follow-up comparisons revealed significant differences between the developing

approach class (M = 1.44, SE = 0.10) and the avoidant class (M = 0.65, SE = 0.22; $\chi^2_{(1)}$ = 10.01, $p < .01$), avoidant and approach classes (M = 2.74, SE = 0.31; $\chi^2_{(1)}$ = 26.84, $p < .001$), indifferent (M = 0.55, SE = 0.10) and avoidant classes ($\chi^2_{(1)}$ = 32.35, $p < .001$), indifferent and approach classes ($\chi^2_{(1)}$ = 43.09, $p < .001$), and developing approach and approach classes (χ^2 = 11.57, $p < .01$).

In sum, the approach class was associated with the highest frequency, quantity, and alcohol-related consequences, significantly higher than the developing approach class. The avoidant class was associated with the lowest frequency and quantity, while the indifferent class was associated with the lowest number of alcohol-related consequences.

Exploratory Examination of Age and Drinking Histories

An auxiliary approach was then also conducted to examine variations in age, school year, and drinking histories according to class (variables from the Drinking History Questionnaire). These variables were examined to aid in better understanding general experience with drinking alcohol as it relates to class and may be sensitive to the development course of drinking with college students. Further, examination of these variables may aid in identifying underlying differences in the developing approach class and the approach class. Some drinking history variables were recoded into continuous variables based on response options and examined using the three-step procedure. Categorical variables that could not be treated as continuous were examined using an auxiliary analysis for categorical distal outcomes allowing for the comparison of probabilities of endorsed response options across classes.

First, we examined mean differences across classes by age and school year. No significant differences were observed in age ($\chi^2_{(3)}$ = 1.87, p = .601) or year in school across latent classes ($\chi^2_{(3)}$ = 11.32, p = .501).

Next, five questions about experiences when drinking were examined including amount of time drinking at present rate (in years), frequency of getting "somewhat high" or "somewhat intoxicated" (occasions per year), frequency of getting drunk (occasions per month), number of drinks needed to get "somewhat high" or "somewhat intoxicated, and number of drinks needed to get drunk. See table 8 for expected means of these drinking history variables according to class.

Overall mean differences were observed for all five variables across classes. Specifically, an overall mean differences between classes was observed amount of time drinking at present rate ($\chi^2_{(3)}$ =37.76, $p < .001$). Follow-up comparisons revealed significant differences between the developing approach class ($M = 1.93$, $SE = 0.16$) and avoidant class ($M = 0.91$, $SE = 0.18$; $\chi^2_{(1)}$ =20.05, $p < .001$), indifferent ($M = 2.14$, $SE = 0.41$) and avoidant classes ($M = 0.91$, $SE = 0.18$; $\chi^2_{(1)}$ =7.21, $p < .01$), and avoidant ($M = 0.91$, $SE = 0.18$) and approach classes ($M = 2.64$, $SE = 0.33$; $\chi^2_{(1)}$ =22.76, $p < .001$).

Overall mean differences were observed for frequency of getting "somewhat high" or "somewhat intoxicated" per month ($\chi^2_{(3)}$ =127.49, $p < .001$). Follow up comparisons revealed significant differences between all 4 classes. Specifically, differences were observed between the developing approach ($M = 2.08$, $SE = 0.21$) and avoidant class ($M = 0.59$, $SE = 0.11$; ; $\chi^2_{(1)}$ = 46.57, $p < .001$), the developing approach and indifferent class ($M = 1.14$, $SE = 0.17$; $\chi^2_{(1)}$ = 13.09, $p < .001$), the developing approach and approach class ($M = 5.21$, $SE = 0.71$; ; $\chi^2_{(1)}$ =16.09, $p < .001$), the indifferent and avoidant class ($\chi^2_{(1)}$ = 14.63, $p < .001$), the indifferent and approach class ($\chi^2_{(1)}$ = 31.48, $p < .001$), and the avoidant and approach class ($\chi^2_{(1)}$ = 42.74, $p < .001$).

Overall mean differences were also observed for frequency of getting drunk per month ($\chi^2_{(3)}$ = 102.78, $p < .001$) with significant differences also seen between all 4 classes. Specifically, differences were observed between the developing approach (M = 1.25, SE = 0.15) and avoidant class (M = 0.38, SE = 0.08; ; $\chi^2_{(1)}$ = 31.67, $p < .001$), the developing approach and indifferent class (M = 0.73, SE = 0.15; $\chi^2_{(1)}$ = 7.05, $p < .01$), the developing approach and approach class (M = 4.51, SE = 0.74; ; $\chi^2_{(1)}$ = 16.48, $p < .001$), the indifferent and avoidant class ($\chi^2_{(1)}$ = 8.69, $p < .01$), the indifferent and approach class ($\chi^2_{(1)}$ = 24.90, $p < .001$), and the avoidant and approach class ($\chi^2_{(1)}$ = 30.75, $p < .001$).

Overall mean differences were observed for number of drinks needed to get "somewhat high" or "somewhat intoxicated" ($\chi^2_{(3)}$ = 33.12, $p < .001$). Follow up comparisons revealed significant differences between the developing approach (M = 3.61, SE = .14) and avoidant classes (M = 2.38, SE = 0.49; $\chi^2_{(1)}$ =5.62, $p < .05$), avoidant and approach classes (M = 5.73, SE = 0.39; $\chi^2_{(1)}$ = 27.78, $p < .001$), and indifferent (M = 3.75, SE = 0.47) and approach classes ($\chi^2_{(1)}$ = 9.92, $p < .01$), and developing approach and approach classes ($\chi^2_{(1)}$ =23.99, $p < .001$). Overall mean differences were also seen for number of drinks needed to get drunk ($\chi^2_{(3)}$ = 36.12, $p < .001$). Follow up comparisons revealed significant differences between the developing approach class (M = 4.71, SE = 0.26) and avoidant classes (M = 2.62, SE = 0.34; $\chi^2_{(1)}$ = 9.75, $p < .01$), avoidant and approach classes (M = 7.08, SE = 0.48; $\chi^2_{(1)}$ = 29.20, $p < .001$), indifferent (M = 4.45, SE = 0.69) and approach classes ($\chi^2_{(1)}$ = 10.59, $p < .01$), and the developing approach and approach classes ($\chi^2_{(1)}$ = 14.08, $p < .001$). The approach class was associated with the highest number of drinks both to get "somewhat intoxicated" and to get drunk (M = 5.72, SE = .39; M = 7.08, SE = 0.48), significantly higher than the developing approach class (M = 3.61, SE = .14; M

= 4.71, *SE* = 0.26). The avoidant class was associated with the fewest number of drinks both to get "somewhat intoxicated" and to get drunk (*M* = 2.28, *SE* = 0.49; *M* = 2.62, *SE* = 0.34).

In sum, the approach class was associated with the longest amount of time drinking at present rate, highest frequency of getting both "somewhat intoxicated" and getting drunk, as well as the highest number of drinks to get "somewhat intoxicated" and to get drunk. The avoidant class was associated with the least amount of time drinking at their present rate, the lowest frequency of getting "somewhat intoxicated" and getting drunk, and the fewest number of drinks to get "somewhat intoxicated" and to get drunk. The developing approach class did not significantly differ from the approach class in terms of amount of time drinking at present rate, but was significantly lower on frequency of getting "somewhat intoxicated" and getting drunk, as well as on number of drinks needed to achieve these states. The indifferent class differentiated from the avoidant class in terms of drinking at their present rate longer, higher frequency of getting "somewhat intoxicated" and getting drunk, as well and requiring more drinks to achieve these states. Further, the indifferent class looked similar to the developing approach class in terms of amount of time drinking at their present rate and drinks required to get "somewhat intoxicated" and drunk, but differed in terms of having lower frequency of getting "somewhat intoxicated" and drunk.

The remaining drinking history questions involved categorical variables. As such, probabilities of endorsed response options are reported across classes (see table 9). Variables examined included rate of drinking prior to establishing current rate, preference for alcohol type, and evaluation of ones' ability to hold liquor compared to peers.

Overall differences were also seen for rate of alcohol consumption before establishing present rate ($\chi^2_{(3)} = 157.97$, $p < .001$). Follow up comparisons revealed differences between the

developing approach and indifferent classes ($\chi^2_{(1)} = 63.10$ $p < .001$), indifferent and avoidant classes ($\chi^2_{(1)} = 13.86$, $p < .01$), and indifferent and approach classes ($\chi^2_{(1)} = 40.79$, $p < .001$). Examination of probabilities by class demonstrated that the indifferent class was most likely to endorse they did not drink at all prior to establishing their current rate, while the approach class was least likely to endorse they did not drink at all prior to establishing their current rate. Compared to the indifferent class, the rate of alcohol consumption prior to establishing current rate was much more variable for the developing approach class.

Overall differences were observed in endorsement of preferred alcohol type ($\chi^2_{(3)} = 54.04$, $p < .001$). Follow up comparisons revealed that this difference was largely driven by significant differences between the developing approach and indifferent class ($\chi^2_{(1)} = 14.71$, $p < .01$), developing approach and avoidant class ($\chi^2_{(1)} = 11.41$, $p < .05$), and avoidant and approach classes ($\chi^2_{(1)} = 12.56$, $p < .05$).

Overall differences were also seen evaluation of ones' ability to hold liquor compared to peers ($\chi^2 = 114.99$, $p < .001$). Follow up comparisons revealed differences between the developing approach and avoidant classes ($\chi^2_{(1)} = 39.22$, $p < .001$), indifferent and avoidant classes ($\chi^2_{(1)} = 13.73$, $p < .01$), indifferent and approach classes ($\chi^2_{(1)} = 13.28$, $p < .01$) and differences in avoidant and approach classes ($\chi^2_{(1)} = 55.92$, $p < .001$). Examination of probabilities showed that the developing approach and approach classes were more likely to endorse "I can drink somewhat more before I am affected" and "I can drink much more before I am affected." Conversely, the indifferent and avoidant classes were more likely to endorse "I can drink somewhat less before I am affected" and "I can drink much less before I am affected."

Table 7. Estimated class means for frequency, quantity and consequences

	Frequency		Quantity		RAPI	
Variable	*M*	*SE*	*M*	*SE*	*M*	*SE*
Class 1 (n= 182) Developing approach	0.84	3.61	3.61	0.19	1.44	0.13
Class 2 (n = 62) Indifferent	0.78	2.89	2.89	0.20	0.55	0.10
Class 3 (n =15) Avoidant	0.34	1.59	1.59	0.44	0.65	0.22
Class 4 (n = 59) Approach	2.07	5.83	5.83	0.37	2.74	0.31

Note. RAPI scores were square-root transformed.

Table 8. Estimated class means for drinking history variables

	How long have you been drinking at your present rate? (years)		On the average, how often do you get at least "somewhat high" or "somewhat intoxicated" from drinking alcoholic beverages? (number of times per month)		On the average, how often do you get drunk? (number of times per month)		When you do get 'somewhat high' or "somewhat intoxicated," how many 'drinks' does it usually take?" (number of drinks)		When you do get "drunk," how many drinks does it usually take? (number of drinks)	
Variable	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*
Class 1 (n= 182) Developing approach	1.93	0.16	2.08	0.21	1.25	0.15	3.61	0.14	4.71	0.26
Class 2 (n = 62) Indifferent	2.14	0.41	1.14	0.17	0.73	0.15	3.75	0.47	4.45	0.69
Class 3 (n =15) Avoidant	0.91	0.18	0.59	0.11	0.38	0.08	2.38	0.49	2.62	0.34
Class 4 (n = 59) Approach	2.64	0.33	5.21	0.71	4.51	0.74	5.73	0.39	7.08	0.48

Table 9. Response probabilities for drinking history questions according to class

DHQ5 *What was your rate of alcohol consumption before you established your current level?*	*P*	*SE*	**DHQ1** *What type of alcoholic beverage do you consume most often when you drink?*	*P*	*SE*	**DHQ10** *In comparison to the average person of your same age, sex, and body weight, how well would you say you "hold your liquor"?*	*P*	*SE*
Class 1 – Developing approach			**Class 1 – Developing approach**			**Class 1 – Developing approach**		
I did not drink at all then	.33	.05	Beer	.33	.05	I can drink much less before I am affected.	.07	.03
I used to drink much less	.23	.04	Wine	.10	.03	I can drink somewhat less before I am affected.	.14	.04
I used to drink somewhat less	.24	.04	Mixed drinks	.44	.05	I can drink about the same amount before I am affected.	.21	.05
I used to drink somewhat more	.14	.03	Straight drinks	.13	.04	I can drink somewhat more before I am affected.	.42	.05
I used to drink much more	.07	.02	Other	.00	.00	I can drink much more before I am affected.	.15	.04
Class 2 – Indifferent			**Class 2 – Indifferent**			**Class 2 – Indifferent**		
I did not drink at all then	.75	.12	Beer	.30	.10	I can drink much less before I am affected.	.25	.09
I used to drink much less	.07	.07	Wine	.17	.10	I can drink somewhat less before I am affected.	.19	.07
I used to drink somewhat less	.00	.00	Mixed drinks	.45	.10	I can drink about the same amount before I am affected.	.20	.06
I used to drink somewhat more	.18	.11	Straight drinks	.00	.00	I can drink somewhat more before I am affected.	.24	.08
I used to drink much more	.00	.00	Other	.08	.09	I can drink much more before I am affected.	.13	.05
Class 3 – Avoidant			**Class 3 – Avoidant**			**Class 3 – Avoidant**		
I did not drink at all then	.36	.10	Beer	.21	.07	I can drink much less before I am affected.	.21	.06
I used to drink much less	.24	.06	Wine	.24	.05	I can drink somewhat less before I am affected.	.35	.06
I used to drink somewhat less	.21	.08	Mixed drinks	.42	.06	I can drink about the same amount before I am affected.	.36	.06
I used to drink somewhat more	.14	.05	Straight drinks	.06	.03	I can drink somewhat more before I am affected.	.09	.06
I used to drink much more	.06	.04	Other	.06	.04	I can drink much more before I am affected.	.00	.00
Class 4 – Approach			**Class 4 – Approach**			**Class 4 – Approach**		
I did not drink at all then	.17	.06	Beer	.38	.08	I can drink much less before I am affected.	.04	.03
I used to drink much less	.39	.07	Wine	.06	.04	I can drink somewhat less before I am affected.	.06	.04
I used to drink somewhat less	.16	.06	Mixed drinks	.49	.08	I can drink about the same amount before I am affected.	.21	.06
I used to drink somewhat more	.18	.06	Straight drinks	.07	.05	I can drink somewhat more before I am affected.	.50	.08
I used to drink much more	.10	.04	Other	.00	.00	I can drink much more before I am affected.	.19	.06

STUDY 2 METHODS

Participants

Undergraduate students were recruited to participate in an in lab experimental study. Students enrolled in psychology courses at the University of South Florida were recruited from a psychology research pool (SONA Systems). Eligible participants must have reported one heavy drinking occasion in the past month (4 drinks per episode for women, 5 drinks per episode for men), be native English speakers and be at least 18 years of age. Heavy drinkers were included in this study as they are expected to have stronger developed approach and avoidance inclinations, expectancies and demand, thereby ensuring greater response to alcohol related stimuli.

A total of 119 participants completed the study. One participant failed to accurately complete the 3 validity checks, resulting in a sample of 118 participants. The total sample consisted of 39.0% males and was predominately Caucasian (72.9; 11.9% African American, 1.7% Asian, 7.6% Multiracial, 5.9% Other). See table 10 for a full report of additional demographic information according to condition and the total sample. On average participants reported consuming alcohol approximately once per week (M = 1.32, SD = 1.48) and a total of 4.65 drinks per occasion (SD = 2.06).

Table 10. Demographic characteristics by condition and study 2 total sample

Characteristic	Condition		
	Bar lab (n = 57)	Conference Room (n= 61)	Combined
Age *M* (SD)	20.40 (2.31)	19.83 (1.69)	20.11 (2.03)
Sex (%)			
Male	45.6	32.8	39.0
Female	54.4	67.2	61.0
Ethnicity (%)			
Caucasian	77.2	68.9	72.9
African-American	10.5	13.1	11.9
Asian	0.0	3.3	1.7
Mixed/Multiracial	8.8	6.6	7.6
Other	3.5	8.2	5.9
Year of education (%)			
Freshman	31.6	32.8	32.2
Sophomore	21.1	23.0	22.0
Junior	22.8	31.1	27.1
Senior	21.1	9.8	15.3
Other	3.5	3.3	3.4
Residence (%)			
On-campus	35.1	36.1	35.6
Off-campus	64.9	63.9	64.4
Employed (%)			
Part-time	31.6	45.9	39.0
Full-time	7.0	8.2	7.6
Not employed	61.4	45.9	53.4

Procedure

Eligible participants were recruited for the study through SONA. Participants meeting initial screening eligibility criteria were invited to participate in the in lab study. Participants were informed that the purpose of the study was to assess responses to visual stimuli associated with common behavior and to assess possible individual differences associated with responses. They were provided with a link to the study's SONA page. Participants clicked on the link to a full description of the study, including estimated time, points (credit) awarded, and eligibility requirements. Participants were informed that the study will take approximately 90 minutes to complete. Participants who were interested signed up for time slots to come into the lab. Participants were randomly assigned to either the experimental or control condition in groups of 5-10 people. Efforts will be made for each group to contain approximately equal numbers of

males and females depending on participant availability. Participants provided written informed consent after research assistants introduced them to the study. Participants in the experimental condition completed the study in a simulated bar setting. The bar setting contained alcohol-related stimuli that would be seen in a naturalistic bar setting (e.g., signs, bottles, bar stools). In the control condition, participants completed the study in a neutral laboratory space that contains no alcohol-related stimuli. Participants spent approximately 10 minutes (i.e., mingle, look around) in the lab prior to the study beginning.

Research assistants read a short introductory script to the study that includes the purpose of the study and emphasizes that there are no right or wrong answers. Research assistants then provided participants with an iPad. The iPad provided a Qualtrics link where the study measures were included. All measures were presented with their full instructions. Instructions for the cue-reactivity task were presented prior to two practice trials and presentation of the images. Following the two practice trials, participants rated their approach and avoidance to 30 images. For each trial a preparatory screen were presented for 4 seconds, followed by the substance image for 6 seconds. Participants then rated their approach and avoidance to the image. Following the ratings, participants received a 10 second break prior to the presentation of the next image. Participants then completed the free associates task and APT. To account for possible order effects, the primary constructs of interest (cue-reactivity, Free Associates Task and APT) were counterbalanced. Upon completion of these 3 tasks, participants were given a 5 minute break prior to completion of remaining measures. At the conclusion of the study, research assistants were available to participants' questions. Participants received class credit for their participation (3 points for the 90 minute session) awarded through SONA.

Measures

The same measures were used from Study 1 to assess the constructs of interest (i.e., approach and avoidance, alcohol expectancies and alcohol demand) as well as for all other variables of interest including demographics, personality, affect, alcohol-related consequences, and drinking behavior.

Data Analytic Strategy

Similar to study 1, outliers (median + or – 2 interquartile ranges) and normality of variables were examined prior to all analyses. Descriptive statistics were computed for variables of interest to characterize the sample.

Hypothesis 2a. We predicted that those in the bar lab setting would score significantly higher on positive expectancies, approach inclinations and demand indices when compared to those in a neutral laboratory setting. To examine this hypothesis, multivariate analyses of variance (MANOVAs) were used to examine mean differences in constructs of interest between the experimental condition and the laboratory condition. If a significant overall effect was evident, univariate effects were then examined to determine where differences occur while correcting for Type I error inflation for each univariate follow up (Bonferroni correction).

Hypothesis 2b. We predicted the bar setting will result in stronger convergence of these constructs due to the situational context that would inherently activate motivational pathways to drink, whereas the neutral laboratory setting would measure more trait specific levels of these constructs. Specifically, stronger correlations among the constructs of interest were expected for individuals in the bar lab condition when compared to those in the neutral laboratory setting. To examine this hypothesis, bivariate correlations among the constructs of interest were conducted within each condition separately (bar lab versus neutral settings). These correlations were

compared using Fisher's z transformation to determine if differences observed in correlational strengths were significant.

Exploratory Aim 3. To address Aim 3, this study determined if the differences in constructs of interest between neutral setting and simulated bar setting vary as a function of drinking-related experiences (i.e., alcohol-related consequences). To investigate this, two-way multivariate analysis of variance was used to test if there is an interaction between condition and drinking history on the constructs of interest.

STUDY 2 RESULTS

Descriptive Statistics

All variables were first examined for normality. Similar to Study 1, assessment of alcohol-related consequences was positively skewed and was square-root transformed to improve normality for purposes of the current analyses. Means and standard deviations for the constructs of interest as well as quantity, frequency and alcohol-related consequences are reported in Table 11 for each setting. Approach and avoidance inclinations are reported for both the cue-reactivity task and the AAAQ. Expectancies are reported for the Free Associate's task (pleasantness ratings, arousal ratings, and calculated salience) and as obtained from the AEQ-2. Table 13 presents Pearson's correlations between constructs of interest for both the bar lab setting and conference room setting. Overall, expected associations were observed between variables, though differences were evident between settings. More details on these associations will be discussed below. Information on demand (including means for demand indices by setting) is reported below.

Table 11. Descriptive statistics for constructs of interest by setting

	Condition			
	Bar lab		Conference Room	
	M	*SD*	*M*	*SD*
Cue Reactivity Approach	3.34	1.87	2.86	1.64
Cue Reactivity Avoidance	3.63	2.22	4.26	2.01
AAAQ Approach	3.12	1.89	2.65	1.42
AAAQ Avoidance	1.00	1.12	1.69	1.58
FA Pleasantness	5.27	1.30	4.48	1.34
FA Arousal	4.73	1.26	4.46	1.35
FA Salience	0.80	0.82	0.45	0.87
AEQ Positive Expectancies	18.61	4.82	17.97	6.10
AEQ Negative Expectancies	6.23	2.69	7.47	2.27
Quantity	4.72	1.85	4.58	1.13
Frequency	1.53	1.68	1.13	1.24
RAPI	1.73	1.45	2.24	1.35

Note. Frequency = number of drinking occasions per week; quantity = number of drinks per occasion; FA= Free Associates. AEQ = Alcohol Expectancy Questionnaire. RAPI = Rutgers adolescent problem index. RAPI scores reported are square root transformed.

Descriptive Statistics and Evaluation of Demand Curve

All demand indices were examined in the current sample for the purposes of comparing across samples. Intensity and O_{max}, Breakpoint and P_{max} were determined using observed values, while elasticity was calculated using the exponential demand equation from Hursh and Silberberg (2008). Literature on the Alcohol Purchase Task suggests examined the indices for outliers greater than 3.29 standard deviations from the means and recoding these scores as one value greater than the next highest nonoutlier value (Murphy & MacKillop, 2006; Tabachnick & Fidell, 2001). A total of 5 values were recoded in this manner. Further, demand indices were positively skewed and square root mean transformations were conducted to improve normality. To examine the performance of the APT separately by condition, data were examined with Hursh and Silberberg's exponential demand equation. Results suggested exceptional fit for both conditions (Bar lab R^2 = .99; Conference Room R^2 = .99). This demonstrates that the data in both samples fit the expected pattern of a decrease in alcohol as price increases. Demand indices were

examined separately by setting (see table 12 for descriptive statistics). However, no significant differences in the demand indices or subsequent demand curve were observed between settings.

Table 12. Descriptive statistics for demand indices by setting

	Condition			
	Bar lab		Conference Room	
	M	SD	M	SD
Intensity	2.59	0.56	2.49	0.63
O_{max}	3.90	1.16	3.92	1.18
Breakpoint	2.79	0.41	2.80	0.46
P_{max}	2.34	0.54	2.29	0.56
Elasticity	0.05	0.04	0.04	0.03

Note. Demand indices are square root transformed.

Table 13. Correlations among study variables by setting

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Cue Approach	-	.65***	.63***	.15	.20	.08	.45***	.16	.43**	.56***	-.12	.07	.13	.19
2. Cue Avoidance	-.72***	-	-.52***	.29*	.29*	-.13	-.37**	.04	-.32*	-.25*	.19	-.25	-.19	.08
3. AAAQ Approach	.75***	-.59***	-	.00	.31*	.04	.37**	.17	.43**	.48***	.16	.13	.22	.23
4. AAAQ Avoidance	-.02	.04	-.09	-	-.21	-.22	.09	.23	.15	.12	.18	-.20	-.23	.40**
5. Intensity	.52***	-.40**	.68**	-.13	-	.39**	.22	-.02	.24	.32*	-.13	.46***	.19	.20
6. Omax	.31*	-.22	.40**	.29*	.51***	-	-.01	-.08	-.02	.16	-.06	.10	.31*	-.07
7. FA Pleasantness Bar: n=56	.39**	-.36**	.40**	-.28*	.50***	.16	-	.61***	.94***	.49***	-.14	.26*	.22	.42**
8. FA Arousal Bar: n=56 Conference: n = 60	.37**	-.32**	.34*	-.23	.31**	.08	.64***	-	.57***	.32*	-.02	.11	.08	.55***
9. FA Salience Bar: n=56	.43**	-.36*	.48***	-.27*	.59***	.27*	.96***	.63***	-	.54***	-.12	.26*	.23	.41**
10. AEQ Positive Expectancies	.37**	-.26*	.49***	.07	.35**	.10	.33*	.33*[*]	.38**	-	.16	.19	.38**	.41**
11. AEQ Negative Expectancies	-.10	0.16	-.01	.17	-.18	-.23	-.17	-.03	-.21	.06	-	.08	.02	.15
12. Quantity	.47***	-.37**	.39**	-.10	.46***	.21	.39**	.46***	.44**	.36**	-.12	-	.10	.18
13. Frequency	.43**	-.32*	.61***	-.11	.38**	.31*	.31*	.27*	.33*	.34*[*]	-.05	.20	-	.24
14. RAPI	.46***	-.29*	.62***	.24	.48***	.19	.12	.12	.19	.53***	.21	.24	.48***	-

Note. Lower left diagonal reports correlations within bar lab setting; Upper right diagonal reports correlations within conference room. Frequency = number of drinking occasions per week; quantity = number of drinks per occasion; RAPI = Rutgers adolescent problem index. Intensity, O_{max} and RAPI scores reported are square root transformed. Bar lab setting: n = 57; Conference room: n =61 unless otherwise noted.
*p < 05, ** p < .01, *** p < .001.

MANOVA Results

The homogeneity of variance assumption was assessed prior to the following analyses using a series of Levene's *F* Tests. First, to examine our main hypotheses, a multivariate analysis of variance as used to assess for differences in the salience of positive expectancies, Intensity and O_{max}, and approach inclinations. Examination of the results of the MANOVA revealed that there was no significant effect of setting on these variables, Wilks' Lamba = 1.10, $F(5,111) = 1.33$, $p = .263$.

Given that no overall differences were seen in the approach-oriented variables, a second MANOVA was conducted to examine possible mean differences in avoidance inclinations and negative expectancies (as measured by the AEQ-2) by setting. A statistically significant MANOVA effect was obtained, Wilks' Lambda = .898, $F(3,114) = 4.33$, $p < .01$). Univariate effects for this model are reported in table 14 (Bonferroni correction .05/3 = .017). Follow up examination of between subjects effects demonstrated that setting had a statistically significant on both negative expectancies ($F(1,116) = 7.46$; $p < .01$) and avoidance inclinations as measured by the AAAQ ($F(1,116$ 7.18; $p < .01$). There was not a significant effect of setting on avoidance inclinations as measured with the cue reactivity task.

Table 14. Univariate effects for setting

Dependent variable	*df*	*df error*	F	Setting	Means	95% CI Lower Bound	95% CI Upper Bound
AEQ Negative Expectancies	1	116	7.46	Bar	6.23	5.58	6.88
				Conference	7.47	6.85	8.10
AAAQ Avoidance Inclinations	1	116	7.18	Bar	1.00	0.64	1.37
				Conference	1.69	1.34	2.04
Cue Avoidance	1	116	2.62	Bar	3.63	-1.40	.14
				Conference	4.26	-0.14	1.40

A series of two-way MANOVAs were conducted to assess for a possible interaction effect between setting and other theoretically relevant variables address exploratory aim 3. Specifically,

age, gender, quantity, frequency and alcohol related consequences were examined as a potential moderating variable on the effects of setting on constructs of interest. In contrast to hypotheses, no significant interaction effects were observed suggesting that these variables did not influence the effect of setting on expectancies, approach and avoidance, and demand indices.

Examination of Correlations

Several significant differences in correlations were observed between settings. Specifically the correlation between approach as measured by cue reactivity and Intensity was significantly different between groups such that the correlation was higher in the bar lab setting (r = .52, p < .001) than the conference room (r = .20, p = .12), z = 1.95, p < .05). The correlation between Intensity and ratings pleasantness on the Free Associates was also significantly different such that the correlation was higher in the bar lab setting (r = .498, p < .001) than the conference room (r = .218, p = .09), z = 1.72, p < .05. The correlation between Intensity and salience was also significantly different such that the correlation was higher in the bar lab setting (r = .589, p < .001) than the conference room (r = .243, p = .06), z = 2.26, p < .05. The correlation between Intensity and the approach scale as measured by the AAAQ was significantly different such that the correlation was higher in the bar lab setting (r = .684, p < .001) than in the conference room (r = .306, p < .05), z = 2.75, p < .001. The correlation between O_{max} and the approach scale as measured by the AAAQ was significantly different such that the correlation was significant in the bar lab setting (r = .393, p < .001) while it was not significant in the conference room (r = .043, p = .74), z = 2.00, p < .05. Further, the correlation between avoidance as measured by the AAAQ and pleasantness was significantly different such that it was higher in the bar lab setting (r = -.282, p < .05) than in the conference room (r = .09, p = .49), z = -2.01, p < .05. The correlation between avoidance as measured by the AAAQ and salience was significantly

different such that it was higher in the bar lab setting (r = -.265, p < .05) than in the conference room (r = .146, p = .26), z = -2.21, p < .05. The correlation between arousal and Intensity was significantly different such that the correlation was higher in the bar lab setting (r = .312, p < .05) than the conference room (r = -.017, p = .900), z = 1.79, p < .05. The correlation between arousal and avoidance as measured by cue reactivity was significantly different such that the correlation was higher in the bar lab setting (r = -.319, p < .01) than the conference room *(*r = .039, p = .766), z = -1.95, p < .05.

Examination of Free Associates Responses

Lastly, we decided to more carefully examine the valence ratings provided by participants in response to each of their five Free Associates to get an exact count of how many positive and how many negative expectancies were endorsed. This was an additional exploratory analysis to attempt to better account for negative expectancies provided in the Free Associates task.

Valence ratings were on a scale of 1 to 7 with 7 representing most pleasant. As such, ratings below 4 were suggestive of a negative expectancy rating, while ratings above 4 were positive expectancies. Responses associated with a rating of 4 were counted as neutral and not included in the present analyses.

First, a one-way analysis of variance (ANOVA) was used to compare the number of positive expectancies in the bar lab versus the conference room. Examination of between subjects effects demonstrated that setting had a statistically significant on the number of positive expectancies provided (F (1,116) = 9.94, p = .002) such that more positive expectancies were provided in the bar lab setting (M = 3.65, SD = 1.36) compared to the conference room (M = 2.84, SD = 1.44). See table 15 for a summary of these results.

Table 15. Univariate effects of setting on number of positive expectancies

	df	*df error*	F	Setting	Means	95% CI Lower Bound	95% CI Upper Bound
Positive expectancies count	1	116	9.94	Bar	3.65	3.29	4.01
				Conference	2.84	2.47	3.20

An additional ANOVA was used to compare the number of negative expectancies in the bar lab versus the conference room. Examination of between subjects effects demonstrated that setting had a statistically significant on the number of negative expectancies provided (F (1,116) = 14.04, p = <.001) such that negative expectancies were provided in the conference room (M = 1.77, SD = 1.38) compared to the bar lab setting (M = 0.91, SD = 1.07). See table 16 for a summary.

Table 16. Univariate effects of setting on number of negative expectancies

	Df	*df error*	F	Setting	Means	95% CI Lower Bound	95% CI Upper Bound
Negative expectancies count	1	116	14.04	Bar	0.91	0.63	1.20
				Conference	1.77	1.42	2.12

Comparison of the Salience of Positive Expectancies

As an additional exploratory aim, the salience of positive expectancies as assessed with the Free Associate's task was examined. The salience score reflects the saliency (i.e., how readily they come to mind) of alcohol expectancies to an individual in the moment and is based on the work of Smith (1993). It was chosen due to its potential sensitivity to context, that is, positive expectancies may become more salient to drinkers when surrounded by alcohol-related stimuli than when in an environment free of such stimuli.

A one-way analysis of variance (ANOVA) was used to compare saliency scores in the bar lab versus the conference room. Homogeneity of variance was first examined using Levene's

Test. Examination of between subjects effects demonstrated that setting had a statistically significant on saliency score (F (1,115) = 4.96, p = .028) such that salience for positive expectancies was higher in the bar lab setting (M = .80, SD = .11) compared to the conference room (M = .45, SD = .11). See table 17 for a summary of these results.

Table 17. Univariate effects of setting on salience

	Df	*df error*	F	Setting	Means	95% CI Lower Bound	95% CI Upper Bound
Salience Score	1	115	4.96	Bar	.80	.58	1.02
				Conference	.45	.24	.67

DISCUSSION

The current study was designed to simultaneously examine constructs pertaining to the Ambivalence Model of Craving, Alcohol Outcome Expectancy Theory, and Behavioral Economics to elucidate whether they tap into the same underlying anticipatory process. Study 1 used latent profile analysis to establish motivational profiles utilizing demand indices, approach and avoidance inclinations, and expectancies. Study 2 used an experimental approach to manipulate environmental cues (simulated bar setting versus a conference room setting) to examine the impact of setting on the activation of expectancies, approach and avoidance, and demand indices.

Based on the overlapping theoretical connections, we anticipated four motivational profiles to emerge that meaningfully differentiated individuals based on drinking histories. Results from the current studies indicated that four potential profiles among college students, three of which were consistent with our hypotheses: approach, avoidance, and indifferent. The approach class was characterized by elevations on constructs associated with appetitive reactions to alcohol, including approach inclinations, positive expectancies, and overall higher demand for alcohol. Not surprisingly, these individuals reported the highest frequency and quantity of drinking and the highest number of alcohol-related consequences. In contrast, the avoidant profile was characterized by motivational tendencies to avoid or anticipate negative consequences related to alcohol use, and was associated with the lowest frequency and quantity of use as well as experiencing low levels of consequences. Finally, the indifferent profile represented those who reported relatively neutral motivational tendencies towards alcohol, and

drinking histories more consistent with social drinking. Specifically, this profile was most strongly associated with a lack of drinking prior to establishing their current rate, which may suggest that these constructs have yet to strongly emerge in response to drinking experience as well as variations in drinking patterns beyond social drinking.

The fourth motivational profile, and contrary to our hypothesis, appeared to represent drinkers with an emerging approach tendency but relatively newer to drinking. Specifically, these individuals clearly had approach oriented tendencies, however, at a more moderate level than the established approach profile. Further, this profile was associated with more moderate drinking and consequences than the approach profile, though significantly higher than the avoidant and indifferent profile. After examining drinking histories, it was evident that the developing approach profile had less overall experience with drinking and getting drunk than those within the approach profile but more experience than the indifferent profile, suggesting they reflect a category of college students who are newer to drinking, and perhaps more importantly, new to the heavy drinking patterns typically observed on college campuses.

Interestingly, the indifferent profile and developing approach profile were similar in the amount of time drinking at their present rate suggesting the indifferent profile is associated with sustaining moderated levels of use and low levels of problems. In contrast, it may be that those in the developing approach class may represent individuals at risk for developing problematic drinking patterns. Theoretically, the differences between the indifferent, developing approach class and approach class may reflect a continuum of risk status that can shift over time, with "low risk," "moderate risk" and "high risk" drinkers differentiating based on levels of approach as described by Stritzke (2007). Indeed, examining all of these constructs from the standpoint of changes may prove highly useful for clarifying risk status. For example, expectancies have

demonstrated developmental shifts indicative of risk for hazardous drinking in adolescence (Christiansen et al., 1989; Smith & Goldman, 1994). Higher demand has also consistently been linked to more risky alcohol use and problems among both college students (Murphy & MacKillop, 2006; Skidmore, Murphy, & Martens, 2014) and adult populations (Gray & MacKillop, 2014; MacKillop, Miranda, et al., 2010).

In summary, the resulting profiles were in line with theory with respect to the Ambivalence Model of Craving, Alcohol Outcome Expectancy Theory and Behavioral Economics. While the hypothesized profiles were based on the four profiles previously established using the AMC (e.g., Schlauch et al., 2015), the resulting approach and avoidance levels within each profile demonstrated expected relationships with drinking behavior that corresponded to theory. Expectancy theory further suggests that positive expectancies readily distinguish between at-risk drinkers and non-problematic drinkers, a distinction that was clear when examining the levels of expectancies and corresponding drinking behavior within the developing approach and approach profile versus the indifferent and avoidant profiles. Further, the same distinction was clear when examining level of demand within the developing approach and approach profile versus the indifferent and avoidant profiles, which also is in line with the theory behind behavioral economics. In sum, the levels of these variables within each profile was consistent with their corresponding theoretical underpinnings.

Although the four emerging profiles were theoretically meaningful, the lack of ambivalent group remained somewhat surprising. An ambivalent profile is characterized by both approach and avoidant motivational tendencies towards alcohol and is hypothesized to develop as a result of both the positive and negative consequences of use. Though we might expect that college students within the sample had experienced both positive and negative consequences of

use, there may be a number of reasons why ambivalence was not ultimately observed. For one, previous research has demonstrated that in a college student sample, avoidance alone was not related to frequency or quantity of drinking (McEvoy, 2004). This suggests that avoidance is not yet having the expected effect on drinking patterns. Indeed, compared to approach inclinations, avoidance inclinations typically develop later due to inherent delays in effects of alcohol problems due to drinking, whereas the effects of drinking are immediately reinforcing (Breiner et al., 1999). In a college student sample, drinking patterns are likely still developing and solidifying as experience with alcohol increases. This is supported by the fact that prior to establishing their current level of drinking, 78% of the current sample drank less or not at all. While it is clear that problematic rates of alcohol use are high in college students, with estimates suggesting approximately 30% of college students meet criteria for DSM-V Alcohol Use Disorder (Hagman, Cohn, Schonfeld, Moore, & Barrett, 2014), the results of the current study points to the importance of the duration of established drinking patterns. In other words, chronicity of problematic use is needed for avoidance to fully develop, and it is clear that many college students “mature out” of these patterns (O'Malley & Patrick, 2004). Importantly, the number of alcohol problems experienced by the sample was relatively low, further suggesting avoidance has not yet had sufficient time to develop in response to an accumulation of problems. Future research may want to consider the development of avoidance inclinations as it differentiates college students who are able to mature out of problematic use and those who cannot.

In sum, results demonstrate that these constructs may develop in concordance with one another in response to drinking experiences as seen in the developing approach profile. However, more experience may be needed before stronger avoidant-oriented motivations emerge. Future

research is needed to examine these constructs longitudinally to clearly establish shifts in response to increased experience with drinking.

To further establish a single underlying process for the AMC, alcohol expectancy theory, and alcohol demand, Study 2 examined if the manipulation of environmental context (bar lab setting versus a conference room) could concurrently modify the constructs on interest. Contrary to our main hypotheses, we did not see the expected overall amplifying effect of the simulated bar setting on approach oriented constructs of alcohol demand or approach inclinations compared to the conference room. This finding was somewhat surprising as previous research has shown that a simulated bar setting increase indices of demand (Amlung & MacKillop, 2014; MacKillop, O'Hagen, et al., 2010). Further, we explored whether the effect of setting on these constructs varied as function of drinking variables (e.g., heavy drinkers versus light drinks, alcohol-related consequences), as previous research has demonstrated that alcohol demand (e.g., Murphy & MacKillop, 2006) and approach inclinations (e.g., Curtin et al., 2005; Schlauch et al., 2015) differentially predict various outcomes as a function of drinker status. However, no moderation was found which means that drinker status did not have the expected effect within a bar lab setting that previous research tentatively would have suggested.

With regard to construct related to competing motivations, avoidance inclinations and negative expectancies were significantly higher in the conference room than the simulated bar setting. As such, an environment free of alcohol stimuli serves to increase avoidance since it may prime cognitions related to other activities (e.g., being in class, etc.). Additionally, it is possible that from a methodological standpoint, a majority of research focuses only on approach oriented constructs which fails to capture the possibility of competing motivations. When explicating assessing for competing desires, it is possible that changes occur in the avoidance dimension

rather than approach dimension as demonstrated in the current study. Indeed, it has been argued that among problematic users, avoidance dimensions may be more predictive of use in clinical samples when compared to approach (Stritzke et al., 2007)

Additionally, we found a difference in the salience of positive expectancies provided in the Free Associates task by setting. In other words, there was a differences in the availability of positive expectancy words in the simulated bar setting than the conference room such that positive expectancies were more salient in the simulated bar setting to participants. As such, though we did not see an overall effect for approach-oriented variables, we found an increase in the saliency of positive expectancies as would be expected in the simulated bar setting. Though not examining saliency specifically, these results are consistent with research establishing the effect of alcohol-related cues on the activation of positive expectancies (Kramer & Goldman, 2003; Reich et al., 2005). We further examined the Free Associates with a count of the number of positive expectancies and negative expectancies provided out of the 5 responses in order to better understanding of the negative expectancies. In line with what would be expected, results demonstrated that those in the simulated bar provided more positive expectancies, while those in the conference room provided more negative expectancies. This tentatively suggests that the Free Associates task provides a probe of expectancies that is more dynamic and sensitive to priming when compared to self-report questionnaires. Indeed, this is essentially the rationale behind using free associates more broadly (Reich & Goldman, 2005). Given the above pattern as well as the established motivational profiles from Study 1, this study supports the need to consider both positive and negative expectancies. Negative expectancies as a whole have been neglected in the literature, however, in the current study they greatly added to the understanding of the effect setting on the anticipatory process that underlies drinking.

We also were able to compare the convergence of these constructs within setting by assessing for differences in correlations between the simulated bar setting and conference room. Several significant differences emerged that overall pointed to stronger correlations between approach, demand and positive expectancies in the simulated bar than in the conference room setting. Though examining of correlations can only tell us so much about the action of these constructs, the fact that there were different correlations observed as a function of setting suggests that the same motivational process is activated by alcohol-related stimuli that ultimately influences the movement of these constructs.

Taken together, the results of the current study furthers our understanding of the anticipatory process behind alcohol use by considering the overlap between theories of alcohol use. Meaningful patterns of motivation and drinking behavior were established, as well as insight into the activation of the anticipatory process that occurs when in the presence of environmental cues. Further, the main commonality behind the constructs of interest from a theoretical standpoint related to differentiating levels of reinforcement from drinking. Tentatively, the motivational profiles from Study 1 support that differentiating levels of reinforcement do indeed influence these constructs in a similar way as can be deduced by the different drinking experiences/histories observed in each profile.

Implications

Theoretically speaking, though clear overlap exists between the AMC, Alcohol Outcome Expectancy Theory, and Behavioral Economics principles, to our knowledge this is the first study to propose and formally support the idea that they all tap into the same underlying anticipatory process. Overall, results of these studies provide partial support that these constructs operate similarly and tap into the same underlying process. A few areas for future research are

apparent that may aid in elucidating this common process and better integrating these theories. Specifically, longitudinal research may aid in better understanding the simultaneous development of expectancies, demand and approach and avoidance. The importance of this is clearly seen in the developmental approach profile established in Study 1, which informs us that these constructs may develop in tandem with one another as experience with drinking increases. Second, ecological momentary assessment (EMA) could be utilized to determine which construct (expectancies, demand, and approach and avoidance) is most predictive of a drinking event. Additionally, connecting approach and avoidance, expectancies and demand to cognitive factors that have been tied to motivation and decision making such as working memory (Finn, 2002) may aid in understanding the underlying relationship between these variables and their influence on problematic decision making.

Additionally, the results of the current study have several clinical implications. First, conceptualizing drinking patterns into motivational profiles could prove to be highly useful in determining individuals at risk for problematic drinking, as these profiles may represent developmental shifts in decisional processes for drinking. Further, greater understanding of the factors associated with the approach and developing approach profile may provide insight into the transition from low risk drinking to high risk drinking. In turn, targets for prevention and intervention methods could be clarified. For example, approach and avoidance (McEvoy et al., 2004), alcohol demand (Murphy, Correia, Colby, & Vuchinich, 2005; Murphy & MacKillop, 2006) and alcohol expectancies (Goldman & Darkes, 2004; Reich & Goldman, 2005) have demonstrated utility in the prediction and assessment of alcohol use and alcohol problems in college student samples.. It is likely that current targeted interventions within anyone theory may serve to modify the constructs from all three. For example, though expectancy challenge

interventions (e.g., Darkes & Goldman, 1993) are focused on expectancies, it may also serve to decrease approach inclinations, alcohol demand and increase avoidance. This would allow for a better understanding of how our interventions influence changes in drinking behavior. Rather than relying on any one of these constructs to evaluate risk, findings suggest an integration of these concepts may help clarify a decisional processes involved in alcohol use, including the conditions placing individuals at greatest risk. Future research examining motivational profiles over time would be needed to support whether shifts in profiles occur as a function of risk status, as well as if these profiles could be utilized in non-college student populations.

Additionally, though we did not see an increase in approach-oriented motivation in Study 2 in response to exposure to alcohol stimuli, we did see an effect for the avoidance dimension. Specifically, both avoidance inclinations and negative expectancies were higher in an environment free of alcohol-related stimuli. This tentatively suggests that part of the problematic decision making associated with alcohol use may occur due to relative decreases in avoidance motivation following exposure to alcohol-related stimuli, rather than increases in approach-related variables. As such, targeting avoidance motivation may serve to more efficiently correct problematic decisional processes. However, future research is needed to address limitations of the current study to further elucidate the dynamic relationships between approach and avoidance oriented motivation and drinking.

Lastly, this study has important methodological implications. First, this study supports the need to assess competing motivations in order to better appreciate the decisional process that leads to drinking. Clearly, both approach oriented and avoidant oriented variables add value when considering drinking outcomes, with results of Study 2 suggest that they operate independently to an extent. Further, results demonstrate the attenuating effect that avoidance

inclinations can have on approach-oriented variables including alcohol demand, a finding that is consistent with previous research (Noyes & Schlauch, 2018). Research should continue to assess both dimensions to gain a better understanding of factors that influence the expression of motivations to drink.

Somewhat surprisingly was the inconsistent findings across various assessment techniques of the same constructs, and a general lack of findings for measures posited to tap current states (e.g., cue-reactivity). For example, no effect of setting on approach and avoidance as assessed with cue-reactivity was observed. Although cue reactivity is thought to measure state or current inclinations to use, it is possible that there is no additive effect of additional alcohol cues (i.e., bar lab) above and beyond those provided by the alcohol images in the task. Thus, greater attention to the assessment of tonic versus phasic motivational constructs (e.g., Sayette, 2016) is needed, including how environmental cues may impact not only current or state like measures but also "trait" like measures.

Limitations and Conclusions

The present study has several limitations to note. Study 1 was an online study, and the cue-reactivity paradigm has not been validated for delivery via an online platform. Generally, online survey methods are less controlled than an in-lab administration. For example, it could be that participant's taking the survey were in distracting settings where they were not focusing on the cues for the full 10 seconds. Additionally, participants may have taken the survey using different devices (e.g., smartphone, laptop, iPad, tablets) that may have influenced their viewing of the cues. However, generally in-person paper-and-pencil methods have been demonstrated to be equivalent to online data collection methods (Weigold, Weigold, & Russell, 2013), mitigating this concern some.

Additionally, the results of Study 1 should be interpreted while considering existing limitations involved with latent profile analysis. Specifically, there is no agreed upon formal way to test and account for the conditional independence assumption which states that the latent class explains all observed covariation between the indicators within each class. This assumption is assumed when modeling in Mplus. However, we followed the recommendations of Muthén (2009) to address this assumption and examined standardized residuals for the covariances, none of which were significant. Additionally, the modeling in Mplus restricts the variances to be equal across classes. As such, the variance covariance structure is rather restricted with the traditional model. Ultimately, as discussed by Masyn (2017), this could impact conclusions about the number of classes. To address this, we attempted to use a step-wise approach to relax these assumptions. However, we were not able to complete this approach due to limitations in power. Future research with larger sample sizes may aid in enumerating motivational profiles based on models that allow for loosening the assumptions of the traditional latent profile analysis.

Lastly, both studies utilized college student samples. As such, examining the convergence of these constructs and establishing motivational profiles in other drinking populations (i.e., non-student adult social drinkers, clinical populations) may differ from the results of the current study. Further, though Study 1 was designed to capture a wide range of a drinking behaviors, the overall rates of problematic drinking were lower than expected. As such, results may differ if a higher level of problematic drinking was obtained.

In spite of limitations, this study offers an important contribution the literature. It serves as a reminder of the importance of looking beyond constructs specific theories focus on and considering the actual process that is being represented. This study provides initial empirical

evidence to support the idea that the constructs put forth by the Ambivalence Model of Craving, Alcohol Outcome Expectancy Theory and Behavioral Economics tap into the same anticipatory process. Subsequently, future research would do well to consider what is already known and the large degree of overlap in concepts instead of narrowing in on theories that discuss the same phenomena in a different way. Importantly, we should be focusing on building off of and integrating the large knowledge base we have to better inform prevention and treatment of alcohol misuse rather than trying to advocate for any one theory. While it may be redundant for researchers to always consider similar constructs simultaneously in their studies, an appreciation for the underlying process that explains the development and expression of these constructs is warranted.

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APPENDIX A

The latent profile analysis for Study 1 was attempted using the approach of Masyn (2017). This approach suggests comparing models that take into account varying structures of the variance covariance matrix since this will ultimately influence model fit. Specifically, the traditional LPA holds the variances equal across classes and all covariance observed between variables is explained by latent class membership (conditional independence). Ultimately, this results in a restrictive model and necessitates more classes. However, Masyn (2017) suggests progressively loosening these restrictions. First, we ran this most restrictive model (conditional independence enforced and class invariant). Secondly, we allowed the variances to vary across classes. Third, we relaxed the conditional independence assumption and allowed for there to be within class correlation between constructs, while the variances were also hold constant across classes. Lastly, we ran the least restrictive model where both covariances are allowed to vary across classes as well as variances. Though theoretically useful to consider potential differences in variance and covariances between classes, we ran into model estimation issues as we increased the number of classes due to limited power. The results for the 1-class, 2-class, and 3-class (where the model ultimately failed to converge) are reported below in table 18. Due to practical limitations, we decided to report the traditional LPA model results (conditional independence enforced and class invariant).

Table 18. Model results with step-wise adjustments to variance covariance structure

	# of classes	Entropy	LL	# parameters	AIC	BIC	aBIC	LMR LRT	BLRT
Step 1	1	-	-2704.33	12	5432.660	5477.805	5439.743	-	-
Class invariant diagonal (conditional independence, variances constant)	2	.725	-2580.79	19	5199.587	5271.066	5211.802	.0069	<.001
	3	.798	-2529.596	26	5111.192	5209.006	5126.539	.1400	<.001
Step 2	1	-	-2704.33	12	5432.660	5477.805	5439.743	-	-
Class varying diagonal (variances allowed to vary)	2	.779	-2540.87	25	5131.732	5225.783	5146.488	.105	<.001
	3	.758	-2439.36	38	4954.721	5097.679	4977.151	.7992	<.001
Step 3	1	-	-2467.73	27	4989.46	5091.03	5005.39	-	-
Class invariant unrestricted (variance covariance structure held constant)	2	.852	-2432.183	34	4932.365	5060.275	4952.434	.3403	<.001
	3	.912	-2401.98	41	4885.961	5040.205	4910.162	.0557	<.001
Step 4	1	-	-2467.73	27	4989.46	5091.03	5005.39	-	-
Class varying unrestricted (covariances and variances free to vary)	2	.844	-2382.62	55	4875.242	5082.154	4907.706	.6878	<.001
	3	-	-	-	-	-	-	-	-

Note. The best Loglikelihood value was not replicated across 2 and 3 class models in step 2, step 3, and step 4 suggesting results may not be trustworthy. The 3-class model for step 3 was not identified. The 3-class model for step 4 did not converge.

Appendix B

USF
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RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-7091

January 25, 2017

Emily Noyes Psychology
4202 E Fowler Ave Tampa,
FL 33647

RE:	**Exempt Certification**
IRB#:	Pro00028354
Title:	Alcohol-Related Attitudes

Dear Ms. Noyes:

On 1/24/2017, the Institutional Review Board (IRB) determined that your research meets criteria for exemption from the federal regulations as outlined by 45CFR46.101(b):

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:
(i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

As the principal investigator for this study, it is your responsibility to ensure that this research is conducted as outlined in your application and consistent with the ethical principles outlined in the Belmont Report and with USF HRPP policies and procedures.

Please note, as per USF HRPP Policy, once the Exempt determination is made, the application is closed in ARC. Any proposed or anticipated changes to the study design that was previously declared exempt from IRB review must be submitted to the IRB as a new study prior to initiation of the change. However, administrative changes, including changes in research personnel, do not warrant an amendment or new application.

Given the determination of exemption, this application is being closed in ARC. This does not limit your ability to conduct your research project.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections.

If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

Kristen Salomon, Ph.D., Vice Chairperson USF
Institutional Review Board

USF
UNIVERSITY OF
SOUTH FLORIDA

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-7091

2/27/2017

Emily Noyes USF
Psychology
4202 E Fowler Ave Tampa,
FL 33620

RE: **Expedited Approval for Initial Review**
IRB#: Pro00029449
Title: Effects of visual stimuli on alcohol-related attitudes

Study Approval Period: 2/26/2017 to 2/26/2018

Dear Ms. Noyes:

On 2/26/2017, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved Item(s): Protocol
Document(s):
IRB Protocol Version 2.docx

Consent/Assent Document(s)*:
Consent Form Version 1.docx.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent documents are valid until the consent document is amended and approved.

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

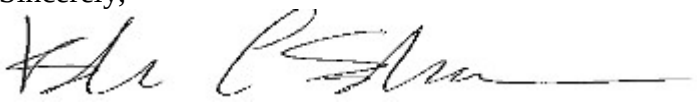
(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program

evaluation, human factors evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,



Kristen Salomon, Ph.D., Vice Chairperson USF
Institutional Review Board

Appendix C

UNIVERSITY OF SOUTH FLORIDA

Informed Consent to Participate in Research Involving Minimal Risk

IRB Study # Pro00029449

You are being asked to take part in a research study. Research studies include only people who choose to take part. This document is called an informed consent form. Please read this information carefully and take your time making your decision. Ask the researcher or study staff to discuss this consent form with you, please ask him/her to explain any words or information you do not clearly understand. The nature of the study, risks, inconveniences, discomforts, and other important information about the study are listed below.

We are asking you to take part in a research study called: **Effect of visual stimuli on alcohol-related attitudes**

The person who is in charge of this research study is Emily Noyes**.** This person is called the Principal Investigator. However, other research staff may be involved and can act on behalf of the person in charge. She is being guided in this research by her faculty advisor, Robert C. Schlauch, Ph.D.

The research will be conducted in the Department of Psychology at the University of South Florida.

Purpose of the study

The purpose of this study is to gain a better understanding of the effects of visual stimuli on alcohol-related attitudes and to assess for individual differences in response to visual stimuli. Greater understanding of these topics has the potential to further our understanding of factors associated with problematic alcohol use and decision making.

Why are you being asked to take part?

We are asking you to take part in this research study because you are an undergraduate student at the University of South Florida who is registered in the SONA-systems psychology participant pool. We have determined you are eligible to participate in this study based on your answers to questionnaires in the SONA prescreen questions.

Study Procedures:

Participation in this study will take approximately 90 minutes. If you take part in this study, you will be asked to:

(2) Power off your cell phone
(3) Answer questions regarding: basic demographic information, alcohol use, and personality
(4) Give urge ratings in response to alcoholic and non-alcoholic photographs.
(5) Answer questions about alcohol consumption in different scenarios.

Total Number of Participants

About 120 individuals will take part in this study at USF.

Alternatives / Voluntary Participation / Withdrawal

You do not have to participate in this research study.

You should only take part in this study if you want to volunteer. You should not feel that there is any pressure to take part in the study. You are free to participate in this research or withdraw at any time. There will be no penalty or loss of benefits you are entitled to receive if you stop taking part in this study.

Benefits

You will receive no benefit(s) by participating in this research study.

Risks or Discomfort

This research is considered to be minimal risk. That means that the risks associated with this study are the same as what you face every day. However, you may experience some discomfort due to answering questions about alcohol use as well as from viewing pictures of alcohol and other substances. You are encouraged to notify study staff if you are experiencing distress during participation. If your participation triggers emotional distress, an advanced graduate student will be available for a free one hour counseling session. Further, there is a risk of breach of confidentiality. However, numerous security measures are in place to keep the information you report confidential. Participants are
assigned an ID number in place of their name for their Qualtrics responses. Data collected for research purposes will be stored in password-protected files in the Department of Psychology at USF. For the purpose of scientific publication, only group means will be reported, and individual participants will never be identified. To ensure participant anonymity, a separate list with the participants' names and signed consent forms will be stored in a different location from the data and only the research staff will have access to this file. Additionally, although the sessions will include as many as 10 participants at a time, all questionnaire data will be completed individually on iPads to help protect the privacy of your responses.

Compensation

Participants will be compensated for their time and effort in completing activities during the in-person session with research participation credits assigned via SONA. It is estimated that completing the study will take 90 minutes and therefor participants will receive 3 SONA credit points.

Costs

It will not cost you anything to take part in the study.

Conflict of Interest Statement

The researchers do not have any conflicts of interest in this study.

Privacy and Confidentiality

We will keep your study records private and confidential. Certain people may need to see your study records. Anyone who looks at your records must keep them confidential. These individuals include:

(i) The research team, including the Principal Investigator, research assistants, and all other research staff.

(ii) Certain government and university people who need to know more about the study, and individuals who provide oversight to ensure that we are doing the study in the right way.

(iii) The USF Institutional Review Board (IRB) and related staff who have oversight responsibilities for this study, including staff in USF Research Integrity and Compliance.

We may publish what we learn from this study. If we do, we will not include your name. We will not publish anything that would let people know who you are.

You can get the answers to your questions, concerns, or complaints

If you have any questions, concerns or complaints about this study, or experience an unanticipated problem, call Emily Noyes at (813) 974-0839.

If you have questions about your rights as a participant in this study, or have complaints, concerns or issues you want to discuss with someone outside the research, call the USF IRB at (813) 974-5638.

Consent to Take Part in this Research Study

I freely give my consent to take part in this study. I understand that by signing this form I am agreeing to take part in research. I have received a copy of this form to take with me.

_____ _____

Signature of Person Taking Part in Study Date

_____

Printed Name of Person Taking Part in Study

Statement of Person Obtaining Informed Consent

I have carefully explained to the person taking part in the study what he or she can expect from their participation. I confirm that this research subject speaks the language that was used to explain this research and is receiving an informed consent form in their primary language. This research subject has provided legally effective informed consent.

_____ _____

Signature of Person Obtaining Informed Consent Date

_____

Printed Name of Person Obtaining Informed Consent