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Can Performance-Based Measures Predict Binge Drinking?

An Empirical Investigation
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Chapter 1

Review of the Literature

Alcohol Use and Binge Drinking Among College Students

Drinking alcohol is a common activity among college students, with between 80-85% reporting that they consumed alcohol in the past year (Wechsler, Lee, Kuo, & Lee, 2000). Although alcohol use is normative, excessive alcohol use on college campuses is an area of concern because it has been shown to disrupt the lives and educational development of students (Biscaro, Broer, & Taylor, 2004). Potential problems include physical harm to a person’s self and others, legal problems, unprotected sexual intercourse, sexual coercion and rape, diminished academic performance, and damage to campus property (Perkins, 2002a). During the 1990s, drinking among college students received increased attention due to alcohol-related tragedies, including cases of acute alcohol poisoning, automobile accidents, falls, drownings, fires, and cases of hypothermia from exposure; together such events contributed to colleges increasing their efforts to reduce excessive alcohol use and attendant problems (Wechsler et al., 2000).

A particularly hazardous pattern of drinking, known as binge drinking, is often seen on college campuses (Hingson, Heeren, Winter, & Wechsler, 2005). Binge drinking reflects excessive alcohol use and has traditionally been defined as 5 or more drinks in a row for men and 4 or more drinks in a row for women (Wechsler et al., 2000). In February of 2004, the National Institute on Alcohol Abuse and Alcoholism (NIAAA) Nation Advisory Council approved a new
measure of binge drinking (NIAAA, 2004). The new measure retains the number of drinks consumed but adds a 2-hr timeframe requirement for consumption. Recent studies have supported the superiority of the new definition. For example, using a sample of 4,580 undergraduates, Cranford, McCabe, and Boyd (2006) found that the number identified as binge drinkers using the new measure was highly correlated with the number of undergraduates identified as binge drinkers using the previous measure; however, the new measure more accurately identified potentially hazardous drinking patterns and showed a higher association with blackouts, being injured while dinking, and missing class or work as the result of drinking compared with the old measure. In addition to using the reformulated NIAAA criteria, Cranford et al. extended the capture period for a binge drinking episode from the past two weeks to the past year. Binge drinking was found to be significantly related to negative consequences even after controlling for gender, race/ethnicity, and age when drinking began. Additionally, those identified as binge drinkers using the 1-yr measure exhibited increased risk for alcohol abuse and were more likely to have seriously contemplated suicide during that period.

Binge drinking is more common among students than non-students, and a higher proportion of college students binge drink than non-students who are the same age (Hingson et al., 2005). Of concern is that the amount of heavy drinking (Wechsler et al., 2000) and rate of high risk behavior associated with drinking (Hingson et al., 2005) appear to be increasing over time. Alcohol-related unintentional deaths among college students increased from 1,575 in 1998 to 1,717 in 2001. This increase cannot be explained by increased college attendance, as the number of alcohol-related college deaths increased from 18.2 to 19.3 unintentional deaths per 100,000 students. Over the same period, reported incidents of driving under the influence of alcohol increased from 2.3 million to 2.8 million in the college population (Hingson et al., 2005).
Although there has been an increase in the amount of heavy drinking among college students, there has also been an increase in the number of students who abstain from drinking. Additionally, the number of students who drink but do not binge drink also declined (Wechsler et al., 2000). This finding suggests that the college population may effectively be separating into two categories: students who are likely to drink heavily and participate in high risk behaviors and those who opt to not drink at all.

Although many college students "mature out" of excessive alcohol use as they progress through college and, ultimately, begin families and careers following graduation (O’Malley, 2005), excessive alcohol continues for some (Jackson, Sher, Gotham, & Wood, 2001; Jennison, 2004; O’Neill, Parra, & Sher, 2001). Jennison (2004) used data from a 10-year longitudinal study to calculate the odds of drinking heavily after graduation based on college drinking patterns. Using a longitudinal design, 1,885 participants completed surveys while in college and again 10 years later. Results indicated that college drinking patterns were related to later alcohol use. For example, women were almost eight times more likely to be drinking heavily 10 years later if they frequently binge drank while in college, whereas men were almost six times more likely to drink heavily if they frequently binge drank in college.

In another longitudinal data set (n = 489), drinking trends were examined beginning in the first year of college (Jackson et al., 2001; O’Neill et al., 2001). Participants were assessed during years 1, 2, 3, 4, 7, and 11. One series of analyses focused on subjective effects rather than quantity consumed and used the outcome variable of feeling high or drunk (Jackson et al., 2001). Complete data was available for 443 participants, who were representative of the full sample. At Year 1, 275 (62%) students reported drinking to the point of feeling drunk. This figure dropped to 243 (55%) at Year 4 and 193 (44%) at Year 7. Jackson et al. argued that this supported the
matur ing out effect for many college students in the sample, but that the stability of drinking patterns for the remainder of the sample cannot be overlooked. The authors noted that intervention programs prior to the first year of college may reduce the number of students who develop patterns of excessive drinking in college. Using logistic regression within the same sample, O’Neill et al. (2001) found that heavy drinking during the first year of college, the amount of drinking during the heaviest drinking year in college, and average consumption of alcohol during college years were all significant predictors of heavy drinking at Year 11. These studies suggest that, for some, the drinking patterns developed early during college will be maintained throughout life.

The combination of immediate and long-term risks resulting from binge drinking makes it important to develop a more thorough understanding of why students binge drink. Growing concern about excessive alcohol use on college campuses has led researchers to try to identify factors that lead some students to drink alcohol in excess whereas other students do not (Biscaro et al., 2004; Dreer, Ronan, Ronan, Dush, & Elliot, 2004). Both environmental and individual difference effects have been explored. Peer behavior, impulsivity, and affect regulation are factors that have shown consistent relations to excessive alcohol use. Researchers have also begun to examine how distress tolerance is related to alcohol use.

**Peer Norms and Other Non-Psychological Factors**

The amount peers actually drink and perceived drinking norms on campus have consistently emerged as strong predictors of alcohol consumption among college students (Perkins, 2002b). One recent study of 818 college students specifically sought to identify the strongest predictors of alcohol consumption and alcohol-related problems from a family of known predictors (Neighbors, Lee, Lewis, Fossos, & Larimer, 2007). Potential predictors
included gender, fraternity or sorority membership, perceived descriptive norms, perceived injunctive norms of peers and parents, coping motives, social motives, enhancement motives, conformity motives, positive expectancies, evaluation of positive effects, negative expectancies, and evaluation of negative effects. Gender, fraternity or sorority membership, perceived descriptive norms, injunctive norms of peers, injunctive norms of parents, enhancement motives, and conformity motives were all significant predictors of alcohol consumption. However, perceived descriptive norms were found to be the strongest predictor of alcohol consumption and exhibited the largest effect size ($d = .84$), followed by fraternity or sorority membership ($d = .47$), gender ($d = .41$), and the perceived injunctive norms of peers ($d = .39$). That perceived injunctive norms emerged as a significant predictor of alcohol consumption demonstrates that both beliefs about the amount and beliefs about the acceptability of peer drinking contribute to an individual's use patterns. Perkins, Haines, and Rice (2005) conducted a similar study, but focused on the impact of perceived norms and actual norms for drinking among college students. The authors used the National College Health Assessment (NCHA), which is a database of national survey data collected since 2000. At the time of the study, the database contained data from 76,145 respondents. The results indicated that perceived drinking norms were the strongest predictor of the amount of alcohol consumed, followed by gender and then actual drinking norms. Although the results of these two studies differed with regard to whether actual norms or perceived norms represented a stronger predictor, the results of both studies demonstrated the importance of actual and perceived peer behavior on the choices made by students.

A student's closest peer may have the most influence on how much that student drinks and the nature of their drinking due to the amount of time spent together. Duncan, Boisjoly, Kremer, Levy, and Eccles (2005) assessed how prior high school drinking behavior for
respondents and their roommates was related to binge drinking in college. Students ($n = 990$) answered questions about binge drinking frequency in high school and during the past two weeks. Among men in the study, but not women, a history of binge drinking in high school reported by both the respondent and his roommate was associated with a nearly 4-fold increase in binge drinking during college, when compared to cases in which the respondent reported binge drinking in high school but his roommate did not. However, among respondents who did not binge drink in high school, roommates' prior binge drinking behavior patterns did not significantly impact their frequency of binge drinking. These results suggest that, at least for men in college, when roommates share a comparable history of binge drinking, and perhaps attitudes toward binge drinking, the likelihood of engaging in binge drinking increases substantially. Research clearly supports a strong connection between peer behavior and drinking norms, both actual and perceived, and the amount students drink.

In addition to peer norms, other non-psychological factors that have consistently demonstrated relations with alcohol consumption are GPA (Singleton, 2007) and sex (Neighbors et al., 2007; Perkins et al., 2005). Higher GPA is correlated with less drinking and males drink more than females. Although peer use, sex, and GPA have been consistently related to the amount of alcohol consumed, the direct impact of these factors are not of primary interest in the current study as the focus will be on psychological individual difference or person factors. However, given their documented predictive value, these constructs will be used as control or background variables, which will allow for tests of the robustness and incremental validity of any obtained results.
Impulsivity

Well-established links have been made between impulsivity and alcohol use both in studies using human participants and in animal studies (Dick et al., 2010). Impulsivity has been shown to be associated with alcohol-related problems among college students (Simons, Gaher, Oliver, Bush, & Palmer, 2005). Simons, Gaher, Oliver, et al. (2005) obtained self-report measures of impulsivity, alcohol consumption, and alcohol-related problems from 56 college undergraduate students and found that higher levels of impulsivity were associated with more alcohol-related problems. In addition, higher reported impulsivity strengthened the relationship between the amount of alcohol consumed and alcohol-related problems. Greater impulsivity has also been associated with increased likelihood of meeting the DSM-IV criteria for alcohol abuse, but not alcohol dependence (Simons, Carey, & Wills, 2009).

While impulsivity has been repeatedly linked to alcohol use, it represents a loose construct (Dick et al., 2010). The construct is most often associated with some form of behavioral disinhibition, but it is not clear what underlying factors are contributing to the under-controlled behavior. There appear to be several underlying personality traits contributing to what is often described as impulsivity and these traits have differential relations with alcohol use. For example, Carlson, Johnson, and Jacobs (2009) obtained self-report measures assessing personality characteristics and binge drinking behavior from 302 college students to assess the relationship between impulsivity and binge drinking. They found that acting quickly and without forethought, thrill seeking, and easily becoming bored were all predictors of binge drinking, while factors such as maintaining attention and focusing on the moment without planning for the future did not account for additional variance. This research suggested that, while there is a
well-established connection between behavioral disinhibition and alcohol use, particular types of impulsive behavior may be more predictive of alcohol abuse than others.

Affect Regulation

A construct often associated with impulsivity is affect regulation or the ability to deal with negative affect. Simon, Gaher, Oliver, et al. (2005) considered the influence of negative affect experienced during the day on alcohol consumption and alcohol-related problems. Additionally, they examined the influence of impulsivity on these relationships. Negative affect was found to be associated with significantly higher alcohol-related problems, but not more alcohol consumption. The relationship between negative affect experienced during the day and alcohol-related problems increased as impulsivity increased. These suggest that feeling bad during the course of a day does not lead to drinking more alcohol, but does increase the likelihood that negative outcomes will result from drinking. The increased risk for drinking-related negative outcomes was greatest among highly impulsive individuals.

As alcohol-related problems are more likely to occur when individuals who are experiencing negative affect choose to consume alcohol, it is important to determine who is prone to drink as the result of feeling bad. Research has shown that individuals who are prone to avoid coping with their emotions and believe that using alcohol will lead to a positive outcome are more likely to drink to cope with difficult situations, to consume more alcohol, and to have more alcohol-related problems (Cooper, Russell, Skinner, Frone, & Mudar, 1992). In effect, individuals who believe that alcohol will help them cope, drink more often and have greater problems as a result. In a recent extension of this research, Simons Gaher, Correia, Hansen, and Christopher (2005) developed a model which theorizes that poor affect regulation contributes to increased likelihood of drinking to cope with negative affective experiences, and drinking to
cope is associated with more drinking-related problems. The reliance on alcohol to cope appears to stem from a belief that it is an effective coping strategy, despite the fact that it leads to more problems. Consistent with this type of process, Carpenter and Hasin (1997) found that individuals who fit the DSM-IV criteria for alcohol dependence were more likely to turn to alcohol to deal with negative affect than those who did not meet the criteria.

**Distress Tolerance**

A factor that appears to be closely linked to both impulsivity and affect regulation - and has been linked to alcohol consumption - is distress tolerance. Buckner, Keough, and Schmidt (2007) found that increased distress tolerance was associated with consuming less alcohol and fewer alcohol-related problems among undergraduate students. In this study, 265 undergraduate students completed a series of questionnaires, including measures of distress tolerance and discomfort intolerance. These two constructs – distress tolerance and discomfort intolerance – although related are not identical. Distress tolerance represents the ability to deal with psychological discomfort, whereas discomfort intolerance measures dealing with physical discomfort. Buckner et al.’s results indicated that whereas greater ability to deal with psychological discomfort was associated with less alcohol consumption and fewer alcohol-related problems, the ability to deal with physical discomfort was not. This suggests that although there is a relationship between people’s ability to deal with psychological and physical discomfort, the emotional and coping demands placed on people by psychological discomfort are different than the emotional and coping demands generated by physical discomfort.

The influence of psychological discomfort on the consumption of alcohol appears to be different between men and women. Simons and Gaher (2005) administered a self-report measure of distress tolerance to 823 college students to examine the relationship between distress
tolerance and alcohol-related problems. The results indicated a significant negative correlation between distress tolerance and alcohol-related problems for men, but not for women. These suggest that men who are less adept at dealing with psychological discomfort are more likely to experience problems when they drink, while the same does not appear to be true for women.

Task Persistence

Task persistence may represent a behavioral construct that links affect regulation, impulsivity, and distress tolerance to alcohol use. Affect regulation, impulsivity, and distress tolerance have all been independently associated with problematic alcohol use; further, each have shown associations with how long individuals will persist on a task when faced with challenge. As such, task persistence may be a unifying or superordinate construct. One line of research on task persistence has proposed that it is a behavioral manifestation of distress tolerance (Steinberg, Williams, Gandhi, Foulds, & Brandon, 2010) and is captured using tasks that either challenge individuals cognitively (e.g., Anagram Persistence Task; APT) or motorically (e.g., Mirror Tracing Persistence Task; MTPT). Task persistence may also be a behavioral manifestation of affect regulation and impulsivity. To date, the predictive utility of task persistence has been studied with a variety of substances. For example, researchers have found a relationship between chronic alcohol abuse and decreased task persistence (Alterman, Tarter, Petrarulo, & Baughman, 1984; Cynn 1992). Decreased task persistence has also been linked to nicotine use (Quinn, Brandon, & Copeland, 1996) and substance abuse treatment dropout (Daughters, Lejuez, Bornavalava, Kahler, Strong, & Brown, 2005).

To date, studies examining the relation between task persistence and excessive alcohol use have focused on individuals with a formal diagnosis of alcohol dependence and those seeking treatment for substance abuse. For example, Cynn (1992) compared 31 males from an
inpatient alcohol rehabilitation center with 31 controls who reported no or minimal alcohol use. The participants in the two groups were matched for age, vocabulary skills, education, and SES. Task persistence was measured using both an anagram task and a diagram tracing task. For each task, a solvable problem was followed by an unsolvable problem and persistence was measured by time spent on the unsolvable problems. The men in treatment for alcohol dependence persisted for a significantly shorter time on both the anagram and diagram tasks. In this study, it was found that younger men ($M = 32.3$) with a formal diagnoses of alcohol dependence did not persist on a task for as much time as did men of the same age who were not diagnosed as alcohol dependent.

Similar results were found in an older study conducted by Alterman et al. (1984), in which 30 year-old men receiving inpatient treatment for alcohol dependence ($n = 20$) were compared to controls ($n = 20$). A composite persistence score was calculated based on three performance-based tasks, including the MTPT. A significant difference was found between the groups, with men in treatment for alcohol dependence persisting significantly less than controls. In another study, Quinn et al. (1996) found a significant negative relation between persistence on the MTPT and problematic alcohol use, while the same result were not found when the APT was used to measure task persistence. Taken as a whole, past research suggests that excessive and problematic alcohol use is related to lower task persistence, although some inconsistency in results have been demonstrated across measures of task persistence.

Task persistence has also been linked of nicotine use. Smoking cessation studies have used task persistence to predict smoking patterns, entering treatment, likelihood of remaining in treatment, and likelihood of sustaining abstinence (Brandon et al., 2003; Quinn et al., 1996; Steinberg et al., 2007). Steinberg et al. (2007) used archival data to examine the relationship
between task persistence and smoking among adolescents. A data set of 1,936 participants from 8th grade to 12th grade was divided into three groups - daily smokers (11.7%), occasional smokers (9.6%), and non-smokers (78.7%). Task persistence was measured by self-report and was based on two true/false questions which asked how likely a person was to keep trying when faced with adversity. Daily smokers reported significantly less persistence than did non-smokers and occasional smokers. There were no significant differences between occasional smokers and non-smokers. It appeared that adolescents who smoked regularly were aware of less ability to persist when they experience difficulty. A persistence deficit could cause difficulties for someone trying to quit smoking, as cessation poses a significant challenge and requires persistence.

Brandon et al. (2003) used two performance-based measures of task persistence, the MTPT and the APT, to examine whether pretreatment task persistence predicted entering treatment for smoking and sustaining abstinence. The study included participants (n = 144) who were at least 18 years old, smoked at least 20 cigarettes per day, and who had smoked for a minimum of one year. Participants were recruited from the community at large. Performance on the MTPT was a significant predictor of treatment entry and sustained abstinence, while the APT was not predictive of either. Participants who persisted longer on the MTPT were more likely to enter treatment and maintain their treatment gains. The authors speculated that the difference in predictive ability between the two measures of task persistence may be the result of the MTPT being a motor task and the APT being a cognitive task, with the latter being more threatening to the population used in the study. It was noted that the sample was not highly educated and that college students had appeared less threatened by the APT in previous studies (see Eisenberger,
Kuhlman, & Cotterell, 1992). The authors further speculated the ability required to persist on the MTPT may be more similar to the ability required to quit smoking.

The relationship between task persistence and smoking was also examined by Quinn et al. (1996). Unlike in the Brandon et al. (2003) study, Quinn et al. utilized a non-smoking comparison group. In their sample, 52 of 109 participants were smokers and had smoked at least 20 cigarettes per day for at least one year. The remaining participants were non-smokers, who had never smoked daily. Results indicated that non-smokers persisted significantly longer on the MTPT and the APT than did smokers. The results of this study suggested that individuals who use nicotine possess less ability to persist on difficult or unpleasant tasks than individuals who do not use nicotine. Significant differences in performance were found for both the MTPT and the APT, with individuals who smoke persisting significantly less than individuals who do not smoke.

Given the similarities in task persistence seen among active smokers and those with alcohol abuse, researchers have examined whether the predictive value of task persistence applies to treatment of other categories of drugs as well. Daughters et al. (2005) examined differences in task persistence between individuals who completed \( n = 102 \) a substance abuse treatment program and those who did not complete the program due to early dropout \( n = 20 \). This study used two measures of task persistence that induced physical stress and two measures of task persistence that induced psychological stress. Significant differences in task persistence were found between completers and non-completers on psychologically stressful tasks, but not on physically stressful tasks. These results suggested that the ability to persist through substance abuse treatment is more dependent on the ability to endure psychological stressors than physical stressors. Similar to the research on smoking cessation, it appeared that lower task persistence
adversely affected treatment success. These findings are consistent with other research that has shown higher levels of drug abuse are associated with significantly lower task persistence on the MTPT and the APT (Quinn et al., 1996).

Summing across past studies, it appears that motor-based task persistence (e.g., the MTPT) may be more predictive than cognitive-based tasks of persistence (e.g., the APT). However, before abandoning cognitive-based tasks, it is worth noting that the null findings have been obtained with less educated, community samples. As conjectured by Brandon et al. (2003), the two types of tasks place very different demands on participants and a college population may be more comfortable with a cognitive challenge. Using both types of persistence tasks in a college sample will allow for direct comparisons and provide information about the mechanisms underlying the relation between task persistence and alcohol use. For example, is the important element willingness to move forward in the face of tedium (MTPT) or is it persistence in face of personal challenge (APT)? An additional difference in the predictive utility of task persistence that has emerged is whether the task exerts psychological or physical distress. Ability to tolerate psychological stress, but not physical stress, has been associated with substance use patterns in inveterate users (Buckner et al., 2007; Daughters et al., 2005). However, such measures have not been assessed in a college age population and may function differently with younger users who have not developed entrenched patterns. As such, a physical distress task – the cold pressor – will be included in the current study to directly test these findings. If similar, null, findings are obtained in a college population, future research can focus on the capacity to tolerate psychological distress exclusively and remove consideration of physical distress tolerance with increased confidence.
The current study seeks to examine the relationship between task persistence and alcohol use patterns in a sample of college students. It is hypothesized that task persistence will show a negative relationship to alcohol use patterns, with lower persistence being associated with increased problem use. To this end, three performance-based measures, capturing psychological and physical discomfort, will be used to assess task persistence: a cold pressor task, which measures the ability to endure physical discomfort; a mirror-tracing task, which uses a motor response to measure the ability to endure psychological discomfort; and an anagram task, which uses a cognitive response to measure the ability to endure psychological discomfort. These measures have not been used in studies of alcohol abuse among college students. In addition to utilizing three performance-based, or behavioral measures, of task persistence, empirically validated self-report measures will be used to assess impulsivity, affect regulation, and distress tolerance. These will allow for the investigation of potential relations between the behavioral measures and the three psychological constructs, and provide information about possible underlying mechanisms for any observed relations between task persistence and alcohol use patterns.

If, as hypothesized, task persistence is found to be an indicator of proneness to abuse alcohol, it offers multiple advantages over self-report assessment of related constructs. Task persistence provides an opportunity to step out of the limits of self-report via the use of a performance-based measure. Performance-based, or behavioral, measures directly assess individuals’ capacity to enact a behavior and extend beyond the limits of their self-perception, which is a limit of self-report. With self-report, some individuals may overestimate their ability, whereas others may underestimate their ability. Behavioral task persistence allows for direct observation of what a person actually does. Another advantage of task persistence is that it will
likely provide a less threatening measure of proneness to alcohol abuse because it appears to be unrelated. These may enhance the validity of obtained results as it will eliminate the press some individuals may experience to provide the “right” or expected response.
Chapter II

Rationale and Hypotheses

In recent years, there has been growing concern about the high-risk behaviors associated with excessive alcohol consumption among college students (Weschler et al., 2000). Although drinking alcohol is common, excessive use can adversely affect students' health, safety, and academic careers. The amount of high-risk behavior associated with drinking has been increasing (Hingson et al., 2005), despite the fact that more students are not consuming alcohol (Weschler et al., 2000). This trend argues for the development of preventative interventions that target students at the highest risk of drinking alcohol in an unsafe manner—repeat binge drinkers. An important step in this process is identifying factors associated with alcohol misuse, allowing for interventions to reach those most in need.

Behavioral measures of task persistence represent performance-based measures that capture how long individuals are willing to endure discomfort when attempting to complete a task. All behavioral task persistence measures are designed to evoke either physical or psychological discomfort. Previous research has found a significant relation between chronic alcohol abuse and low task persistence (Alterman et al., 1984; Cynn 1992). However, both Alterman et al. (1984) and Cynn (1992) drew their samples from inpatient alcohol treatment facilities and the average age of participants was above 30 years. To our knowledge, no studies have attempted to assess whether decreased task persistence is also associated with alcohol abuse.
among younger individuals or those who do not meet formal diagnostic criteria for alcohol dependence. Prior research has shown associations between both perceived ability to persist and actual behavioral task persistence and nicotine use. For example, Steinberg et al. (2007) found 8th to 12th graders who regularly used nicotine self-reported less ability to persist when challenged than did non-smokers and occasional smokers. Brandon et al. (2003) found that behavioral measures of task persistence predicted continued smoking and willingness to embark on a quit attempt.

Research to date suggests that not all behavioral task persistence measures are equally related to substance use patterns. In particular, measures that require physical persistence have shown weaker relations when compared to those that require psychological persistence. Additionally, the nature of the psychological challenge (motor vs. cognitive) has also been associated with differential predictive utility. However, to date, no study has examined the full complement of behavioral task measures in a college age sample. As such, the aim of the current study is to assess the ability of three distinct behavioral task persistence measures to predict alcohol use patterns in a of sample college students. A secondary aim is to investigate if any observed relations can be accounted for by self-report measures of distress tolerance, affect regulation and impulsivity, all known predictors of alcohol use patterns (Buckner et al., 2007; Simons, Gaher, Oliver, et al., 2005). Lastly, post-hoc analysis will be conducted to assess the robustness of all statistically significant results. As such, the formal hypotheses can be grouped into sets of primary and secondary hypotheses.
Primary Hypotheses

The three primary hypotheses will test the ability of each behavioral measure to predict frequency of binge-drinking episodes and the amount of alcohol typically consumed during a 2-week period.

Hypothesis I: It is predicted that there will be no relationship between the outcome of a cold pressor task and number of binge drinking episodes in the last two weeks.

Hypothesis II: It is predicted that there will be no relationship between the outcome of a cold pressor task and amount of alcohol typically consumed during a 2-week period.

Hypothesis III: It is predicted that a significant negative relationship will emerge between time spent working an anagram task and number of binge drinking episodes in the last two weeks.

Hypothesis IV: It is predicted that a significant negative relationship will emerge between time spent working an anagram task and amount of alcohol typically consumed during a 2-week period.

Hypothesis V: It is predicted that a significant negative relationship will emerge between time spent working on a mirror-tracing task and number of binge drinking episodes in the last two weeks.

Hypothesis VI: It is predicted that a significant negative relationship will emerge between time spent working on a mirror-tracing task and amount of alcohol consumed during a 2-week period.

Secondary Hypotheses

The next set of hypotheses will examine the underlying structure of any relationships identified in the primary hypotheses.
Hypothesis VII: It is predicted that the negative relationship between time spent working on an anagram task and number of binge drinking episodes in the last two weeks will no longer be significant after impulsivity, affect regulation, and distress tolerance are included in the analysis.

Hypothesis VIII: It is predicted that the negative relationship between time spent working on an anagram task and amount of alcohol typically consumed during a 2-week period will no longer be significant after impulsivity, affect regulation, and distress tolerance are included in the analysis.

Hypothesis IX: It is predicted that the negative relationship between time spent working on a mirror-tracing task and number of binge drinking episodes in the last two weeks will no longer be significant after impulsivity, affect regulation, and distress tolerance are included in the analysis.

Hypothesis X: It is predicted that the negative relationship between time spent working on a mirror-tracing task and amount of alcohol typically consumed during a 2-week period will no longer be significant after impulsivity, affect regulation, and distress tolerance are included in the analysis.
Chapter III

Method

Participants

The participants in the current study will be 100 undergraduate students from a private Midwestern university. Cohen's recommendations for calculating sample sizes required for adequate power were used as a starting point to calculate the sample size (Cohen, 1992). Analysis of the primary hypotheses will use regression analysis with a single predictor and a single criterion, which is essentially a correlation. Therefore, correlational analysis with one independent variable and the assumption of a medium effect size was used to determine the sample size; the number of participants recommended was 85. The current study will use 100. This number was selected to ensure adequate detection of the primary effect and to better detect significant differences in the secondary hypotheses and the post hoc analysis, which includes nine different predictor variables. Participants will be recruited through the psychology department participant pool and receive research credit in psychology classes as compensation. Inclusion criteria will be age 18 or above; there are no exclusion criteria.

Measures

Mirror Tracing Persistence Task (MTPT). The MTPT requires participants to trace eight geometric shapes while viewing their hand movements in a mirror. The current study will use the same procedure utilized in studies conducted by Brandon et al. (2003) and Quinn et al.
(1996). In this procedure, the first and last designs are easy to trace geometric designs, whereas the middle six designs are extremely difficult. The middle six designs are intended to be very difficult to solve in order to induce stress and frustration; the MTPT measures the ability to persist on a motor task under distress. Each trial is timed and participants are allowed a maximum of 5 minutes to complete each design. Participants are not expected to complete every design. If participants do not complete a design within 5 minutes, they are asked to move on to the next design. The dependent measure is the mean time spent on all designs a participant does not successfully solve. In the Brandon et al. study, the internal reliability alpha coefficient was found to be .92 across designs.

The MTPT is introduced to participants as a measure of motor functioning. Participants are seated in front of an apparatus that includes an upright “mirror” (a reflective metal plate) set at a slight angle and an adjustable plate that partially blocks the view of the table in front of them. The apparatus is designed and positioned to block participants’ view of both the sheet of paper in front of them and their hand while writing on the sheet of paper. However, they are able to see the paper and their hand by using the mirror. Participants are instructed to trace 8 geometric shapes using only the mirror to guide their drawing. They are told to alert the research assistant when they have completed the tracing or have given up. After five minutes of effort, if they have not completed the tracing or have given up, they are instructed to move on to the next shape. The amount of time they spend working on each shape is recorded. Past research has shown that the mean time spent persisting on each unsolved trial was 179.19 seconds (Brandon et al., 2003) (Appendices A and B).

**Anagram Persistence Task (APT).** The APT is based on an anagram task developed by Eisenberger and used in research assessing the effects of perceived task difficulty on task
persistence (Eisenberger & Leonard, 1980). Quinn et al. (1996) developed the APT, which was further refined by Brandon et al. (2003). Participants are asked to solve 11 anagrams. Trials 1, 5, 9, 10, and 11 are relatively easy to solve anagrams (e.g., NTRAI = TRAIN) and are included to maintain participants’ motivation. The remaining trials include anagrams that are extremely difficult to solve (e.g., LMMAE = MALAE). The difficult to solve anagrams are intended to induce stress and frustration, as the APT was designed to assess task persistence in the cognitive domain when experiencing distress (Quinn et al., 1996). The anagrams are printed on index cards, one anagram per card. The stack of cards and a sheet of paper with 11 numbered lines are placed in front of the participants and they are asked to solve the first anagram. They are instructed to move to the next trial if they solve the anagram or give up. If participants persist in working but are unable to solve the problem in 4 minutes, they are instructed to move to the next trial. The dependent measure is the mean amount of time spent working on the six extremely difficult to solve anagrams (items 2, 3, 4, 6, 7, 8). No participant successfully solved the six difficult to solve anagrams in the study conducted by Brandon et al. and the mean time spent on each difficult trial was 84.61 seconds. The authors found an internal consistency alpha coefficient of .95 across the six trials (Appendices C and D).

Cold pressor task. A cold pressor will be used to assess capacity to tolerate physical discomfort. The cold pressor task involves having participants submerge their hand in cold water (around 32 degrees Fahrenheit). The amount of time individuals are able to submerge their hand has been shown to be positively correlated with the ability to perform under stress and negatively correlated with emotional disturbance (see Budoff & Liebowitz, 1964). The cold pressor task involves filling a plastic bucket with water and ice and allowing the bath to sit until the temperature is around the freezing point (32 ± 2 degrees Fahrenheit). Participants are
instructed to submerge one hand to the bottom of the bucket and hold it in the bath as long as they can tolerate the pain. The dependent measure is how long participants are able to hold their hand in the bath. Past research has shown mean time spent submerged to be 23.21 seconds (Younger et al., 2008) (Appendix E).

**Barratt Impulsiveness Scale-11 (BIS-11).** The BIS-11 consists of 30 items designed to measure impulsiveness (Patton, Stanford, & Barratt, 1995). Each question on this self-report questionnaire is answered on a 4-point Likert-type scale (1 = Rarely/Never 4 = Almost Always/Always). Scores are summed; higher scores are indicative of greater levels of impulsiveness. To reduce the likelihood of response bias, some questions are worded to assess low impulsivity and must be reverse scored. The maximum total score an individual can obtain is 120. The total score will be used as the dependent measure in the current study. A factor analysis conducted by Patton et al. and revealed that in addition to a primary factor of Impulsivity there were three second order factors they labeled Motor Impulsiveness (sample item = I act on the spur of the moment.), Nonplanning Impulsiveness (sample item = I say things without thinking.), and Attentional Impulsiveness (sample item = I don’t “pay attention.”). The psychometric properties of the BIS-11 have been assessed in undergraduate student, substance abuse patient, general psychiatric patient, and inmate populations. Internal consistency alpha coefficients for each of the four groups listed have fallen between .79 and .83, indicating adequate internal consistency. The BIS-11 has been shown to reliably differentiate between populations, with undergraduate students scoring significantly lower than patient groups and (male) prison inmates scoring significantly higher than males in either patient or student groups (Appendix F).
Distress Tolerance Scale (DTS). The DTS is a 14-item self-report questionnaire developed by Simons and Gaher (2005). The DTS is unidimensional and captures tolerance, appraisal, absorption, and regulation of affective distress (sample question = Feeling distressed or upset is unbearable to me.). Each item is rated on a 5-point Likert-type scale ranging from Strongly agree (1) to Strongly disagree (5). All items are summed to create a single score and higher scores indicate higher tolerance for affective distress. The maximum score is 70. In the current study, total score will be used as the dependent measure. The DTS has demonstrated good convergent and discriminate validity; it has shown negative correlations with measures of affective distress and affective dysregulation and with alcohol and marijuana used as a coping motive. By contrast, the DTS was positively correlated with reported ability to regulate moods. The DTS has been shown to be quite stable over time. Six-month test-retest reliability revealed a coefficient of .61 (Simons & Gaher, 2005) (Appendix G).

Difficulties in Emotion Regulation Scale (DERS). The DERS is a 36-item self-report questionnaire designed to assess difficulty regulating emotions during times of distress (Gatz & Roemer, 2004). Each item is rated on a scale from 1 (almost never) to 5 (almost always); individual items are summed to create an overall score and higher scores reflect greater difficulty regulating emotions. A minimum score of 36 and a maximum score of 180 can be obtained. Total score will be used as the dependent measure in the current study. In addition to an overall score, the scale provides six subscale scores: lack of awareness of emotional responses [sample question = I am attentive to my feelings. (reverse scored)]; lack of clarity of emotional responses (sample question = I have no idea how I am feeling); nonacceptance of emotional responses (sample item = When I’m upset, I feel guilty for feeling that way.); limited access to emotion regulation strategies perceived to be effective (sample item = When I’m upset, I believe that I’ll
end up feeling very depressed.); difficulties controlling impulses when experiencing negative emotions (sample question = When I’m upset, I lose control over my behaviors.); and difficulties engaging in goal-directed behaviors when experiencing negative emotions (sample item = When I’m upset, I have difficulty concentrating.).

The DERS has shown high internal consistency with a Cronbach’s alpha of .93 and good convergent validity (Gatz & Roemer, 2004). Scores on the DERS have shown significant positive correlations with other measures of emotional regulation, with self-harm and with partner abuse. The DERS has also been shown to be a stable measure; the test-retest correlation coefficient was .88 for a range of 4 to 8 weeks between administrations (Appendix H).

**Demographic survey.** A demographic survey was created to obtain the following information: age, sex, class, GPA, major, ethnicity, marital status, enrollment status, residence type, and extracurricular activities. This information will be utilized during post-hoc analysis in order to assess the robustness of any statistically significant results (Appendix I).

**Drinking Behavior Survey (DBS).** The DBS was developed for the current study to assess alcohol use and perceived alcohol use norms. It is based on a measure used in an unpublished dissertation (Price, 2010) and uses standard language for assessing alcohol use. Questions 14 through 26 are drawn from the criteria found in the *Diagnostic and Statistical Manual of Mental Disorders* – fourth edition (DSM-IV) for alcohol abuse and alcohol dependence, with changes made in the wording to make the language more understandable to participants. The information gather from questions 14 through 26 will be used to provide descriptive information about the participants. The DBS uses standard drink units to quantify and capture alcohol use patterns. Questions assess the frequency of alcohol use, typical amount of alcohol consumed while drinking, drink preferences, and number of binge drinking episodes.
during the two weeks. In addition to asking participants to report on their own alcohol use, they are asked to report on what they perceive to be typical peer use. The primary outcome variable will be the number of binge drinking episodes during the past two weeks, which is question 9 for male participants and question 11 for female participants. The DBS also includes a question assessing how representative the prior two weeks is of the participant's typical drinking pattern for the past year and, if divergent how much did it vary. A second outcome variable measuring the typical number of drinks consumed during a 2-week period will also be used in the current study. This measure will be calculated by multiplying the number reported on Question 1 by the number reported on Question 3 and multiplying the total by two (Appendix J).

**Procedure**

The study protocol will be approved by the University Institutional Review Board before any data is collected to ensure compliance with standards for human participants. Participants will be recruited from the pool of undergraduates seeking research credit for psychology courses. Confidentiality of participant responses will be maintained throughout the data collection process, as each participant will be assigned a number for identification and no names will be associated with individual responses. Signed consent forms will not include the participant number.

Participants will complete the experiment individually. A research assistant will direct each participant through the experimental protocol. Upon entering the room, participants will be informed that they will be completing both self-report measures and performance-based measures. They will be told that the self-report measures include questions about demographic information, alcohol use patterns for themselves and their peers, impulsivity, how they cope with distress, and how they regulate their emotions. The performance-based measures will be
presented as measures of physical pain tolerance, problem-solving ability, and motor functioning. After explaining the components of the study, each participant will sign a consent form and the experiment will begin.

Each participant will complete the demographic and drinking behavior surveys first. This will be followed by either the remaining self-report measures or the three performance-based measures. To reduce order effects, a coin flip done prior to the experimental session will determine which set of measures is administered first. A flip of heads will result in the self-report measures being administered first and a flip of tails will result in the performance-based measures being administered first. Additionally, the order of the individual measures within each set will be rotated across participants. The self-report measures will be grouped into a single packet and will include a unique participant number at the top of each measure. The data from the performance-based measures will be recorded by research assistants who will log the time spent working on each individual item on a record sheet (Appendix H).

After participants have completed all measures they will be debriefed. Debriefing will include providing participants with a written summary of the aim of the study, along with a verbal summary. After being debriefed, participants will be thanked for their participation and research credit will be awarded. It is anticipated that participants will complete the entire experiment in 45 to 75 minutes, with the majority finishing the study in about 60 minutes. The wide range in anticipated time to complete the experiment is due to the anticipated variability in the amount of time spent working on any individual performance-based task. The predicted times to complete the APT and MTPT were calculated by using the mean times working on individual items from a prior study (Brandon et al., 2003).
Chapter IV

Proposed Analyses

The primary purpose of this study (Hypotheses I-VI) is to assess whether persistence on three performance-based tasks that induce discomfort – a cold pressor task, an anagram task, and a mirror-tracing task – predicts binge drinking frequency and the amount of alcohol typically consumed during a 2 week period among college students. To examine these relations, six separate linear regression equations will be built, one for each primary hypothesis. Linear regression will be used to test the primary hypotheses as the outcome variables – number of binge drinking episodes in that past two weeks and amount of alcohol typically consumed in a 2-week period – are continuous. Specifically, the following equations will be built:

Hypothesis I: It is predicted that there will be no relation between the outcome of a cold pressor task and number of binge drinking episodes in the last two weeks. The amount of time, in seconds, individuals keep their hands submerged in the icy bath will be entered as the predictor variable and the self-reported number of binge drinking episodes in the last two weeks will be entered as the criterion variable.

Hypothesis II: It is predicted that there will be no relationship between the outcome of a cold pressor task and amount of alcohol typically consumed during a 2-week period. The amount of time, in seconds, individuals keep their hands submerged in the icy bath will be entered as the
predictor variable and the calculated number of standard drinks typically consumed during a 2-week period will be entered as the criterion variable.

Hypothesis III: It is predicted that a significant negative relation will emerge between time spent working on an anagram task and number of binge drinking episodes in the last two weeks. Mean time, in seconds, individuals spend attempting to solve the six extremely difficult anagrams on the APT will be entered as the predictor variable and self-reported number of binge drinking episodes in the last two weeks will be entered as the criterion variable.

Hypothesis IV: It is predicted that a significant negative relationship will emerge between time spent working an anagram task and amount of alcohol typically consumed during a 2-week period. Mean time, in seconds, individuals spend attempting to solve the six extremely difficult anagrams on the APT will be entered as the predictor variable and the calculated number of standard drinks typically consumed during a 2-week period will be entered as the criterion variable.

Hypothesis V: It is predicted that a significant negative relation will emerge between time spent working on a mirror-tracing task and number of binge drinking episodes in the last two weeks. Mean time, in seconds, individuals spend tracing geometric shapes that they are unable to successfully complete on the MTPT will be entered as the predictor variable and self-reported number of binge drinking episodes in the last two weeks will be entered as the criterion variable.

Hypothesis VI: It is predicted that a significant negative relationship will emerge between time spent working on a mirror-tracing task and amount of alcohol consumed during a 2-week period. Mean time, in seconds, individuals spend tracing geometric shapes that they are unable to successfully complete on the MTPT will be entered as the predictor variable and the calculated
number of standard drinks typically consumed during a 2-week period will be entered as the criterion variable.

A secondary aim of the study (Hypotheses IV-V) is to examine the underlying structure of the relations identified in the first six hypotheses by including additional factors in the analysis in order to assess how these factors influence the predictive power of the predictor variables. Specifically, the influence of impulsivity, affect regulation, and distress tolerance on the relation between persistence on performance-based tasks that induce discomfort and binge drinking frequency will be assessed. To examine the influence of these three factors, a mediation model will be constructed in keeping with Baron and Kenny’s recommendations for mediation testing (Baron & Kenny, 1986). Baron and Kenny specify that mediation requires testing four relations (or paths): 1) the relation of the predictor variable and the criterion variable (in this study, Hypotheses 1-3); 2) the relation of the predictor variable and the mediator variable; 3) the relation of the mediator variable and the criterion variable; and 4) the relation of the predictor variable and the criterion variable once the influence of the mediator variable is included. Mediation is said to have occurred if the relation between the predictor and criterion variables is significantly reduced (or eliminated) when the mediator variable is included in the analysis. In testing Hypotheses VII, VII, IX and X, all four of Baron and Kenny’s paths with be tested separately for each performance-based task that shows a significant relation with the criterion variable in Hypotheses 1-6.

Specifically, the following regression equations will be built:

Hypothesis VII: It is predicted that the negative relationship between time spent working on an anagram task and number of binge drinking episodes in the last two weeks will no longer be significant after impulsivity, affect regulation, and distress tolerance are included in the analysis.
Equation 1: The relation between mean time (in seconds) individuals spend attempting to solve the six extremely difficult anagrams on the APT and the BIS-11, DERS, and DTS total scores will be tested by regressing total scores of the BIS-11, DERS, and DTS on the ATP.

Equation 2: The relation between binge drinking and the BIS-11 (total score), DERS (total score), and DTS (total score) will be tested by regressing the number of binge drinking episodes on BIS-11, DERS, and DTS total scores.

Equation 3: The final equation that tests mediation will have two steps: In Step 1, mean time on the APT will be entered as the predictor variable and number of binge drinking episodes will be entered as the criterion variable. In step 2, total scores on the BIS-11, DERS, and DTS will be added to the equation as a block of predictor variables.

Hypothesis VIII: It is predicted that the negative relationship between time spent working on an anagram task and amount of alcohol typically consumed during a 2-week period will no longer be significant after impulsivity, affect regulation, and distress tolerance are included in the analysis.

Equation 1: The relation between mean time (in seconds) individuals spend attempting to solve the six extremely difficult anagrams on the APT and the BIS-11, DERS, and DTS total scores will be tested by regressing total scores of the BIS-11, DERS, and DTS on the ATP.

Equation 2: The relation between binge drinking and the BIS-11 (total score), DERS (total score), and DTS (total score) will be tested by regressing the amount of alcohol typically consumed during a 2-week period on BIS-11, DERS, and DTS total scores.

Equation 3: The final equation that tests mediation will have two steps: In Step 1, mean time on the APT will be entered as the predictor variable and amount of alcohol typically consumed
during a 2-week period will be entered as the criterion variable. In step 2, total scores on the BIS-11, DERS, and DTS will be added to the equation as a block of predictor variables.

Hypothesis IX: It is predicted that the negative relationship between time spent working on a mirror-tracing task and number of binge drinking episodes in the last two weeks will no longer be significant after impulsivity, affect regulation, and distress tolerance are included in the analysis.

Equation 1: The relations between the mean time (in seconds) individuals spend tracing geometric shapes and the BIS-11, DERS, and DTS total scores will be tested by regressing total scores on the BIS-11, DERS, and DTS on the MTPT.

Equation 2: The relation between binge drinking and the BIS-11 (total score), DERS (total score), and DTS (total score) will be tested by regressing the number of binge drinking episodes on BIS-11, DERS, and DTS total scores.

Equation 3: The final equation that tests for mediation will have two steps. In Step 1, mean time on the MTPT will be entered as the predictor variable and number of binge drinking episodes will be entered as the criterion variable. In Step 2, total scores on the BIS-11, DERS, and DTS will be added to the equation as a block of predictor variables.

Hypothesis X: It is predicted that the negative relationship between time spent working on a mirror-tracing task and amount of alcohol typically consumed during a 2-week period will no longer be significant after impulsivity, affect regulation, and distress tolerance are included in the analysis.

Equation 1: The relations between the mean time (in seconds) individuals spend tracing geometric shapes and the BIS-11, DERS, and DTS total scores will be tested by regressing total scores on the BIS-11, DERS, and DTS on the MTPT.
Equation 2: The relation between binge drinking and the BIS-11 (total score), DERS (total score), and DTS (total score) will be tested by regressing the amount of alcohol typically consumed during a 2-week period on BIS-11, DERS, and DTS total scores.

Equation 3: The final equation that tests for mediation will have two steps. In Step 1, mean time on the MTPT will be entered as the predictor variable and amount of alcohol typically consumed during a 2-week period will be entered as the criterion variable. In Step 2, total scores on the BIS-11, DERS, and DTS will be added to the equation as a block of predictor variables.

The robustness of any identified relations will be examined during post hoc analysis. The models will be retested following the specifications above, with the addition of three control variables entered as a first step. Perceived peer drinking norms (defined as the number of perceived peer binges in the last two weeks), GPA, and Sex will be entered as control variables.
References


Appendix A

MTPT (Do not reinforce for completing tasks or correct answers)

Instructions: This part of the study will require you to trace drawings using a mirror. Please place your hand into the apparatus, and look at your hand in the mirror. You will notice that all motions you make are inverted. You will be asked in a few minutes to place drawings in the apparatus, and trace them.

In front of you, there are 8 folders. Each folder contains one type of drawing, as you can see there are many copies of each drawing. Please take the folder marked number 1, and place it on the table next to you. Take the first drawing out of the folder and place it here (point) in the mirror-tracing apparatus. When I tell you to, take the red pen next to you and trace the drawing beginning at the start position. Follow the arrow on the drawing and do not pick up your pen. Make sure that when you are tracing the red ink stays directly on the black line. If you go off the black line, I will ask you to start over with a new sheet of paper until you complete the best possible drawing.

However,

if you feel you have completed the best drawing that you can possibly produce, even though it still contains mistakes, you may also go on to the next folder which contains a new drawing.

Before going on to the next folder, hand me your completed drawing and place the folder back in stack. Then, take the next numbered folder out of the stack and place it on the table next to you. Then, begin drawing the next figure.

Do you have any questions?

When I ask you to begin, please start with folder #1.

O.K., Begin
Appendix B

MTPT Shapes

Shape 1

Shape 2

Shape 3

Shape 4
Shape 5

Shape 6

Shape 7

Shape 8
Appendix C

**APT (Do not reinforce for completing tasks or correct answers)**

Instructions: *This stack contains 11 index cards. There is an anagram with one correct possible solution on each card. When I say begin, you will turn over the first card and attempt to solve the anagram. Please write your answer on the numbered line that corresponds to the number on the card. If you solve the anagram, turn the card over and place it to the left of the stack. If you believe you are unable to solve any anagram, you may also move onto the next item by turning the card over and placing it to the left. When instructed, you will turn over the next card and begin working to solve the anagram. You may not go back and attempt to solve earlier items.*

*Do you have any questions? Ready, begin.*

*(If the participant does not successfully solve the anagram after 4 minutes, instruct her or him to move on.)*

<table>
<thead>
<tr>
<th>Anagram</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. BEAHC</td>
<td>BEACH</td>
</tr>
<tr>
<td>2. KLYXI</td>
<td>KYLIX</td>
</tr>
<tr>
<td>3. LMAAE</td>
<td>MALAE</td>
</tr>
<tr>
<td>4. QYUIA</td>
<td>YAQUI</td>
</tr>
<tr>
<td>5. NTRAI</td>
<td>TRAIN</td>
</tr>
<tr>
<td>6. CINAI</td>
<td>INIAC</td>
</tr>
<tr>
<td>7. LBFUE</td>
<td>FULBE</td>
</tr>
<tr>
<td>8. DPSUA</td>
<td>PADUS</td>
</tr>
<tr>
<td>9. EOCVI</td>
<td>VOICE</td>
</tr>
<tr>
<td>10. AEWTR</td>
<td>WATER</td>
</tr>
<tr>
<td>11. IFNLG</td>
<td>FLING</td>
</tr>
</tbody>
</table>
Appendix D

Anagram Solution Sheet

SUBJECT # ____________ DATE: ___________

1. ___________________________________________________________________

2. ___________________________________________________________________

3. ___________________________________________________________________

4. ___________________________________________________________________

5. ___________________________________________________________________

6. ___________________________________________________________________

7. ___________________________________________________________________

8. ___________________________________________________________________

9. ___________________________________________________________________

10. __________________________________________________________________

11. __________________________________________________________________
Appendix E

**Cold Pressor Task**

Instructions: *This bucket contains water that is around 32 degrees Fahrenheit. When I say begin, please place your arm into the bucket until the palm of your hand is flat on the bottom and hold it there for as long as you are able.*

*Ready, begin.*
**Appendix F**

**BIS-11**

Directions: People differ in the ways they act and think in different situations. This is a test to measure some of the ways in which you act and think. Read each statement and indicate what is true for you. Do not spend too much time on any statement. Answer quickly and honestly.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rarely/Never</td>
<td>Occasionally</td>
<td>Often</td>
<td>Almost Always/Always</td>
</tr>
</tbody>
</table>

1. I plan tasks carefully
2. I do things without thinking
3. I am happy-go-lucky
4. I have “racing” thoughts
5. I plan trips well ahead of time
6. I am self-controlled
7. I concentrate easily
8. I save regularly
9. I find it hard to sit still for long periods of time
10. I am a careful thinker
11. I plan for job security
12. I say things without thinking
13. I like to think about complex problems
14. I change jobs
15. I act “on impulse”
16. I get easily bored when solving tough problems
17. I have regular medical/dental checkups
18. I act on the spur of the moment
19. I am a steady thinker
20. I change where I live
21. I buy things on impulse
22. I finish what I start
23. I walk and move fast
24. I solve problems by trial-and-error
25. I spend or charge more than I earn
26. I talk fast
27. I have outside thoughts when thinking
28. I am more interested in the present than the future
29. I am restless at lectures or talks
30. I plan for the future
Appendix G

ID # __________

DTS

Directions: Think of times that you feel distressed or upset. Select the item from the menu that best describes your beliefs about feeling distressed or upset.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>Mildly Agree</td>
<td>Equally Agree and Disagree</td>
<td>Mildly Disagree</td>
<td>Strongly Disagree</td>
</tr>
</tbody>
</table>

1. Feeling distressed or upset is unbearable to me.
2. When I feel distressed or upset, all I can think about is how bad I feel.
3. I can't handle feeling distressed or upset.
4. My feelings of distress are so intense that they completely take over.
5. There's nothing worse than feeling distressed or upset.
6. I can tolerate being distressed or upset as well as most people.
7. My feelings of distress or being upset are not acceptable.
8. I'll do anything to avoid feeling distressed or upset.
9. Other people seem to be able to tolerate feeling distressed or upset better than me.
10. Being distressed or upset is always a major ordeal for me.
11. I am ashamed of myself when I feel distressed or upset.
12. My feelings of distress or being upset scare me.
13. I'll do anything to stop feeling distressed or upset.
14. When I feel distressed or upset, I must do something about it immediately.
15. When I feel distressed or upset, I cannot help but concentrate on how bad the distress actually feels.
Appendix H

**DERS**

Please indicate how often the following statements apply to you by writing the appropriate number from the scale below on the line beside each item:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>almost never (0-10%)</td>
<td>sometimes (11-35%)</td>
<td>about half the time (36-65%)</td>
<td>most of the time (66-90%)</td>
<td>almost always (91-100%)</td>
</tr>
</tbody>
</table>

1) I am clear about my feelings.
2) I pay attention to how I feel.
3) I experience my emotions as overwhelming and out of control.
4) I have no idea how I am feeling.
5) I have difficulty making sense out of my feelings.
6) I am attentive to my feelings.
7) I know exactly how I am feeling.
8) I care about what I am feeling.
9) I am confused about how I feel.
10) When I’m upset, I acknowledge my emotions.
11) When I’m upset, I become angry with myself for feeling that way.
12) When I’m upset, I become embarrassed for feeling that way.
13) When I’m upset, I have difficulty getting work done.
14) When I’m upset, I become out of control.
15) When I’m upset, I believe that I will remain that way for a long time.
16) When I’m upset, I believe that I’ll end up feeling very depressed.
17) When I’m upset, I believe that my feelings are valid and important.
18) When I’m upset, I have difficulty focusing on other things.
19) When I’m upset, I feel out of control.
20) When I’m upset, I can still get things done.
21) When I’m upset, I feel ashamed with myself for feeling that way.
<table>
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<tr>
<td>almost always (91-100%)</td>
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</tbody>
</table>

22) When I'm upset, I know that I can find a way to eventually feel better.
23) When I'm upset, I feel like I am weak.
24) When I'm upset, I feel like I can remain in control of my behaviors.
25) When I'm upset, I feel guilty for feeling that way.
26) When I'm upset, I have difficulty concentrating.
27) When I'm upset, I have difficulty controlling my behaviors.
28) When I'm upset, I believe that there is nothing I can do to make myself feel better.
29) When I'm upset, I become irritated with myself for feeling that way.
30) When I'm upset, I start to feel very bad about myself.
31) When I'm upset, I believe that wallowing in it is all I can do.
32) When I'm upset, I lose control over my behaviors.
33) When I'm upset, I have difficulty thinking about anything else.
34) When I'm upset, I take time to figure out what I'm really feeling.
35) When I'm upset, it takes me a long time to feel better.
36) When I'm upset, my emotions feel overwhelming.
Appendix I

ID # __________

Demographic Survey

1. Age: ______

2. Sex (circle one): F   M

3. Class: 1st year  Sophomore  Junior  Senior

4. Cumulative GPA: ______

5. Major: ________________

6. Ethnicity (circle all that apply):
   African American/Black  White  Asian  Native Hawaiian/Pacific Islander
   Hispanic or Latino  American Indian/Alaska Native  Other: ________________

7. Marital Status:
   Single  Married  Separated  Divorced  Widowed  Civil Union

8. Enrollment:
   Full-time  Part-time

9. Residence:
   On-campus  Off-campus

10. List extracurricular activities (check all that apply):
    ______ club team  ______ intermural athletics  ______ volunteering
    ______ clubs  ______ varsity sports  ______ other
Appendix J

ID # __________

Drinking Behavior Survey

DIRECTIONS: The following questions are about alcohol use. Some questions ask about the number of drinks consumed. To answer these questions, use the following definitions for a standard drink: 12 oz of beer, 5 oz of wine, 12 oz of wine cooler, and 1.5 oz of liquor.

1. During a typical week, how many days do you consume alcohol? __________

2. During a typical week, how many days do the majority of your peers drink? __________

3. How many standard drinks do you consume during a typical drinking occasion? __________

4. How many standard drinks do the majority of your peers consume during a typical drinking occasion? __________

5. What is your drink of choice? (Please circle)
   Canned/Bottled Beer   Draft Beer   Wine   Wine Cooler
   Mixed Drink          Other __________

6. What do you usually drink? (Please circle)
   Canned/Bottled Beer   Draft Beer   Wine   Wine Cooler
   Mixed Drink          Other __________

7. What is the average quantity, in standard drink units, of liquor, beer, and wine that you consume during a week?

NOTE: A standard drink is defined by 1.5 oz of liquor, 12 oz of beer, and 5 oz of wine.

(please circle or write the number of standard drinks)

**Liquor:** 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 _____ (write in number if greater than 15)

**Beer:** 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 _____ (write in number if greater than 15)

**Wine:** 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 _____ (write in number if greater than 15)
8. What is the most you have drunk at one time (i.e., greatest number of standard drinks) since classes started in August of 2011 ______?

NOTE: A **standard drink** is defined by 12 oz of beer, 5 oz of wine, 12 oz of wine cooler, and 1.5 oz of liquor.

9. **MALES ONLY:** Over the past 2 **weeks**, how many times have you had 5 or more **standard drinks** within a 2 hour period? (Please circle one)

   NOTE: A **standard drink** is defined by 12 oz of beer, 5 oz of wine, 12 oz of wine cooler, and 1.5 oz of liquor.

   0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 ___ (write in number if greater than 14)

10. **MALES ONLY:** Over the past 2 **weeks**, how many times has your typical male peer had 5 or more **standard drinks** within a 2 hour period? (Please circle one)

    NOTE: A **standard drink** is defined by 12 oz of beer, 5 oz of wine, 12 oz of wine cooler, and 1.5 oz of liquor.

    0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 ___ (write in number if greater than 14)

11. **FEMALES ONLY:** Over the past 2 **weeks**, how many times have you had 4 or more **standard drinks** within a 2 hour period? (Please circle one)

    NOTE: A **standard drink** is defined by 12 oz of beer, 5 oz of wine, 12 oz of wine cooler, and 1.5 oz of liquor.

    0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 ___ (write in number if greater than 14)

12. **FEMALES ONLY:** Over the past 2 **weeks**, how many times has your typical female peer had 4 or more **standard drinks** within a 2 hour period? (Please circle one)

    NOTE: A **standard drink** is defined by 12 oz of beer, 5 oz of wine, 12 oz of wine cooler, and 1.5 oz of liquor.

    0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 ___ (write in number if greater than 14)
13. The amount people drink can vary based on external events. Events such as holidays and birthdays may result in a person drinking more than usual, while events such as exams and term paper due dates may result in a person drinking less than usual. With that in mind, how does your drinking in the past two weeks compare to your typical drinking pattern over the course of the last year? (please circle one) If it is more or less, please indicate how much more or less by writing number of standard drinks it was more or less than typical for you.

Less (how much less _____)       Typical       More (how much more _____)

For questions 14-26 please respond with YES or NO

14. In the past year, has using alcohol resulted in you not being able to fulfill major obligations at work, school, or home (e.g., missing class; poor work performance)?

   YES       NO

15. In the past year, have you used alcohol in situations in which it is physically hazardous (e.g., driving an automobile while impaired by alcohol; using machinery while intoxicated)?

   YES       NO

16. In the past year, have you experienced alcohol-related legal problems (e.g., driving under the influence; underage drinking tickets; drunk and disorderly conduct)?

   YES       NO

17. In the past year, have you continued to use alcohol despite having problems in relationships that were caused or made worse by the effects of alcohol use (e.g., arguments with partner; physical fights; fights with your parents)?

   YES       NO

18. In the past year, have you found that you need to drink more and more to get the buzz or “high” that you want?

   YES       NO

19. In the past year, have you found that drinking the same amount of alcohol has much less effect that it used to have?

   YES       NO
20. In the *past year*, have you had physical experiences like tremors or shakes after a night of drinking or when you stopped drinking?

YES  NO

20a. If yes, have these physical experiences been upsetting or difficult to tolerate?

YES  NO

21. In the *past year*, have you ever continued to drink to avoid the physical experiences that occur when you stop drinking?

YES  NO

22. In the *past year*, have you consumed alcohol in larger amounts or over a longer period than was intended?

YES  NO

23. In the *past year*, have you wanted to cut back or control how much you drink and not been able to do so.

YES  NO

24. In the *past year*, have you spent a lot of time getting, using, or getting over the effects of alcohol?

YES  NO

25. In the *past year*, have you stopped doing social, work, school, or recreational activities because of your drinking?

YES  NO

26. In the *past year*, have you continued to drink even though drinking has caused repeated physical or psychological problems that are likely due to or made worse by drinking (e.g., continued drinking even though you know that it makes you feel depressed)?

YES  NO
Appendix K

ID # __________

Record Form

APT
1. _________ sec
2. _________ sec
3. _________ sec
4. _________ sec
5. _________ sec
6. _________ sec
7. _________ sec
8. _________ sec
9. _________ sec
10. _________ sec
11. _________ sec

MTPT
1. _________ sec  _____ completed
2. _________ sec  _____ completed
3. _________ sec  _____ completed
4. _________ sec  _____ completed
5. _________ sec  _____ completed
6. _________ sec  _____ completed
7. _________ sec  _____ completed
8. _________ sec  _____ completed

Cold pressor task
_______ sec

Administered first:  self-report  Performance-based

Self-report order:  A  B  C

Performance-based order: A  B  C
Appendix L

Debriefing

This study was designed to examine the relation between task performance (specifically, persistence) and alcohol use behavior (specifically, binge drinking). The anagram task and the mirror-tracing task are designed to induce frustration due to the difficulty of successfully solving some items, with the anagram and mirror-tracing tasks representing cognitive and motor tasks, respectively. The task in which you placed your hand in the freezing water is a measure of pain tolerance. It is hypothesized that people who binge drink more frequently will persist less on cognitive and motor tasks, but not on a pain-inducing task. Additionally, the influence of distress tolerance, impulsivity, and emotional regulation are also being examined. The goal of the study is to identify factors that are related to greater frequency of binge drinking. Other students will be participating in this study at a later date, so we ask that you not share specific information about the study (i.e., specific geometric shapes and anagrams) with any student who may participate in the study at a future date.

As part of the study, you were asked to provide information about your drinking behavior. Although we are not able to provide you with personalized information about your drinking patterns at this time as your data has not been scored or interpreted, if participation in this study has raised questions or concerns in you about your alcohol use patterns there are several campus resources at your disposal. First, online you can complete the B.A.R.T., which is an anonymous web-based assessment of alcohol use patterns that offers personalized feedback about your level of risk (http://www.xavier.edu/health-wellness/prevention-wellness/BART.cfm); second, if you wish to talk with someone in person, you may contact the
Psychological Services Center at (513) 745-3531 or the McGrath Health and Wellness Center at (513) 745-3022. Thank you for your participation.
November 22, 2011

Jason Menting
1014 Dana Ave, Apt. 3
Cincinnati, OH 45207

Dear Mr. Menting:

The IRB reviewed the revisions to your protocol #1122, Can Performance-Based measures Predict Binge Drinking? An Empirical Investigation. We very much appreciate your attention to the issues raised, and your treatment of them.

Therefore, your study is approved in the Full Board Review category under Federal Regulation 45CFR46. Approval expires November 22, 2012. A progress report, available at http://www.xavier.edu/irb/forms.cfm, is due by that date. If you wish to modify your study, it will be necessary to obtain IRB approval prior to implementing the modification. If any adverse events occur, please notify the IRB immediately.

If you have any questions, please contact the IRB office at 745-2870. Thank you for your compliance efforts.

Sincerely,

[Signature]

Morell E. Mullins, Jr., Ph.D.
Chair, Xavier University IRB
MEM/sb

C: Susan Kenford, advisor

Enclosure: Stamped Informed Consent
Appendix N

January 9, 2012

Jason Menting
1014 Dana Ave. Apt. 3
Cincinnati, OH 45207

Re: Protocol #1122, Can Performance-Based Measures Predict Binge Drinking? An Empirical Investigation

Dear Mr. Menting:

The IRB has reviewed the request to modify your study, referenced above. We understand that you will be adding a new assessment measure to the protocol. We are able to continue to approve your study based on the information you provided. Therefore, your above-referenced study, as modified, continues to be approved in the Full Board Review category under Federal Guidelines 45CFR46. Your approval expires on November 22, 2012 and a Progress Report is due by that date. The form can be found online at www.xavier.edu/irb/forms.

Please note that if you wish to further modify your study, it will be necessary to obtain IRB approval prior to implementing the modification. If any adverse events occur, please notify the IRB immediately.

We truly appreciate your efforts and attention to compliance within the spirit of human subject’s protection. We wish you great success with your research.

Sincerely,

[Signature]

Morell E. Mullins, Jr., Ph.D.
Chair, Institutional Review Board
Xavier University

MEMO:

e: Susan Kenford, advisor
INFORMED CONSENT FORM

You are being given the opportunity to volunteer to participate in a project conducted through Xavier University. The aim of the following study is to examine the relation between task performance, emotions, and certain behaviors that may be observed in college students. You were recruited for this study because you are a college student above the age of 18 years.

During the study, you will be asked to complete one survey about your demographic information, one survey about your alcohol use patterns, and three questionnaires that assess behavior, emotions, and cognitive regulation. You are free to not answer any item for any reason. In addition, you will be asked to complete one cognitive behavioral task, one motor behavioral task, and one behavioral task assessing pain tolerance. As part of the study, you will be asked to submerge your hand and forearm into very cold water that measures 52-34°F and keep your hand submerged for as long as you can tolerate. Submerging your hand in this water will cause physical discomfort and pain. You will be free to remove your hand at any time that you wish. During the cognitive and motor behavioral tasks, you will be free to choose any item at any time and to move to the next item; you will also be free to fully stop and not complete any additional items.

Therefore, the time you spend on any task is up to you. The entire study is expected to take approximately 90 minutes.

There are no direct benefits to you for participating in this study. However, the information you provide will advance our understanding of how different behaviors and emotions are related.

Confidentiality will be maintained for all information you provide. Your date will be assigned an identification number; this number will not be included on your signed consent form and will never be connected with your name. All results will be reported in an aggregate or group format. No individual profiles or answers will be reported. All data will be stored in a locked closet that is only accessible to the principal investigators and will be destroyed five years after the publication of study results. The signed consent form will be stored in a separate locked closet that is only accessible to the principal investigators and will be destroyed five years after the conclusion of the study. You will be awarded 1.25 hours of research participation credit for completing this study.

Refusing to participate in this study will IN NO WAY AFFECT YOUR ACCESS TO SERVICES provided by Xavier University. YOU MAY WITHDRAW FROM THE STUDY AT ANY TIME WITHOUT PENALTY. If you decide to participate in the project, please sign this form.

If you have any questions at any time during the study, you may contact Jason Meekins at jason.meekins@xavier.edu or Susan Kenford, Ph.D., at (513) 745-3415. Questions about your rights as a research subject should be directed to Xavier University's Institutional Review Board at (513) 745-2870.

I have been given information about this research study and its risks and benefits and have had the opportunity to ask questions and to have my questions answered to my satisfaction. I freely give my consent to participate in this research project.

__________________________  ____________________________
Signature:                  Date:

THE DATE APPROVAL STAMP ON THIS CONSENT FORM INDICATES THAT THIS PROJECT HAS BEEN REVIEWED AND APPROVED BY XAVIER UNIVERSITY'S INSTITUTIONAL REVIEW BOARD.

APPROVED
Xavier University
Institutional Review Board
Date: 11/19/07

3800 Victory Parkway, Cincinnati, Ohio 45207-2351 Phone: 513 745 2070 Fax: 513 745 2871 info@xavier.edu
Chapter V

Dissertation

Abstract

Heavy alcohol consumption and binge drinking are common among college students and can have adverse consequences (Wechsler, Lee, Kuo, & Lee, 2000). As such, it is important to identify those at the highest risk of consuming dangerous amounts of alcohol in order to implement preventative intervention strategies. The current study examined the predictive utility of performance-based measures of persistence, both physical (cold pressor) and psychological (mirror-tracing and anagram solution) in identifying those prone to binge drink and consume large quantities in a sample \( N = 139 \) of college students. Individual difference factors, including affect regulation, distress tolerance, and impulsivity, were examined as possible mediators. The majority of the sample used alcohol (76.3%) and 54.0% reported binge drinking. Contrary to prediction, all forms of task persistence were unrelated to binge drinking or amount of alcohol consumed; however, lower persistence on the mirror-tracing task predicted meeting modified DSM-IV criteria for alcohol abuse \( (p = .03) \), suggesting that task persistence may be more related to alcohol problems rather than amount of alcohol consumed. Affect regulation and distress tolerance showed no direct effects. Impulsivity showed a modest direct effect but no indirect effects and did not mediate the observed relation between task persistence and problem alcohol use.
Can Performance-Based Measures Predict Binge Drinking?  
An Empirical Investigation

Drinking alcohol is a common activity among college students. Research has shown that between 80-85% of college students consume alcohol at least once during a given year (Wechsler, Lee, Kuo, & Lee, 2000). Although a common practice, drinking alcohol presents risks to students’ physical well-being (Perkins, 2002a, Wechsler et al., 2000) and academic achievements (Biscaro, Broer, & Taylor, 2004). In order to help students avoid these negative consequences through early intervention, it is important to identify factors that contribute to high risk alcohol use patterns.

Binge drinking is a particularly hazardous pattern of consuming alcohol and is common on college campuses (Hingson, Heeren, Winter, & Wechsler, 2005). Binge drinking is defined as consuming 5 or more drinks for men and 4 drinks for women (NIAAA, 2004). Binge drinking appears to be a part of the college experience for many students, as a higher proportion of college students binge drink than same-aged, non-student peers (Hingson et al., 2005). However, this pattern carries considerable risk, as data indicate an increased incidence of alcohol-related deaths among college students. For example, from 1999 to 2001, alcohol-related unintentional deaths rose from 1,575 to 1,717. This rise cannot be explained by an increase in college attendance, as the deaths increased from 18.2 to 19.3 per 100,000 students. The prevalence of driving under the influence of alcohol also increased during that time period among college students. However, at the same time that high risk alcohol consumption increased, abstaining from drinking alcohol also increased and college populations appear to be moving toward a bimodal pattern of heavy, abusive drinking and abstinence (Wechsler et al., 2000).
One positive finding from the research on college alcohol use patterns is that many students “mature out” of excessive alcohol use as they progress through college and, ultimately, begin families and careers following graduation (O’Malley, 2005). However, a subset of students follow a separate trajectory and develop a pattern of drinking excessively during college that continues after graduation (Jackson, Sher, Gothman, & Wood, 2001; Jennison, 2004; O’Neill, Parra, & Sher, 2001). This long term risk, along with the risks students who binge drink are exposed to during their college years, belies viewing binge drinking as a developmentally expected and acceptable behavior among college students.

Concern about excessive alcohol use on college campuses has led researchers to try to identify factors that lead some students to drink alcohol in excess whereas other students do not (Biscaro et al., 2004; Dreer, Ronan, Ronan, Dush, & Elliot, 2004). Among environmental factors, peer behavior has consistently shown the greatest relations to alcohol use factors (Perkins, 2002b); in terms of person-factor, or individual differences, impulsivity and affect regulation has shown consistent relations to alcohol use patterns (Dick et al., 2010; Simons, Gaehner, Oliver, et al., 2005). More recently, researchers have begun to examine how distress tolerance is related to alcohol use (Buckner, Keough, & Schmidt, 2007).

**Peer Norms and Other Non-Psychological Factors**

The amount peers actually drink and perceived drinking norms on campus have consistently emerged as strong predictors of alcohol consumption among college students (Perkins, 2002b). Multiple studies have shown that normative drinking behavior among peers emerges as the strongest predictor of alcohol consumption (Neighbors, Lee, Lewis, Fossos, & Larimer, 2007; Perkins, Haines, & Rice, 2005). Roommates appear to be particularly influential
when they share similar histories of alcohol use, at least among young men (Duncan, Boisjoly, Kremer, Levy, & Eccles, 2005).

In addition to peer norms, two other non-psychological factors that have consistently demonstrated relations with alcohol consumption are GPA (Singleton, 2007) and sex (Neighbors et al., 2007; Perkins et al., 2005). Higher GPA is correlated with less drinking, and males drink more than females. Although peer use, sex, and GPA have been consistently related to the amount of alcohol consumed, the direct impact of these factors is not of primary interest in the current study as the focus is to identify particular psychological individual difference or person factors that may place students at particular risk within a shared environmental milieu.

**Impulsivity**

Well-established links have been made between impulsivity and alcohol use, both in studies using human participants and in animal studies (Dick et al., 2010). Past research suggests that impulsivity is associated with patterns of alcohol use and binge drinking among college students. For example, higher levels of impulsivity have been shown to be associated with increased alcohol-related problems among college students (Simons, Gaher, Oliver, Bush, & Palmer, 2005). Greater impulsivity has also been associated with increased likelihood of meeting DSM-IV criteria for alcohol abuse, but not alcohol dependence (Simons, Carey, & Wills, 2009). Within the broader construct of impulsivity, acting quickly and without forethought, thrill seeking, and easily becoming bored have been identified as attributes particularly predictive of binge drinking (Carlson, Johnson, & Jacobs, 2009).

**Affect Regulation**

A construct often associated with impulsivity is affect regulation, or the ability to deal with negative affective states. The relationship between affect regulation and alcohol use
appears somewhat complex. A strong body of research supports that in the general population, individuals who use alcohol to cope with difficult situations and negative affective states consume greater quantities of alcohol and experience more alcohol-related problems (Cooper, Russell, Skinner, Frone, & Mudar, 1992). Research has found that some individuals rely on alcohol as a coping strategy (Carpenter & Hasin, 1997) despite the greater number of life problems this strategy creates (Simons Gaer, Correia, Hansen, & Christopher, 2005). One aspect of coping is addressing negative feelings. Simons, Gaer, Oliver, et al. (2005) found that students who reported experiencing higher levels of negative affect during the day did not consume more alcohol when compared to their low negative-affect peers, but did experience more alcohol-related problems. Within that study, individuals high in impulsivity who experienced negative affect exhibited the highest number of alcohol-related problems. These data suggest that routine or daily affective experience is related to the consequences of alcohol consumption, particularly among individuals who are impulsive. These individuals may be turning to alcohol as a coping strategy to deal with the negative affect and due to their trait impulsivity, become more disinhibited after consuming an equivalent amount of alcohol as a non-impulsive or affectively neutral peer.

**Distress Tolerance**

A factor that appears to be closely linked to both impulsivity and affect regulation – and has been linked to alcohol consumption – is distress tolerance. Distress tolerance is the ability to tolerate psychological discomfort. Buckner et al. (2007) found that increased distress tolerance was associated with consuming less alcohol and fewer alcohol-related problems among undergraduate students. The influence on alcohol use of being able to tolerate psychological discomfort may be different between men and women. For example, in a sample of 823 college
students Simons and Gaher (2005) found that men, but not women, who reported higher distress tolerance demonstrated fewer alcohol-related problems.

**Task Persistence**

Task persistence may represent a behavioral construct that links affect regulation, impulsivity, and distress tolerance to alcohol use. Affect regulation, impulsivity, and distress tolerance have all been independently associated with problem alcohol use (Buckner et al., 2007; Dick et al., 2010; Simons, Gaher, Oliver, et al., 2005). Further, distress tolerance has been shown to be associated with how long individuals will persist on a task when faced with a challenge, leading researchers to propose that task persistence is a behavioral manifestation of distress tolerance (Steinberg, Williams, Gandhi, Foulds, & Brandon, 2010). The relation between task persistence and distress tolerance has been captured using tasks that challenge individuals cognitively (e.g., Anagram Persistence Task; APT) or motorically (e.g., Mirror Tracing Persistence Task; MTPT). As such, task persistence may be a unifying or superordinate construct that represents the behavioral manifestation of affect regulation, impulsivity, and distress tolerance. To date, the predictive utility of task persistence has been studied with a variety of substances. For example, researchers have found a relationship between chronic alcohol abuse and decreased task persistence (Alterman, Tarter, Petrarulo, & Baughman, 1984; Cynn, 1992). Decreased task persistence has also been linked to nicotine use (Quinn, Brandon, & Copeland, 1996) and substance abuse treatment dropout (Daughters, Lejuez, Bornavalava, Kahler, Strong, & Brown, 2005). To date, studies examining the relation between task persistence and excessive alcohol use have focused on individuals with a formal diagnosis of alcohol dependence and those seeking treatment for substance abuse. Therefore, it is unclear
what relation exists between task persistence and alcohol consumption among people who do not carry a psychological diagnosis or require formal treatment.

Research to date suggests that not all behavioral task persistence measures are equally related to substance use patterns and successful completion of treatment. In particular, measures that require physical persistence have shown weaker relations when compared to those that require psychological persistence (Alterman et al., 1984; Cynn, 1992; Daughters et al., 2005). Additionally, the nature of the psychological challenge (motor vs. cognitive) has also been associated with differential predictive utility (Quinn et al., 1996). However, to date, no study has examined the full complement of behavioral task measures in a college age sample. As such, the aim of the current study is to assess the ability of three distinct behavioral task persistence measures to predict alcohol use patterns in a sample of college students. A secondary aim is to investigate if any observed relations can be accounted for by self-report measures of distress tolerance, affect regulation and impulsivity, all known predictors of alcohol use patterns (Buckner et al., 2007; Simons, Gaher, Oliver, et al., 2005).

The primary hypotheses tested the predictive utility of three behavioral measures (APT, MTPT, and the cold pressor task) on two drinking behavior measures (binge drinking episodes in prior 2 weeks and total number of drinks consumed during a typical 2-week period). Specifically, it was hypothesized that performance on the cold pressor task would not predict binge drinking or number of drinks consumed, performance on an anagram task would show a significant negative relation with binge drinking episodes and number of drinks consumed, and performance on a mirror-tracing task would show a significant negative relation with binge drinking episodes and number of drinks consumed. Secondary hypotheses were examined in an attempt to identify the underlying structure between any significant relations identified in the
primary hypotheses. Specifically, it was predicted that the relations between performance on an anagram task and binge drinking and total alcohol consumed would no longer be significant after impulsivity, affect regulation, and distress tolerance are included in the analysis. As such, impulsivity, affect regulation, and distress tolerance were expected to mediate any observed relations between performance on the mirror-tracing and anagram tasks and binge drinking and total alcohol consumed. In addition to the primary hypotheses capturing alcohol use quantitatively through consumption patterns, post hoc exploratory analyses assessed if the hypothesized relations between the performance measures and use would hold when alcohol use was captured not by quantity consumed but by consequences or outcome of use, as assessed by modified DSM-IV criteria for abuse and dependence.

Method

Participants

One hundred and forty participants from a private Midwestern university were recruited for the current study. One participant was 40 years of age and was removed from the data due to being in a developmental period that was inconsistent with the research questions. As a result, the final sample contained 139 participants. The average age of the participants was 20.23 years. There were nearly an equal number of women (53%) and men (47%) that participated. The overwhelming majority of the participants were Caucasian (88%). The junior class (41%) was the most represented year.

Measures

**Mirror Tracing Persistence Task (MTPT).** The MTPT requires participants to trace eight geometric shapes while viewing their hand movements in a mirror. The current study used the same procedure utilized in studies conducted by Brandon et al. (2003) and Quinn et al.
(1996). In this procedure, the first and last designs are easy to trace geometric designs, whereas the middle six designs are extremely difficult. The middle six designs are intended to be very difficult to solve in order to induce stress and frustration; the MTPT measures the ability to persist on a motor task under distress. Participants are seated in front of an apparatus that is designed and positioned to block participants’ view of both the sheet of paper in front of them and their hand while writing on the sheet of paper. However, they are able to see the paper and their hand by using the mirror. Each trial is timed and participants are allowed a maximum of 5 minutes to complete each design. If participants do not complete a design within 5 minutes, they are asked to move on to the next design. The dependent measure is the mean time spent on all designs a participant does not successfully solve. The internal consistency of the MTPT in the current study was .94 across shapes, which is comparable to the coefficient of .92 obtained by Brandon et al. The mean time participants persisted was 214.48 seconds, which is significantly greater than the 179.19 seconds mean persistence in the Brandon et al. study, $t(243) = 3.10, p < .01$.

**Anagram Persistence Task (APT).** The APT was based on an anagram task first developed by Eisenberger in the 1970’s and used in research assessing the effects of perceived task difficulty on task persistence (Eisenberger & Leonard, 1980). Quinn et al. (1996) developed the APT, which was further refined by Brandon et al. (2003). Participants are asked to solve 11 anagrams. Trials 1, 5, 9, 10, and 11 are relatively easy to solve anagrams (e.g., $NTRA1 = TRAIN$) and are included to maintain participants’ motivation. The remaining trials are anagrams that are extremely difficult to solve (e.g., $LMAAE = MALAE$). The difficult to solve anagrams are intended to induce stress and frustration, as the APT was designed to assess task persistence in the cognitive domain when experiencing distress (Quinn et al., 1996). Participants receive a
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stack of index cards with one anagram printed on each and are asked to record their responses on a separate sheet of paper. After 4 minutes of working and not being able to solve an item, participants are instructed to move to the next trial. The dependent measure is the mean amount of time spent working on the six extremely difficult to solve anagrams (items 2, 3, 4, 6, 7, 8). In the current study, the internal reliability coefficient across the six difficult items was .94 and the mean time participants persisted was 56.88 seconds. In a prior study by Brandon et al., the internal consistency coefficient was comparable, at .95, but the mean time spent working on the six difficult anagrams was longer at 84.61 seconds, which is significantly different than the current study, \( t(277) = 5.12, p < .01 \).

**Cold pressor task.** A cold pressor was used to assess capacity to tolerate physical discomfort. The cold pressor task involved having participants submerge their hand in cold water (around 32 degrees Fahrenheit) for as long as they could tolerate. The amount of time individuals are able to submerge their hand has been shown to be positively correlated with the ability to perform under stress and negatively correlated with emotional disturbance (see Budoff & Liebowitz, 1964). The cold pressor task involves filling a plastic bucket with water and ice and allowing the bath to sit until the temperature is around the freezing point (32 ± 2 degrees Fahrenheit). Past research using the same procedure produced mean time submerged of 23.21 seconds (Younger et al., 2008). In the current study, the average time participants kept their hand submerged was 91.80 seconds, over three times that of Younger et al., (2008).

**Barratt Impulsiveness Scale-11A (BIS-11A).** The BIS-11A consists of 30 items designed to measure impulsiveness. Each question on this self-report questionnaire is answered on a 4-point Likert-type scale (1 = Rarely/Never 4 = Almost Always/Always). The BIS-11A is a precursor to the BIS-11 and was used during the development of the latter measure (Barratt,
1994). The BIS-11 has been shown to reliably differentiate between populations, with undergraduate students scoring significantly lower than patient groups and (male) prison inmates scoring significantly higher than males in either patient or student groups (Patton, Stanford, & Barratt, 1995). It provides an overall score that can range from 30 to 120, with higher scores representing greater impulsivity. Second order factors that can be measured are Motor Impulsiveness (sample item = I act on the spur of the moment.), Nonplanning Impulsiveness (sample item = I say things without thinking.), and Attentional Impulsiveness (sample item = I don’t “pay attention.”). Only the overall impulsivity score was utilized in the current study. The BIS-11A is highly similar to the BIS-11, with 24 identical items, and was used in the current study. After analyzing the data in the current study, the internal consistency of the BIS-11A was found to be unacceptably low with an alpha coefficient of .50. In order to improve internal reliability, each item’s relation to the total score was examined and the item with the lowest correlation was removed in an iterative manner until an acceptable internal consistency of .81 was achieved, resulting in the removal of 15 of the original 30 items. The remaining 15 items were included in the analysis. Examples of retained items are “I do things without thinking” and “I solve problems by trial and error.” As a result, scores ranged from 15 to 60.

**Distress Tolerance Scale (DTS).** The DTS is a 14-item self-report questionnaire developed by Simons and Gaher (2005). The DTS is unidimensional and captures tolerance, appraisal, absorption, and regulation of affective distress (sample question = Feeling distressed or upset is unbearable to me.). Each item is rated on a 5-point Likert-type scale ranging from *Strongly agree* (1) to *Strongly disagree* (5). All items are summed to create a single score and higher scores indicate higher tolerance for affective distress; scores can range from 14 to 70. The DTS has demonstrated good convergent and discriminate validity; it has shown negative
correlations with measures of affective distress and affective dysregulation and with alcohol and marijuana used as a coping motive. By contrast, the DTS has shown positive correlations with self-reported ability to regulate moods. The DTS has been shown to be quite stable over time. Six-month test-retest reliability revealed a coefficient of .61 (Simons & Gaher, 2005). In the current study, the internal reliability coefficient of the DTS was .84.

**Difficulties in Emotion Regulation Scale (DERS).** The DERS is a 36-item self-report questionnaire designed to assess difficulty regulating emotions during times of distress (Gatz & Roemer, 2004). Each item is rated on a Likert-type scale from 1 (*almost never*) to 5 (*almost always*); individual items are summed to create an overall score; scores can range from 36 to 180 and higher scores reflect greater difficulty regulating emotions. The DERS has shown high internal consistency with a Cronbach's alpha of .93 and good convergent validity in prior studies (Gatz & Roemer, 2004). Scores on the DERS have shown significant positive correlations with other measures of emotional regulation, with self-harm, and with partner abuse. The DERS has also been shown to be a stable measure; the test-retest correlation coefficient was .88 for a range of 4 to 8 weeks between administrations. An internal consistency coefficient of .85 was obtained in the current study.

**Drinking Behavior Survey (DBS).** The DBS is a 26-item measure developed for the current study to assess alcohol use and perceived alcohol use norms. It was based on a measure used in an unpublished dissertation (Price, 2010) and used standard drink quantities to assess alcohol use patterns. The DBS provided data on binge drinking frequency and typical quantities of alcohol consumed. Questions 14 through 26 were drawn from the criteria found in the *Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition* (DSM-IV) for alcohol abuse and alcohol dependence, with minor changes made in the wording to make the language
more understandable and applicable to college participants. Binge drinking was operationally defined as 5 or more drinks in a two hour period for men and 4 or more drinks in a two hour period for women. The DBS included a question that asked how often the respondent engaged in this behavior during the prior two weeks, which represented the binge drinking measure. Amount of alcohol consumed during a 2-week period was calculated by multiplying number of days a participant reported drinking during a typical week by the number of drinks they typically consume per occasion and then multiplying the total by two. The DBS included four questions related to alcohol abuse and nine questions related to alcohol dependence. Participants were determined to have met criteria for abuse if they endorsed one of the four items specifically related to alcohol abuse. There were nine questions to assess the seven items within the dependence criteria, as two questions were related to tolerance and two questions were related to withdrawal symptoms. As a result, participants met criteria for dependence if they endorsed three or more items from seven items within the dependence criteria. These were not treated as mutually exclusive categories, so participants could meet criteria for abuse and dependence.

Procedure

After providing informed consent, participants were asked to provide demographic information and to complete the DBS before moving on to complete either the self-report or performance-based measures. The order of administration of both the three self-report and the three performance-based measures alternated between participants in order to minimize potential order effects. Fifty-one percent of participants completed the self-report measures first and 49% completed the performance-based measures first.
Results

All data was visually assessed for normalcy prior to analyses. Among the alcohol use variables, one participant was identified as an outlier, as the reported number of binge drinking episodes was greater than three standard deviations above the mean. This value was recoded as three standard deviations above the mean to retain its place in the distribution but reduce distorting effects. There were no additional aberrant data. All the performance-based measures had limits on the time participants could spend working on individual items, eliminating the possibility of high-value outliers. All participants persisted long enough to suggest that they exerted some effort to solve the individual items and produced usable data. In a few cases (n = 7), participants successfully completed each item on the MTPT and their data could not be utilized when evaluating performance on that particular task.

Demographics

Demographic data for the sample is contained in Table 1 and Table 2. On average, reported GPA was 3.28, with women (M = 3.36, SD = .39) reporting significantly higher GPA than men (M = 3.20, SD = .43), t(137) = 2.37, p = .02. Majors varied greatly, with psychology the most represented (29%). Significantly more women (44%) were majoring in psychology than were men (12%), χ²(1, N = 139) = 17.01, p <.001. The vast majority of the students were Non-Hispanic White (87%) and all participants were single (100%). Participants were equally likely to reside on-campus (54%) and off-campus (46%), χ²(1, N = 139) = .87, ns. Participants reportedly engaged in a variety of extracurricular activities.

Alcohol Use

Consuming alcohol and heavy alcohol use were common activities among participants (see Table 3). However, men were significantly more likely to consume alcohol, t(137) = 2.29, p
= .02, and to binge drink than women $t(137) = 2.93, p = .004$. Data about drinking occasions per week, drinks per occasion, and binge drinking episodes during the past two weeks are presented in Table 4. Men drank significantly more often than women, $t(137) = 2.60, p = .01$; additionally, men drank significantly more per drinking occasion than women, $t(136) = 3.84, p < .001$, and men consumed significantly more alcohol during a typical 2-week period than women, $t(136) = 3.71, p < .001$.

**Performance-Based Measures**

Time spent completing the MTPT, APT, and cold pressor task was compared in order to determine the degree of overlap between measures. The MTPT, $r(129) = .11, ns$, and the APT, $r(136) = .15, ns$, were not significantly correlated with the cold pressor task. This suggests that the cold pressor task measures a unique form of persistence (i.e. physical) that is distinct from what is measured by the MTPT and APT. The MTPT and APT are designed to induce psychological distress. As expected, these measures were modestly, but significantly correlated, $r(130) = .21, p = .02$.

Results from the MTPT, APT, and cold pressor task are summarized in Table 5. Men persisted longer than women on the MTPT, but the difference was not significant, $t(130) = 1.57, ns$. Men also persisted longer than women on the APT, but, again, the difference was not significant, $t(137) = 1.93, ns$. There was a significant difference in time spent between men and women on the cold pressor task. Men persisted significantly longer than women, $t(136) = 3.35, p = .001$.

**Self-Report Measures**

Data from the DERS, DTS, and modified BIS-11 are presented in Table 6. Mean scores for the DERS, DTS, and modified BIS-11 were $M = 91.83$, $M = 50.82$, and $M = 31.33$, \ldots
respectively. No significant differences were found between men and women on any of the three measures.

**Analyses for Primary Hypotheses**

The first two hypotheses were supported; specifically, it was predicted that performance on the cold pressor task would not be a significant predictor of number of binge drinking episodes during the prior two weeks or a significant predictor of amount of alcohol consumed during a 2-week period. This first hypothesis was tested by regressing binge drinking episodes on the cold pressor task performance. Results showed no relation ($\beta = .12, \text{ ns, 95\% CI [-.001, .008]}$), nor was the cold pressor task performance predictive of number of drinks consumed during a typical 2-week period ($\beta = .16, \text{ ns, 95\% CI [-.003, .100]}$). However, additional hypotheses were not supported. It was predicted that performance on the MTPT and the APT would predict number of binge drinking episodes during the prior two weeks and number of drinks consumed during a typical 2-week period, with less time spent persisting on the MTPT and APT predicting more binge drinking episodes and more drinks consumed. Time spent working on the APT was not predictive of binge drinking episodes during the prior two weeks ($\beta = -.07, \text{ ns, 95\% CI [-.011, .004]}$) or amount of alcohol consumed during a typical 2-week period ($\beta = -.07, \text{ ns, 95\% CI [-.110, .047]}$). Time spent persisting to solve items on the MTPT was not predictive of binge drinking episodes during the prior two weeks ($\beta = -.11, \text{ ns, 95\% CI [-.001, .001]}$). Performance on the MTPT failed to predict the amount of alcohol typically consumed during a 2-week period ($\beta = -.11, \text{ ns, 95\% CI [-.064, .014]}$).

**Analyses for Secondary Hypotheses**

According to the mediation analysis procedure developed by Baron and Kenny (1986), a significant relationship is required between a predictor and criterion variable in order to assess
for potential mediation variables. This mediation approach was used in developing the secondary hypotheses. As no relations were identified in the primary hypotheses, the secondary hypotheses could not be examined using Baron and Kenny’s procedure. However, the pathways between self-report measures and other variables were able to be examined using an alternative mediation testing procedure developed by Preacher and Hayes (2008), which does not require a significant relationship between a predictor and criterion; this strategy can be used to examine indirect effects and uses a bootstrapping process to generate possible samples.

Using the Preacher and Hayes (2008) technique for assessing multiple mediators, the self-report measures (DTS, DERS, modified BIS-11A) were tested as potential mediators of the relations between the performance-based measures and measures of alcohol use. Separate models were created to examine the relations between the self-report measures, MTPT performance, and number of binge drinking episodes during the prior two weeks and relations between the self-report measures, APT performance, and number of binge drinking episodes during the prior two weeks. Models were also created to examine the relation between the three performance-based measures and total number of drinks consumed during a typical 2-week period.

The results are presented in Tables 7, 8, 9, and 10. Examining the confidence interval for the bootstrapping samples is the recommended method for identifying significant relations between variables. If the confidence interval does not contain zero, then there is a significant relation. No significant indirect effects were identified using the Preacher and Hayes (2008) bootstrapping method.
Exploratory Analyses

Additional analyses were conducted to identify predictors other than the hypothesized performance measures of binge drinking episodes and amount of alcohol typically consumed. The primary hypothesis examined the relation between performance-based measures and alcohol use measures. However, the direct relations between self-report measures and alcohol use measures were not examined. This testing was done as part of exploratory analysis. The relation between each of the three self-report measures on number of binge drinking episodes during the prior two weeks and number of drinks consumed during a typical 2-week period were assessed. Further, differences between men and women were examined. Results of the tests of the three self-report measures and binge drinking episodes revealed only one significant result. Affect regulation ($\beta = -.44, \text{ns}, 95\% \text{ CI} [-.27, .05]$) and distress tolerance ($\beta = .21, \text{ns}, 95\% \text{ CI} [-.01, .05]$) were not related to binge drinking. However, among all participants, self-reported impulsivity, as measured by the BIS, was a significant predictor of binge drinking episodes during the prior two weeks ($\beta = .21, p = .01, 95\% \text{ CI} [.012, .106]$). Among women, BIS scores significantly predicted binge drinking during the prior two weeks ($\beta = .27, p = .02, 95\% \text{ CI} [.011, .137]$) and the amount of alcohol typically consumed during a 2-week period ($\beta = .30, p = .01, 95\% \text{ CI} [.154, 1.149]$). Among men, BIS scores significantly predicted meeting the criteria for alcohol abuse ($Wald = 5.29 \beta = .10, p = .02$). Performance on the MTPT was found to be a significant predictor of meeting the criteria for alcohol abuse ($Wald = 4.66 \beta = -.005, p = .03$) among all participants. Once sex was entered into the equation, a significant interaction emerged. Examination of the interaction revealed a significant relation between MTPT performance and meeting the criteria for alcohol abuse in women ($Wald = 6.42 \beta = -.008, p = .01$) and not in men ($Wald = .42 \beta = -.002, \text{ns}$). A mediation model was created to examine the
relations between self-report measures, MTPT performance, and meeting modified DSM criteria for alcohol abuse because of the significant relationship between MTPT and meeting the criteria for alcohol abuse. No significant indirect effects emerged.

**Discussion**

The current study examined whether persistence in solving challenging tasks could predict alcohol use patterns, including binge drinking. In addition to assessing for primary relations between three different types of task persistence, one physical and two psychological, and alcohol use patterns, the constructs of affect regulation, distress tolerance, and impulsivity were investigated as potential mediating factors of any obtained relations. The research question derived from growing concerns about hazardous behavior related to alcohol use among college students (Wechsler et al., 2000) and the benefit of identifying at-risk students early in order to provide intervention. It was hypothesized that task persistence might function as a behavioral marker of high risk drinking.

Participants in the study drank with a high degree of frequency, with 76% reporting that they typically consumed some alcohol during a 2-week period. Among those who consumed alcohol, 69% binge drank at least one time during the prior two weeks, representing 54% of the full sample. The study sample's consumption is higher than recent national norms, which have found binge drinking among college students has declined from a peak of 45.6% in 2006 to 39.1% in 2011, the most recent data available (SAMHSA, 2012); however, it is consistent with prior data both concerning binge drinking at the university the sample was drawn from, which in 2010 had a binge drinking rate of 57.6% (Xavier 2010 Core Data; Core Institute, 1994) and binge drinking in a national sample of 18 - 20 year olds, which found 72% of those who used alcohol binge drank in the prior 30 days (Office of Juvenile Justice and Delinquency Protection,
2005), suggesting that the sample engaged in comparable drinking patterns as same-aged peers. In the current sample, men were significantly more likely to binge drink than women and consumed approximately twice as much alcohol during a typical 2-week period. Men averaged 25 drinks in a 2-week period and women averaged 13 drinks. Thirty-seven percent of the sample \( (n = 52) \) met DSM criteria for abuse and 17% \( (n = 24) \) met criteria for alcohol dependence. Among the 52 participants who met criteria for abuse, 16 also met criteria for dependence, leaving 26% \( (n = 36) \) who met criteria for only abuse. These data indicate that fully 43% \( (n = 60) \) of the sample experienced detrimental outcomes from their drinking behavior by meeting DSM criteria for abuse or dependence.

As a first step in identifying possible early, objective markers of problem drinking, the current study tested the specific hypotheses that time spent working on the MTPT and APT would predict binge drinking and the amount of alcohol consumed during a 2-week period, with less persistence being associated with greater frequency of binge drinking and more alcohol consumed. However, these hypotheses were not supported. Instead the results revealed no relation between persistence on either of the two tasks – one tapping primarily motor persistence in the face of frustration (the MTPT) and the other tapping primarily cognitive persistence in the face of frustration (the APT) – and binge drinking and the total quantity of alcohol consumed. However, the MTPT, but not the APT, was a significant predictor of meeting criteria for alcohol abuse, suggesting that when drinking is quantified in terms of outcomes rather than amount consumed, a behavioral measure of the capacity to tolerate frustration and work toward a goal may hold some promise in discriminating truly problem from merely heavy drinking. The category of abuse was not treated as a mutually exclusive category from dependence in this study because abuse criteria emphasize problems resulting from heavy alcohol consumption which
would provide some information about alcohol-related problems. This finding was examined further and was found to hold for women but not for men. Although without additional data, inferences drawn from this relation are highly speculative and should be treated with caution. This finding may suggest that a behavioral persistence task can sensitively index women most vulnerable to hazardous or problem drinking. As the relation did not emerge for men, it may be that the motivators and individual difference risk factors associated with progressing from merely heavy to hazardous drinking are different for young women. However, tests of possible mediation by self-report measures of affect regulation, distress tolerance, and impulsivity all produced null results, despite a significant zero-order relation between impulsivity and binge drinking among women. This absence of indirect effects suggests that the cause of the relation between abusive drinking and the MTPT is distinct from the relation between impulsivity and binge drinking and not accounted for by affective factors; however it is also possible that as the affective measures were self-report, women most susceptible to hazardous drinking may not be skilled at self-reflection or recognizing and reporting internal states.

In addition to testing the relation between alcohol use patterns and performance on measures of persistence in the face of psychological distress, a measure of the capacity to persist in the face of physical distress – a cold pressor task – was also included. As problem drinking was conceptualized as a potential method of escaping from psychological discomfort, it was hypothesized that no relation would emerge between performance on the cold pressor task and the two drinking variables. This hypothesis was supported by the data. In our sample, the ability to tolerate physical pain was unrelated to drinking patterns. This finding is consistent with the idea that expectancies about the ameliorative effects of alcohol may be associated with the ability of alcohol to diminish or manage frustration but do not extend to concrete physical discomfort.
As such, the factors that make it difficult for one to tolerate physical discomfort are distinct from those associated with problems related to psychological discomfort. Consistent with this idea, the cold pressor task showed no significant relation with either of the psychological persistence tasks ($r = .11$ with the MTPT; $r = .15$ with APT), indicating that the factors that allow one to sustain physical discomfort are different from those that allow one to sustain psychological discomfort. However, it should be noted that the current sample persisted for three times longer than a prior sample protocol (Younger et al., 2008), suggesting that, as a sample, they may have had atypically high pain tolerance.

In addition to testing the ability of behavioral measures of persistence to predict alcohol use patterns, the study also sought to test a proposed mechanism for why behavioral measures of persistence that bear no surface relation to alcohol use would be able to predict consumption patterns. To this end, it was hypothesized that any observed relations would be mediated by self-report measures of affect regulation, distress tolerance, and impulsivity. These constructs were chosen based on past research showing relations between each and alcohol use (Buckner et al., 2007; Dick et al., 2010; Simon, Gaier, Correia, et al., 2005). However, as the primary hypotheses that performance measures of psychological task persistence would be related to binge drinking and quantity of alcohol consumed were not supported, classical mediation analyses following the strategy outlined and promoted by Baron and Kenny (1986) could not be performed. Additionally, among the three measures, only impulsivity showed any significant relation to alcohol use, thereby violating another requirement of the Baron and Kenny approach, which requires that mediating factors have a zero-order or direct relation with the outcome as well. However, an alternative approach to mediation analysis developed by Preacher and Hayes (2008) does not require significant zero-order relations between predictor and criterion variables.
and was used to test for possible indirect effects. Using this method, affect regulation, distress tolerance, and impulsivity did not emerge as mediating variables or show any significant relation to any of the alcohol outcome measures. Although the self-report measures were included to investigate possible mediation and were not the primary focus of the study, the lack of relation between self-reported affect regulation, distress tolerance, and alcohol use variables was unexpected based on past research (Buckner et al., 2007; Simons, Gaer, Correia, et al., 2005) and suggests that the current sample may have differed in important ways from those of past research and the results from this study may have limited generalizability.

To this end, there are several aspects of the sample that bear consideration and may account for the lack of significant findings. First, the base rate for binge drinking in this sample was very high, thereby making it difficult to identify more problem drinking patterns due to restricted range. As noted, 54% of the total sample binge drank on at least one occasion during the prior two weeks, which exceeds national norms. Additionally, and perhaps more importantly, among participants who reported some alcohol use, 69% reported binge drinking on at least one occasion, thereby indicating that only a limited number of participants who drank alcohol did so in a moderate or controlled manner. The aim of the study was to identify behavioral measures that could identify students who are engaging in high risk drinking behavior in order to avoid response bias found with self-report measures. It was hoped that behavioral measures could sensitively index students at risk for problem drinking and discriminate them from students who used alcohol in a more controlled or moderate manner. The problem introduced with a high base rate is that discrimination becomes impossible when there are limited null cases. In effect, although it is probable that there were varied motivations for the binge drinking reported, and some of the sample are at high risk to continue with problem
alcohol use whereas others will mature out of high quantity drinking upon graduation and are not at risk for progression toward formal alcohol-related diagnoses, this could not be teased apart. If it were possible to follow that sample over time, it is likely that 5 to 10 years out, alcohol use rates would show much more variability, as data shows that alcohol use and binge drinking peaks among individuals 18 – 25 years old and thereafter declines (SAMHSA, 2012). As such, those students who are currently binge drinking due to normative and environmental reasons are likely to show significantly reduced consumption, hence leaving only those who are drinking due to individual difference factors. Within this framework, the high base rate effectively introduces many "false positives" when using binge drinking episodes to capture risk of sustained problem drinking. Certainly all the participants in the sample who reported binge drinking placed themselves at acute risk and used alcohol in a hazardous manner; this behavior should not be minimized or accepted as an inevitable aspect of the college experience. However, it is likely that the majority will not continue hazardous use over time, and the study hypotheses may have been more appropriate for a longitudinal design that utilized a long time horizon. It appeared that binge drinking for most in the current sample was not related to individual difference factors that may predispose them to viewing alcohol in utilitarian terms; rather, the sample engaged in high risk binge drinking regardless of their level of affect regulation, distress tolerance, and impulsivity. For these students, factors such as peer norms (Perkins, 2002b) may have been a better predictor of consumption patterns.

Second, the current sample showed different levels of task persistence on all three performance tests than have prior samples. As noted, persistence was three-fold on the physical persistence task and significantly different from prior samples on both the psychological persistence tasks. These latter differences are not readily understood, as they are not uniform in
direction. On one, the MTPT, the sample persisted significantly longer; on the other, the APT, they showed significantly less persistence than other samples. Within the sample, the MTPT and the APT showed a significant, but modest, relation with each other ($r = .21$) indicating that although both are conceptualized as measures of persistence in the face of psychological distress, there is considerable unique variance in their underlying structures. However, one possible explanation for the high persistence on the MTPT is that participants may have persisted, despite distress, due to high expectations about performance. Certainly the sample’s performance on the MTPT was anomalous when compared to prior studies. Examination of the sample’s MTPT revealed a ceiling effect and extended persistence. Fully 32% of the sample that did not successfully complete the items persisted for the full time allotted and the sample as a whole persisted for significantly longer than prior samples on the same mirror-tracing task. For example, when compared with a sample of community residents (Brandon et al., 2003) using the same protocol, the current sample persisted for 214 seconds, compared to 179 seconds for the community sample, $t(243) = 3.10, p < .01$. This difference may be the result of the current sample being comprised of college students with high performance expectations. College students have consistently demonstrated a tendency to be highly optimistic about their ability to perform, which is related to high self-efficacy (Svanum & Bigatti, 2006). The MTPT appears to be easy to complete, but is actually very difficult. Anecdotally, participants often made comments about how they should have been able to easily complete the task. Their inability to perform well may have threatened their belief about performance ability, leading them to persist for long periods of time. Additionally, college attendance itself requires a degree of persistence and ability to tolerate frustration in pursuit of a goal. As such, the MTPT may be less sensitive when used with college students. In keeping with the idea that the MTPT operates differently in
the college population is a recently published study which found the MTPT to be a significant predictor of smoking cessation in a community sample (Steinberg et al., 2012), demonstrating the MTPT can be an effective measure for differentiating substance use patterns. Just as the high prevalence of binge drinking produced a restricted range, the sample’s high persistence resulted in a restricted range, reducing the measure’s discriminative properties. Removing the task’s time limits may have more effectively differentiated among the participants’ ability to persist in the face of distress.

However, the sample persisted less on the APT than anticipated, based on past samples’ performance (Brandon et al., 2003). One possible reason is that the APT may not have induced a marked level of distress. Participants in the current study persisted for 57 seconds on the difficult to solve anagrams, which was significantly less than a community sample which persisted for 85 seconds, t(277) = 5.12, p < .01, (Brandon et al., 2003). The current sample also did not exhibit the same level of frustration as they did when trying to solve the MTPT. This lower persistence may be the result of participants comparing the jumbled letters with words they knew and quickly determining that they knew no words comprised of the given letters. In essence, the task may have been less threatening because they did not perceive themselves capable of solving the challenging items. The effect may have been twofold; they did not become highly distressed and they were not motivated to persist. Additionally, it is noteworthy that past research has shown that the APT has weaker predictive power and relations with substance abuse outcomes than does the MTPT (Quinn et al., 1996). Past research has shown that individuals are able to make decisions quickly about the perceived likelihood of correctly solving an item. People tend to give up more quickly when they perceive a task to be impossible to solve and persist longer when they perceive success to be more likely (Eisenberger, &
Leonard, 1980). As such, people may have quickly determined that the difficult to solve anagrams could not be solved and moved on to the next item. Although some past research (Brandon et al., 2003) has hypothesized that individuals’ speed in determining they could not solve the difficult anagram problems might have been related to limited higher — or formal — education, as the studies used community samples, the current study offers a countervailing view. Based on the current sample, it may be that college students are even more prone to rapidly assess the likelihood of success and may be more certain about the extent of their knowledge and thereby, are more comfortable desisting quite rapidly.

Despite the absence of significant results between performance-based measures of task persistence and alcohol use behavior, it was anticipated that distress tolerance, affect regulation, and impulsivity would still show both direct and mediating effects between the variables. However, in large part, this did not emerge. Only impulsivity showed a direct relation with consumption. None of the variables showed any indirect mediational effects. The most likely explanation for the absence of mediation is that, as there were no significant direct effects between the performance measures and alcohol use patterns, there was far too little power to detect modest indirect effects. The high base rate of heavy alcohol use required a much larger sample than anticipated. With binge drinking being such a common activity, the students in this sample were likely drinking heavily regardless of affective states, perceived ability to regulate affect, and tolerance of negative affect. In conducting exploratory analyses, impulsivity did emerge as a significant predictor of binge drinking for women and meeting criteria for alcohol abuse among men. This significant finding suggests that acting without foresight of consequences may be more likely to lead college students to drink excessively than difficulty dealing with distress. A study published in 2011 found a correlation between impulsivity and
binge drinking among college students (Kazemi, Wagenfeld, Van Horn, Levine, & Dmochowski, 2011), further supporting this relationship.

There are several limitations in the current study. First, the sample was exclusively drawn from a private university in the Midwest with higher than normative binge drinking rates, which limits the generalizability of results. Different patterns of alcohol use may emerge at larger, public universities or in a different region of the country. Second, there was no measure of how subjectively-distressing participants found the performance-based measures. In order to reduce the likelihood that participants would guess the intention of the study, a self-report measure of distress was not administered after completing each task. As a result, behavioral observations are the only information available to indicate how distressing the tasks were and, despite impressions, it may be that the APT was as distressing as the MTPT. Third, the impulsivity measure used showed very poor initial internal consistency, resulting in the elimination of half of the items. Although this was the only self-report measure to show a relation with alcohol use, a better measure may have performed more robustly and captured variance missed by the current measure.

Despite the limitations of this study and modest significant results, the information obtained from this study has use for guiding future research. As anticipated, there was no relation between a measure of physical discomfort (i.e., cold pressor task) and alcohol use behavior, which is consistent with prior research finding psychological distress and not physical distress is related to substance abuse patterns (Buckner et al., 2007; Daughters et al., 2005). There appears to be little value in continuing to explore potential relations between persistence in the face of physical distress and binge drinking. The high prevalence of binge drinking among college students creates challenges in identifying problem use because so many are engaging in
high risk behavior. It may be more beneficial to examine relations between predictor variables and alcohol-related problems. Future research may examine the relation between task performance and problems resulting from alcohol use, including fines, academic problems, and physical injuries. Finally, it may be that designs such as this study are more appropriate for predicting long-term problems and not acute risk. Given that there is a solid research base to support performance measures as predictors of substance use and cessation in community samples and among long-term users (Alterman et al., 1984; Brandon et al., 2003; Cynn 1992; Daughters et al., 2005; Quinn et al., 1996; Steinberg et al., 2012), it appears premature to abandon this methodology in the college population without assessing its utility in predicting distal outcomes. As noted above, data suggest that many students will mature out of problem use (O’Malley, 2005) and it would be important to track individuals over time to determine if task persistence might function as a marker of future alcohol use patterns, once range is less restricted. If this turns out to be the case, then early intervention programs tailored to students who “carry” the marker and are most at risk for long-term alcohol use problems could be developed and implemented alongside programs aimed at reducing normative hazardous use.
References


Footnotes

1 In light of the anomalies that emerged in the current sample's performance measure outcomes when compared to the results found in prior samples of community residents, a series of analyses were conducted to investigate potential confounding factors. A number of possible researcher effects were explored. The data was collected by five investigators: three female undergraduate research assistants, one male undergraduate research assistant, and the primary (male) graduate student investigator. All types of data were collected by each investigator, as participants completed all tasks in one session under the guidance of one investigator. First, the data were examined for differences between the individual investigators, with no significant differences found. Second, the data was collapsed by sex of the investigator and examined again. There were no main effects of sex of the investigator and no interaction between sex of the investigator and the sex of participant. The reason for the anomalies remains a mystery and worthy of additional investigation. All research assistants completed rigorous training in administration of the measures and continued adherence to administration protocol was checked throughout the length of the study in order to ensure consistency. It may be that the obtained results were unique to this university setting and may not hold true at other universities. Conversely, it may be that our findings captured a marked, but unanticipated, difference between college and community samples. As such, we encourage further study of these measures within college populations to determine if the current results are as aberrant as they appear when viewed in the context of prior research.
Table 1

*Individual Characteristics as a Percentage of the Sample*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Males (n = 66)</th>
<th>Females (n = 73)</th>
<th>Total (n = 139)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year in college</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First year</td>
<td>16.7</td>
<td>13.7</td>
<td>15.1</td>
</tr>
<tr>
<td>Sophomore</td>
<td>19.7</td>
<td>24.7</td>
<td>22.3</td>
</tr>
<tr>
<td>Junior</td>
<td>42.4</td>
<td>39.7</td>
<td>41.0</td>
</tr>
<tr>
<td>Senior</td>
<td>21.2</td>
<td>21.9</td>
<td>21.6</td>
</tr>
<tr>
<td>Major **</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychology</td>
<td>12.1</td>
<td>43.8</td>
<td>28.8</td>
</tr>
<tr>
<td>Other</td>
<td>87.9</td>
<td>56.2</td>
<td>71.2</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>6.1</td>
<td>8.2</td>
<td>7.2</td>
</tr>
<tr>
<td>White</td>
<td>86.4</td>
<td>87.7</td>
<td>87.1</td>
</tr>
<tr>
<td>Native Hawaiian/</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacific Islander</td>
<td>0.0</td>
<td>1.4</td>
<td>0.7</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>4.6</td>
<td>2.7</td>
<td>3.6</td>
</tr>
<tr>
<td>American Indian/</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alaska Native</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Other</td>
<td>1.5</td>
<td>0.0</td>
<td>0.7</td>
</tr>
<tr>
<td>Residence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-campus</td>
<td>53.0</td>
<td>54.8</td>
<td>54.0</td>
</tr>
<tr>
<td>Off-campus</td>
<td>47.0</td>
<td>45.2</td>
<td>46.0</td>
</tr>
<tr>
<td>Extracurricular activities†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Club Team</td>
<td>19.7</td>
<td>21.9</td>
<td>20.9</td>
</tr>
<tr>
<td>Intramural **</td>
<td>37.9</td>
<td>17.8</td>
<td>27.3</td>
</tr>
<tr>
<td>Volunteering **</td>
<td>34.8</td>
<td>63.0</td>
<td>49.6</td>
</tr>
<tr>
<td>Clubs</td>
<td>53.0</td>
<td>67.1</td>
<td>60.4</td>
</tr>
<tr>
<td>Varsity Sports</td>
<td>12.1</td>
<td>6.8</td>
<td>9.4</td>
</tr>
</tbody>
</table>

*Note. * = p < .05 between males and females; ** = p < .01 between males and females; *** = p < .001 between males and females; † Total exceeds 100% as form allowed for endorsement of participation in multiple activities*
Table 2  
*Age and Academic Performance*

<table>
<thead>
<tr>
<th>Variable</th>
<th>M (SD)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LL</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>20.23 (1.2)</td>
<td>20.02</td>
</tr>
<tr>
<td>Females</td>
<td>20.15 (1.2)</td>
<td>19.87</td>
</tr>
<tr>
<td>All participants</td>
<td>20.23 (1.2)</td>
<td>20.03</td>
</tr>
<tr>
<td>**GPA *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>3.20 (0.4)</td>
<td>3.09</td>
</tr>
<tr>
<td>Females</td>
<td>3.36 (0.4)</td>
<td>3.27</td>
</tr>
<tr>
<td>All participants</td>
<td>3.28 (0.4)</td>
<td>3.21</td>
</tr>
</tbody>
</table>

*Note. CI = confidence interval; * = p < .05 between males and females; ** = p < .01 between males and females; *** = p < .001 between males and females*
Table 3
Alcohol Use Characteristics as a Percentage of the Sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Males (n = 66)</th>
<th>Females (n = 73)</th>
<th>Total (n = 139)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typically consumed alcohol *</td>
<td>84.8</td>
<td>68.5</td>
<td>76.3</td>
</tr>
<tr>
<td>Binge drank during prior two weeks **</td>
<td>66.7</td>
<td>42.5</td>
<td>54.0</td>
</tr>
<tr>
<td>Met modified DSM criteria for abuse</td>
<td>40.9</td>
<td>34.2</td>
<td>37.4</td>
</tr>
<tr>
<td>Met modified DSM criteria for dependence</td>
<td>18.2</td>
<td>16.4</td>
<td>17.3</td>
</tr>
<tr>
<td>Met modified DSM criteria for abuse or dependence</td>
<td>45.5</td>
<td>41.1</td>
<td>43.2</td>
</tr>
</tbody>
</table>

Note. * = $p < .05$ between males and females; ** = $p < .01$ between males and females; *** = $p < .001$ between males and females.
## Alcohol Use Patterns

<table>
<thead>
<tr>
<th>Variable</th>
<th>M (SD)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical drinking occasions per week*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>1.86 (1.2)</td>
<td>1.57</td>
</tr>
<tr>
<td>Females</td>
<td>1.34 (1.2)</td>
<td>1.07</td>
</tr>
<tr>
<td>All participants</td>
<td>1.59 (1.2)</td>
<td>1.39</td>
</tr>
<tr>
<td>Drinks per occasion***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>5.83 (3.8)</td>
<td>4.89</td>
</tr>
<tr>
<td>Females</td>
<td>3.72 (2.5)</td>
<td>3.12</td>
</tr>
<tr>
<td>All participants</td>
<td>4.73 (3.4)</td>
<td>4.16</td>
</tr>
<tr>
<td>Binge episodes over two weeks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>1.76 (1.8)</td>
<td>1.31</td>
</tr>
<tr>
<td>Females</td>
<td>1.17 (1.8)</td>
<td>0.76</td>
</tr>
<tr>
<td>All participants</td>
<td>1.45 (1.8)</td>
<td>1.15</td>
</tr>
<tr>
<td>Number of drinks consumed during a typical 2-week period***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>24.90 (21.8)</td>
<td>19.54</td>
</tr>
<tr>
<td>Females</td>
<td>13.39 (14.1)</td>
<td>10.08</td>
</tr>
<tr>
<td>All participants</td>
<td>18.89 (19.0)</td>
<td>15.69</td>
</tr>
</tbody>
</table>

Note. CI = confidence interval; * = $p < .05$ between males and females; ** = $p < .01$ between males and females; *** = $p < .001$ between males and females; Units of standard drink units (12 oz. of beer, 8 oz. of wine; 12 oz. of wine cooler, and 1.5 oz. of liquor); Number of drinks consumed during a typical 2-week period was calculated using the following formula: (Typical drinking occasions per week times X Drinks per occasion) X 2
**Table 5**

*Performance-Based Measures*

<table>
<thead>
<tr>
<th>Variable</th>
<th>$M (SD)$</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LL</td>
</tr>
<tr>
<td><strong>MTPT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>226.38 (78.7)</td>
<td>206.57</td>
</tr>
<tr>
<td>Females</td>
<td>203.62 (87.1)</td>
<td>182.71</td>
</tr>
<tr>
<td>All participants</td>
<td>214.48 (83.6)</td>
<td>200.09</td>
</tr>
<tr>
<td><strong>APT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>63.86 (46.6)</td>
<td>52.40</td>
</tr>
<tr>
<td>Females</td>
<td>50.58 (34.2)</td>
<td>42.60</td>
</tr>
<tr>
<td>All participants</td>
<td>56.88 (41.0)</td>
<td>50.01</td>
</tr>
<tr>
<td><strong>Cold Pressor Task</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>109.70 (61.5)</td>
<td>94.59</td>
</tr>
<tr>
<td>Females</td>
<td>75.40 (58.9)</td>
<td>61.56</td>
</tr>
<tr>
<td>All participants</td>
<td>91.80 (62.3)</td>
<td>81.31</td>
</tr>
</tbody>
</table>

*Note.* CI = confidence interval; Performance on the MTPT, APT, and cold pressor task were measured in seconds; $* = p < .05$ between males and females; $** = p < .01$ between males and females; $*** = p < .001$ between males and females.
Table 6
Self-Report Measures

<table>
<thead>
<tr>
<th>Variable</th>
<th>M (SD)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LL</td>
</tr>
<tr>
<td>DERS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>90.37 (14.5)</td>
<td>86.77</td>
</tr>
<tr>
<td>Females</td>
<td>93.19 (13.6)</td>
<td>89.93</td>
</tr>
<tr>
<td>All participants</td>
<td>91.82 (14.1)</td>
<td>89.43</td>
</tr>
<tr>
<td>DTS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>51.86 (9.5)</td>
<td>49.50</td>
</tr>
<tr>
<td>Females</td>
<td>49.88 (9.5)</td>
<td>47.65</td>
</tr>
<tr>
<td>All participants</td>
<td>50.82 (9.5)</td>
<td>49.21</td>
</tr>
<tr>
<td>Modified BIS-11A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>30.86 (6.5)</td>
<td>29.26</td>
</tr>
<tr>
<td>Females</td>
<td>31.74 (6.4)</td>
<td>30.24</td>
</tr>
<tr>
<td>All participants</td>
<td>31.33 (6.4)</td>
<td>30.25</td>
</tr>
</tbody>
</table>

Note. CI = confidence interval; maximum score on DERS = 180; maximum score on DTS = 75; maximum score on modified BIS-11 = 60; * = p < .05 between males and females; ** = p < .01 between males and females; *** = p < .001 between males and females.
Table 7
Indirect Effects of Self-Report Measures for MTPT on Binge Drinking Model

<table>
<thead>
<tr>
<th></th>
<th>Point Estimate</th>
<th>SE</th>
<th>Z</th>
<th>p value</th>
<th>Bootstrapping BCa 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>DERS</td>
<td>0.0001</td>
<td>0.0004</td>
<td>0.30</td>
<td>0.77</td>
<td>-0.0008 0.0012</td>
</tr>
<tr>
<td>DTS</td>
<td>-0.0004</td>
<td>0.0004</td>
<td>-0.90</td>
<td>0.37</td>
<td>-0.0021 0.0002</td>
</tr>
<tr>
<td>BIS</td>
<td>0.0002</td>
<td>0.0004</td>
<td>0.34</td>
<td>0.73</td>
<td>-0.0007 0.0014</td>
</tr>
<tr>
<td>Total</td>
<td>-0.0001</td>
<td>0.0006</td>
<td>-0.14</td>
<td>0.89</td>
<td>-0.0014 0.0012</td>
</tr>
</tbody>
</table>

Note. BCa, bias corrected and accelerated; 5,000 bootstrap samples
Table 8
*Indirect Effects of Self-Report Measures for MTPT on Drinks in a 2-Week Period Model*

<table>
<thead>
<tr>
<th></th>
<th>Point Estimate</th>
<th>SE</th>
<th>Z</th>
<th>p value</th>
<th>Bootstrapping BCa 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>DERS</td>
<td>-0.0037</td>
<td>0.0045</td>
<td>-0.83</td>
<td>0.41</td>
<td>LL: -0.0203  UL: 0.0020</td>
</tr>
<tr>
<td>DTS</td>
<td>-0.0025</td>
<td>0.0034</td>
<td>-0.74</td>
<td>0.46</td>
<td>LL: -0.0177  UL: 0.0023</td>
</tr>
<tr>
<td>BIS</td>
<td>0.0014</td>
<td>0.0036</td>
<td>0.39</td>
<td>0.70</td>
<td>LL: -0.0047  UL: 0.0142</td>
</tr>
<tr>
<td>Total</td>
<td>-0.0048</td>
<td>0.0056</td>
<td>-0.87</td>
<td>0.39</td>
<td>LL: -0.0193  UL: 0.0078</td>
</tr>
</tbody>
</table>

*Note.* BCa, bias corrected and accelerated; 5,000 bootstrap samples
Table 9

<table>
<thead>
<tr>
<th>Product Estimate</th>
<th>SE</th>
<th>Z</th>
<th>p value</th>
<th>Bootstrapping BCa 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LL</td>
</tr>
<tr>
<td>DERS</td>
<td>-0.0003</td>
<td>0.0007</td>
<td>-0.44</td>
<td>0.66</td>
</tr>
<tr>
<td>DTS</td>
<td>0.0013</td>
<td>0.0011</td>
<td>1.13</td>
<td>0.26</td>
</tr>
<tr>
<td>BIS</td>
<td>-0.0017</td>
<td>0.0011</td>
<td>-1.51</td>
<td>0.13</td>
</tr>
<tr>
<td>Total</td>
<td>-0.0008</td>
<td>0.0014</td>
<td>-0.58</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Note. BCa, bias corrected and accelerated; 5,000 bootstrap samples
Table 10

Indirect Effects of Self-Report Measures for APT on Drinks in a 2-Week Period Model

<table>
<thead>
<tr>
<th>Point</th>
<th>Products of Coefficients</th>
<th>Bootstrapping BCa 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Point Estimate</td>
<td>SE</td>
</tr>
<tr>
<td>DERS</td>
<td>0.0059</td>
<td>0.0082</td>
</tr>
<tr>
<td>DTS</td>
<td>0.0096</td>
<td>0.0098</td>
</tr>
<tr>
<td>BIS</td>
<td>-0.0132</td>
<td>0.0101</td>
</tr>
<tr>
<td>Total</td>
<td>0.0023</td>
<td>0.0139</td>
</tr>
</tbody>
</table>

Note. BCa, bias corrected and accelerated; 5,000 bootstrap samples
Summary

*Title:* Can Performance-Based Measures Predict Binge Drinking? An Empirical Investigation

*Problem.* Consuming large amounts of alcohol is a common activity among college students that can result in adverse consequences (Biscaro, Broer, & Taylor, 2004; Perkins, 2002; Wechsler, Lee, Kuo, & Lee, 2000). However, it is difficult to identify individual difference factors that can predict which students are more prone to consume large amounts of alcohol, putting themselves at risk in the process. Identifying at-risk individuals would allow for the implementation of early intervention strategies that focus on harm reduction. Previous research has found a relation between alcohol abuse and task persistence (Alterman, Tarter, Petraruolo, & Baughman, 1984; Cynn, 1992). However, the results of these studies cannot be generalized to college students as past participants were adults who chronically abused alcohol and had a formal diagnosis of alcohol dependence. The current study sought to examine whether task persistence could predict high risk alcohol use, as measured by binge drinking and total quantity of alcohol consumed. To aid in understanding the relation between task persistence and alcohol use measures, affect regulation, distress tolerance, and impulsivity were included as possible mediator variables. It was hypothesized that individuals who binge drank more often and consumed greater quantities of alcohol would persist less on psychologically frustrating tasks and that poor affect regulation, low distress tolerance, and greater impulsivity would account for this relation.

*Method.* Data was collected from 139 college students from a small, private, liberal arts university in the Midwest. Each participant completed three performance-based measures – Mirror Tracing Persistence Task (MTPT), Anagram Persistence Task (APT), and cold pressor task – and completed three self-report measures – Barratt Impulsiveness Scale-11A (BIS-11A), Distress Tolerance Scale (DTS), and Difficulties in Emotion Regulation Scale (DERS) – and
answered questions about their alcohol use patterns. The mean age of participants was 20.23
($SD = 1.2$) and men ($n = 66$) and women ($n = 73$) were equally represented in the sample.
Drinking was a very common behavior, as nearly 76% reported consuming alcohol on a regular
basis. Fifty-four percent of the full sample reported binge drinking within two weeks of
participating in the study. Linear regression was used to test whether the task persistence
measures were significant predictors of binge drinking and amount of alcohol consumed.

*Findings.* None of the three performance-based measures were found to predict frequency of
binge drinking or quantity of alcohol consumed. However, the MTPT was related to meeting
modified DSM-IV alcohol abuse criteria for the full sample and among women, but not men.

Follow-up mediation analysis using Preacher and Hayes (2008) approach that allows for but does
not require a significant direct effect was utilized to assess for indirect effects of distress
tolerance, affect regulation, and impulsivity for both the primary outcome variables of binge
drinking episodes and total quantity consumed, as well as the secondary outcome of meeting
abuse or dependence criteria. No significant relations emerged and none of the self-report
measures showed significant mediation effects on the relation between task persistence and any
of the alcohol use variables.

Binge drinking, and consuming large amounts of alcohol more generally, was a very
common behavior among participants, as 69% of participants who reported drinking also
reported binge drinking. This high base rate appears to have impeded the ability to separate
individuals who binge drank due to person factors and those who did so as the result of other
factors, such as peer behavior. However, as noted, among college students, task persistence was
more predictive of alcohol-related problems rather than quantity consumed.
Implications. The current study demonstrated that the relation between task persistence and alcohol use patterns identified in community samples did not generalize to a sample of college students. However, there appears to be value in continuing to examine the relation between task persistence, particularly as measured by the MTPT, and alcohol use outcomes rather than alcohol use quantities. Specifically, future research may examine predictors of early alcohol-related problems, as opposed to measures of quantity consumed, as this may more effectively identify students who are at higher risk.
References


