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**AN EVENT-LEVEL ANALYSIS OF DRINKING BEHAVIORS IN COLLEGE
FRESHMEN**

A Dissertation in
Biobehavioral Health

by

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ABSTRACT

The Center for Disease Control and Prevention indicates that alcohol use is the third leading preventable cause of death in the United States and results in approximately 79,000 deaths annually. College students are at particular risk of alcohol-related consequences due to their heavy drinking tendencies, with multiple studies indicating over 40% of students engage in the practice of binge drinking. Although there have been some promising findings with respect to programs that serve to reduce alcohol use and limit associated harm, researchers note the pressing need for the continued examination of etiological variables that can improve prevention efforts. Two important predictors of drinking outcomes identified in both the etiological and prevention literature are protective and risk behaviors students engage in while drinking. Although associations between drinking-related protective and risk behaviors and drinking outcomes have been well studied on their own, there is a lack of research examining how both types of behaviors operate collectively. Further, these variables are often assessed globally, such that students are asked to report their typical, or average use of these behaviors. Thus, it is unclear as to what types of protective and risk behaviors are most influential of drinking outcomes, whether these associations are consistent across multiple drinking events, and whether the use of these variables is consistent from one drinking event to the next.

Accordingly, there were three aims of the dissertation: 1) to examine the collective influence of individual drinking-related protective and risk behaviors on alcohol use and related consequences using a global assessment, 2) to examine the stability of drinking-related protective and risk behaviors over time, as well as relationships between these variables, alcohol use, and related consequences using an event-level assessment, and 3) to examine whether gender differences exist in the use of protective and risk behaviors over time.

Several findings emerged from the current study. Results of the global analysis revealed pacing protective behaviors, and drinking to get drunk, mixing, and mass consumption risk behaviors accounted for significant, unique variance in drinking outcomes. Results of the event-level analysis revealed that use of individual protective and risk behavior constructs were stable over time, however the associations between individual protective and risk behavior constructs, alcohol use, and consequences varied. Finally, results of the test for gender differences indicated that use of protective and risk behaviors over time was equivalent between males and females, with the exception of social protective behaviors and drinking to get drunk risk behaviors. Findings reinforce the importance of including components in prevention programs that aim to increase the use protective behaviors and decrease the use of risk behaviors, and also highlight the need for additional research that examines context-specific predictors of these constructs.

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CHAPTER ONE: INTRODUCTION

Alcohol use continues to be a significant public health issue among college populations, with reports suggesting that more than 40% of students engage in the excessive drinking phenomenon known as binge drinking, defined as five or more drinks for males or four or more drinks for females in a sitting (Johnston, O'Malley, Bachman, & Schulenberg, 2010; NIAAA, 2006; Wechsler, Davenport, Dowdall, Moeykens, & Castillo, 1994; Wechsler, Dowdall, Maenner, Gledhill-Hoyt, & Lee, 1998; Wechsler, Lee, Kuo, & Lee, 2000; Wechsler, Lee, Kuo, Seibring, Nelson, & Lee, 2002). The risks of heavy alcohol use among this group are great with a staggering number of consequences reported each year (Hingson, Heeren, Winter, & Wechsler, 2005; Hingson, Zha, & Weitzman, 2009). Such outcomes range in severity and include hangovers, blacking out, academic problems, sexual assaults, injury, and death, to name a few (Hingson et al., 2005, 2009; Perkins, 2002). Recent research suggests that alcohol use among this population is particularly risky given its negative impact on brain development, which is still occurring during this time (Doremus-Fitzwater, Varlinskaya, & Spear, 2010; Zeigler et al., 2005). Further, consequences of drinking are not limited to drinkers themselves but also other individuals in their immediate environment as well as society at large (Perkins, 2002).

Studies have identified numerous variables as predictors of both alcohol use and related consequences that vary among individuals such as attitudes, expectancies, and normative beliefs (Collins & Carey, 2007; Ham & Hope, 2003; Sher & Rutledge, 2007), as well as those that are environmental in nature including peer and parental influences (Abar & Turrisi, 2008; Neighbors, Lee, Lewis, Fossos, & Larimer, 2007; Turrisi, Ray, & Abar, 2010). Efficacious prevention efforts that incorporate findings from such studies have been developed in the form of cognitive skills-based training, normative re-education, brief motivational feedback, and parent-

based programs (Larimer & Cronce, 2007; 2002; Turrisi et al., 2009; Wood et al., 2010). Despite the efficacy of these programs, heavy drinking by college students continues to be a major social problem with epidemiological research pointing to a disappointingly stable pattern of use over the previous several decades (Johnston et al., 2010; Wechsler et al., 2002). Accordingly, there exists a need for additional etiological research that improves the informational bases of these interventions (Larimer & Cronce, 2007).

Drinking-related Protective and Risk Behaviors

Two important predictors of drinking outcomes identified in the college drinking literature are protective and risk behaviors students engage in while drinking. Protective behaviors can be defined as actions that serve to limit alcohol use and related harm, and include behaviors such as pacing drinks, setting drink limits, and walking home with a friend (Benton et al., 2004; Delva et al., 2004; Martens et al., 2004; Ray, Turrisi, Abar, & Peters, 2009). Risk behaviors, on the other hand, are actions that lead to increased alcohol use and harm, and in most studies include participation in drinking games and pre-gaming (also called pre-partying) (Borsari, 2004; Borsari et al., 2007; LaBrie & Pedersen, 2008; Ray, Turrisi, Abar, Abar, & Peters, 2007). Research has consistently revealed an inverse relationship between drinking-related protective behaviors and drinking outcomes (Martens et al., 2004, Lewis, Rees, Logan, Kaysen & Kilmer, 2010, Ray et al., 2009). Conversely, a positive association between drinking-related risk behaviors and drinking outcomes has been observed (Borsari et al., 2007; Pederson & LaBrie, 2006; Ray, Stapleton, Turrisi, & Phillion, 2011).

Although the associations between both drinking-related protective and risk behaviors and alcohol-related harm have been well studied in isolation, there is a lack of research examining how these behaviors operate collectively. In a recent study, Ray et al. (2011)

examined the general use of both types of variables by college students and revealed three typologies of drinkers: (1) a low risk group with more frequent use of protective behaviors and less frequent use of risk behaviors (10% of the sample), (2) a high risk group with more frequent use of risk behaviors and less frequent use of protective behaviors (30% of the sample), and (3) a mixed group, with average use of both risk and protective behaviors (60% of the sample). These typologies were also associated with alcohol consumption and experienced consequences such that the high risk group reported the most drinking and consequences, the low risk group reported the least amount of drinking and consequences, and the mixed group reported moderate levels of drinking and consequences. Although this was the first study to document that a high percentage of first-year college students engage in both types of behaviors, there are some notable limitations to this study. First, like other studies on this topic, behaviors were assessed in a global manner, such that participants were asked to report their general use of these constructs when drinking, along with general drinking patterns over the month prior to assessment, and consequences experienced over the course of the past year. Because of this limitation, it was not possible to determine how individuals used either or both protective and risk behaviors on a given night and how this use was related to alcohol use and related consequences. An additional drawback was the cross-sectional nature of the data. Finally, the study did not explore which of the individual protective and risk constructs accounted for unique variance in drinking outcomes.

Given the centrality of drinking-related protective and, somewhat less so, risk behaviors in common alcohol interventions, the importance of examining variations in the use of both types of behaviors simultaneously cannot be emphasized enough (Larimer & Cronce, 2007; Larimer et al., 2007; Martens, Cimini et al., 2007). Little is known about whether individuals tend to trade off the use of risk and protective behaviors on a given drinking occasion and how this is related

to harm. For example, it is possible that some individuals engage in mainly protective actions one night, and risk behaviors on another, or it is possible that they engage in both types of behaviors during the same drinking occasion. In addition, there may be certain protective behaviors that are used inconsistently that result in heavier drinking occasions and consequences. A similar argument can be made for varied patterns of specific risk behaviors, alcohol use, and consequences. Thus research that examines whether use of these constructs is consistent over time, as well as the association of individual protective and risk behavior categories with alcohol use and consequences seems warranted.

Current Study

These types of questions are particularly well suited for a longitudinal, event-level analysis. As discussed above, most studies have examined protective and risk behaviors globally, such that students report what they do typically, or on average. An examination of these constructs at the event-level allows for more specific measurement and extends our understanding on the associations between these behaviors and drinking outcomes on specific occasions versus use averaged over time. Further, the longitudinal aspect allows for an understanding of the variation in protective and risk behaviors, an area that has yet to be examined in the literature. Studies have highlighted the importance of event-level data collection to capture the specific associations between drinking motives, affect, and other behavioral risks in relation to alcohol use on a given evening that would not be revealed using global assessments of these variables (Mohr et al., 2005; Neal & Carey, 2007; Neal & Fromme, 2007a, 2007b; Neal et al., 2006; Simons, Gaher, Oliver, Bush, & Palmer, 2005).

The current study is an examination of the use of drinking-related protective and risk drinking behaviors and their association with alcohol use and consequences at the longitudinal,

event-level. The ultimate goal is to provide new perspectives on the use of these behaviors that inform interventions designed to incorporate such constructs. Specific aims of the research are as follows:

Research Aims

Aim 1: To examine the collective influence of individual drinking-related protective and risk behaviors on alcohol use and related consequences using a global assessment.

Innovation: Aim 1 extends current research by examining drinking-related protective and risk behaviors simultaneously in relation to alcohol use and related consequences. Through this analysis, the influence of total use of both protective and risk behaviors is examined followed by an examination of the influence of individual categories of both constructs. Analyses for this aim are conducted at the global level, allowing for an understanding of their influence when averaged over multiple drinking occasions. The analysis of these relationships at the global level offers a replication of previous studies, and permits a comparison of findings between this approach, and the event-level analytic approach outlined in Aim 2.

Hypothesis: When protective and risk behaviors are summed together to create overall scores for each construct, both variables will have significant influence on alcohol use and related consequences. When multiple categories of both behaviors are examined, not all will account for unique variance in drinking outcomes.

Aim 2: To examine the stability of drinking-related protective and risk behaviors over time, as well as the relationships between these variables, alcohol use, and related consequences using an event-level assessment.

Innovation: Aim 2 extends current research by providing insight into questions that have yet to be addressed in the college drinking literature. Specifically, no studies have examined the

stability of these behaviors over time, thus we do not know whether individuals are consistent in their use of protective and risk actions from one drinking occasion to the next. Further, the relationships between these variables and drinking outcomes are typically subjected to a global assessment, thus little information is available regarding the influence of these behaviors on specific drinking occasions. A longitudinal, event-level analysis allows for an examination of the association between these behaviors and drinking outcomes on a given occasion, whether these associations vary across different events, as well as whether the use of protective and risk behaviors on a given occasion influences their use on subsequent occasions.

Hypothesis: Some variability in the use of protective and risk behaviors over time will be observed, whereas the relationships between individual protective and risk behavior constructs and drinking outcomes will be consistent over time. Further, individual protective and risk behavior constructs identified as having significant influence on drinking outcomes through the analysis in Aim 1 will be the same variables that significantly influence drinking outcomes in Aim 2.

Aim 3: To examine whether gender influences the use of drinking-related protective and risk behaviors over time.

Innovation: Aim 3 extends current research as no studies have examined whether the use of protective and risk behaviors over time is equivalent for both males and females. This is an important variable to consider as gender differences in alcohol use itself have been well-documented in the college drinking literature, with rates of alcohol use and binge drinking higher for males than females (Ham & Hope, 2003; Johnston et al., 2010). Further, there is mixed evidence for gender differences with respect to previous studies on drinking-related protective and risk behaviors (Pedersen & LaBrie, 2006; Walters, Roudsari, Vader, & Harris, 2007). Ray et

al. (2011) found no gender differences in drinker typologies based on protective and risk behavior constructs.

Hypothesis: No gender differences will be observed in the relationships between individual protective and risk behavior constructs over time. Specifically, any variation observed in the use of behaviors over time will be consistent for both males and females.

CHAPTER TWO: REVIEW OF THE LITERATURE

Alcohol Use in College

In a recent 2011 report, the World Health Organization (WHO) identified alcohol use as the third largest risk factor for disease globally, and the number one risk factor for disease in the Americas (WHO, 2011). They note that alcohol use results in 2.5 million deaths annually, and plays a role in more than 250 types of disease and injury. Most striking, they report that a larger percentage of worldwide deaths can be explained by alcohol use relative to those caused by HIV/AIDS. Reports from the Center for Disease Control and Prevention (CDC) underscore the burden of alcohol use in the United States as they recognize alcohol use as the third largest cause of death in terms of life-style related factors, and estimate that close to 79,000 persons die each year due to excessive use of alcohol (CDC, 2010a). Further, a report by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) suggest that alcohol use results in nearly \$185 billion in costs to society annually, as a result of both healthcare expenditures and loss of productivity (Harwood, 1998).

An examination of harmful drinking patterns reveals that adolescents and young adults are at particular risk of negative outcomes given the trends of alcohol consumption within this segment of the population. Recent data indicate the practice of binge (or heavy-episodic) drinking, defined as consuming four or more drinks per occasion for females and five or more drinks per occasion for males, is most prevalent among individuals between the ages of 18 and 24 (Kanny, Liu, & Brewer, 2011). In their ongoing national study of adolescents and young adults, Johnston et al. (2010) reinforce this notion as they note that heavy drinking peaks in the early 20s. NIAAA estimates a figure of 10.8 million underage drinkers in the U.S. (NIAAA, 2010a) and the CDC notes that more than 10% of all alcohol in the U.S. is consumed by

individuals between the ages of 12 and 20 (CDC, 2010b). The WHO (2011) reports 9% of deaths among individuals aged between 15 and 29 years can be attributed to alcohol, relative to 4% of the overall population.

College students represent a subset of the population spanning ages of adolescence and young adulthood that is of particular concern with regards to their drinking practices (O'Malley & Johnston, 2002). Johnston et al. (2010) report that approximately 8 out of 10 college students have tried alcohol, with 4 out of 10 admitting to binge drinking at least once within the month prior to assessment. They note that rates of binge drinking have remained steady in this population since 1993, whereas they are declining among students in 12th grade, as well as within their non-college aged peers. Similar findings from another longitudinal national study focused specifically on college student alcohol use have been documented, with prevalence rates of binge drinking in this population remaining steady at just under 45% (Wechsler et al., 1994; 1998; 2000; 2002). Further, in their most recent national assessment, Wechsler et al. (2002) found that nearly 1 in 4 students could be classified as frequent binge drinkers, meaning these individuals reported binge drinking three times or more within a two week period.

Consequences of alcohol use can be both short- and long-term in nature ranging from injury, violence, and risky sexual behavior to psychological issues, disease and societal problems, to name a few (CDC, 2010a). College students regularly experience such alcohol-related harm. In a review of consequences of college alcohol use, Perkins (2002) identified three main categories of harm reported among college students including damage to self, damage to other people, as well as damage to society. Damage to self includes outcomes such as academic impairment, physical consequences (e.g., blacking out, vomiting), unintended and unprotected sex, legal consequences (e.g., driving while intoxicated), injury, suicide, and death. Damage

experienced by others as a result of one's drinking includes vandalism, interpersonal violence, sexual violence, and other disturbances such as harassment, noise, and having to take care of drunk individuals. Societal damages include property damage, student attrition, poor relationships between colleges and their surrounding communities, additional demands on college staff, as well as legal costs. Table 1.1 below is adapted from statistics reported by NIAAA (NIAAA, 2010b), and taken from research conducted by Hingson et al. (2005, 2009), and is meant to provide a brief picture of the magnitude of consequences reported each year on college campuses. In addition to the data provided below, Dawson, Grant, Stinson, and Chou (2004) estimate that 21 to 23% of college students (excluding those who live with their parents) meet criteria for a substance abuse disorder (i.e., alcohol abuse or dependence). Finally, there is an emerging body of research indicating that significant brain development is still in progress during the college years of traditional students, and, as a result, alcohol use can be particularly damaging at this time (Brown et al., 2008; Doremus-Fitzwater et al., 2010; Masten, Faden, Zucker, & Spear, 2008).

Table 1.1

Annual Alcohol-related Consequences among College Students

Consequence	Magnitude (number of students)
Drunk Driving	3,360,000
Assault	696,000
Injury	599,000
Unsafe Sex	400,000
Health Problems	150,000
Police Involvement	110,000
Sexual Abuse	97,000
Death	1,825

Etiology and Prevention

Given the vast amount of epidemiological research documenting the prevalence and severity of alcohol use in college, there is a substantial body of additional research focusing on both etiology and prevention of alcohol use and related problems in this population. Such research helps to identify variables that predict alcohol use, as well as provides insight into approaches that are successful in reducing drinking and related consequences. In their comprehensive review of factors that influence college drinking, Ham and Hope (2003) identified both individual level and environmental level alcohol use predictors. Demographic variables, personality variables, past drinking history, alcohol expectancies, drinking motives, stress and coping, and academic and athletic involvement were all noted as individual influences on alcohol use and related harm. Peer and family influences were identified as key environmental influences and, within this subset of variables, included one's living environment, social context of drinking, as well as social norms. A similar review was conducted by Baer (2002) in which family history of alcohol use, personality, drinking motives, expectancies, perceived norms, and social affiliation were identified as important factors that serve to explain individual variation in college alcohol use.

In studying drinking-related protective and risk behaviors, gender is an important variable to consider. Ham and Hope (2003) discuss that male students historically drink more than females, as well as are more likely to binge drink. Accordingly, they note that males are also more likely to meet criteria for a substance use disorder, and discuss research suggesting that males are more likely to experience alcohol-related consequences. Differences in alcohol use are also reflected in the recent research discussed above by Johnston et al. (2010), as research conducted over the past several decades consistently reflects higher use among males than

females. The authors also note that although differences in drinking rates are observed, the gender gap is closing such that males are reporting less alcohol use over time, whereas use among females is increasing.

In terms of prevention, the most successful efforts target many of the variables implicated in the etiology of the problem. For example, NIAAA (2006) has labeled brief motivational interventions as a Tier 1 strategy, meaning this approach has evidence of effectiveness in the college population, and reviews of individual-focused strategies have supported this finding (Larimer & Cronce, 2002, 2007). Such interventions typically involve a brief group or individual session in which students receive detailed feedback about their drinking behaviors from either a professional or peer provider. This information is delivered in a manner that is intended to motivate students to change their risky drinking patterns. Feedback given to participants includes information on their typical and peak drinking quantity and frequency, as well as compares this information to data on typical drinking among students at their college or university (i.e., social norms), highlights students' expectancies towards alcohol use (e.g., alcohol makes it easier to talk to people), lists past consequences students have experienced, and identifies risk factors including family history of alcoholism and tolerance (Larimer et al., 2007). Recent research suggests this type of feedback is efficacious in reducing alcohol use even when delivered via mail or computer, in the absence of a clinician or peer provider (Larimer & Cronce, 2007). Other individual-level interventions with some research support include feedback on normative beliefs alone, those that are designed specifically to target alcohol expectancies, and cognitive skills-based interventions (Larimer & Cronce, 2007). Parent-based approaches have also been found to be efficacious in reducing alcohol use among students transitioning to college (Turrisi, Jaccard, Taki, Dunnam, & Grimes, 2001) through their influence on students' attitudes and beliefs about

alcohol use (Turrise, Abar, Mallett, & Jaccard, 2010). Finally, there is evidence that a multifaceted approach is beneficial. For example, interventions that combine parent-based and brief motivational interventions have been shown to be efficacious (Turrise et al., 2009; Wood et al. 2010).

Although the literature indicates some evidence of success in reducing alcohol use and related consequences when implementing one or multiple programs among samples of college students, the epidemiological literature highlights the need for improvement in such efforts, as drinking rates remain high (Johnston et al., 2010; Wechsler et al., 2002). In their review of individual-level prevention approaches, Larimer and Cronce (2007) identified the need for research on variables that serve to both moderate and mediate Tier 1 interventions as a high priority. Accordingly, an emerging body of research has focused on the role of drinking-related protective and risk behaviors (i.e., actions students engage in while drinking that serve to protect one from or lead one to increased risk of alcohol use and related harm) in relation to alcohol use and consequences. Drinking-related protective behaviors include, but are not limited to, actions such as pacing one's drinks, setting limits on his or her alcohol use, drinking water between alcoholic drinks, and making sure to walk home with a friend (Martens et al., 2005; Ray et al., 2009; Sugarman and Carey, 2009). Conversely, drinking-related risk behaviors include participation in drinking games, pre-gaming or pre-partying (i.e., consuming alcohol before going out to a social event in which more alcohol may ultimately be consumed), mixing alcoholic beverages without keeping track of quantity, and extreme drinking practices such as funneling beers, in which students consume mass quantities of alcohol in a limited amount of time (Barnett, Wel, & Czachowski, 2009; Borsari, 2004; Borsari et al. 2007; Ray et al. 2011). These behaviors, particularly ones that are protective in nature, are often included as a

component of the feedback utilized in the motivational prevention approaches described above. Yet, evidence is mixed in terms of the influence these behaviors have in mediating intervention efficacy, suggesting the need for additional research on the influence of drinking-related protective and risk behaviors in relation to alcohol use and related consequences (Larimer et al., 2007; Martens, Cimini et al., 2007). Examination of the research on these constructs reveals they are often analyzed separately in studies, which makes it difficult to determine the relative importance of these variables in relation to alcohol use. This work is discussed in more detail below.

Drinking-related Protective Behaviors

Literature indicates students who engage in protective behaviors (e.g., setting limits, pacing one's drinks) when drinking consume less alcohol and are at lower risk of experiencing alcohol-related consequences compared to students who engage in these behaviors less frequently, or not at all (Benton et al., 2004; Delva et al., 2004; Haines, Barker, & Rice, 2006; Martens et al., 2004, Ray et al., 2009). Martens et al. (2004) found students who rarely engaged in protective behaviors when drinking were twice as likely to experience consequences compared to students who sometimes engaged in the behaviors, and four times as likely to experience consequences compared to students who usually engaged in protective drinking actions. Delva et al. (2004) also observed a similar dose-response relationship when examining the relationship between protective behaviors and alcohol-related consequences. They divided participants into four quartiles based on the frequency to which students reported using protective behaviors including low, low to midlevel, midlevel to high, and high, and found a negative relationship between number of consequences experienced in relation to each quartile of protective behaviors use. Finally, studies indicate protective behaviors are associated with alcohol-related

consequences after controlling for alcohol use (Martens et al., 2004; Ray et al., 2009), underscoring the importance of these behaviors in reducing alcohol related harm.

Research in this area has also focused on correlates of protective behaviors, including background variables such as gender and family history that serve to help us understand how these behaviors operate for different individuals (Benton et al., 2004; Walters et al., 2007). In addition, variables that are potentially amenable to change via intervention efforts have been examined, including drinking motives, attitudes towards use of protective behaviors, beliefs related to both descriptive and injunctive norms, as well as one's self-efficacy of engaging in protective behaviors, and one's perception that engaging in such behaviors leads to reduced harm (Benton, Downey, Glider, & Benton, 2008; Martens, Ferrier et al., 2007; Ray et al, 2009). Walters et al. (2007) found that females reported using protective actions significantly more often than males, and individuals with a positive family history of problem drinking reported engaging in protective behaviors less frequently. Similarly, Delva et al. (2004) found that women engaged in protective drinking behaviors more frequently than their male counterparts. Benton et al. (2004) reported that protective behaviors had a stronger effect on men in reducing alcohol-related consequences after drinking six drinks as compared to women. Martens, Ferrier, et al. (2007) found negative associations between motivations to drink for social reasons (e.g., celebrating), enhancement (e.g., drinking because it feels good) and the likelihood of engaging in protective behaviors, which in turn was associated with drinking tendencies. Benton et al. (2008) reported that students underestimate the use of protective behaviors, which is associated with the use of these behaviors. Finally, Ray et al. (2009), found students who were more likely to perceive their friends would support them engaging in protective behaviors, who believed they were able to engage in protective behaviors, and who believed protective behaviors were more

likely to lead to reduced harm reported more positive attitudes towards protective behaviors, and in turn, used them more frequently.

Drinking-related Risk Behaviors

Another area of literature has emerged focusing on drinking-related risk behaviors within college student populations, such as participation in drinking games (Borsari, 2004; Johnson & Sheets, 2004; Nagoshi, Wood, Cote, & Abbit, 1994; Pedersen & LaBrie, 2006; Zamboanga, Leitkowski, Rodriguez, & Cascio, 2006), and pre-gaming or prepartying, defined as drinking alcohol prior to attending another social event (Borsari et al., 2007; LaBrie & Pedersen, 2008; Pedersen & LaBrie, 2007). Similar to studies on protective behaviors, research has focused on the relationship between these behaviors and alcohol use and related harm, as well as correlates of engaging in drinking-related risk behaviors. In a review of 19 studies specific to drinking games conducted between 1975 and 2003, Borsari (2004) reported that participation in drinking games is related to both increased consumption of alcohol, as well as related problems. In a more recent study of mandated students, Borsari et al. (2007) found that on the night students received an alcohol violation, 62% of students reported either pre-gaming, participating in drinking games or both. Other recent studies highlight the association between pre-gaming and increased consumption during the day of specific drinking events, as well as increased levels of related consequences (LaBrie & Pedersen, 2008; Pedersen & LaBrie, 2007).

With respect to variables associated with the use of risk behaviors, Pedersen and LaBrie (2006) reported that both male and female college students engage in drinking games at similar rates, although women are more likely to report experiencing consequences as a result. Similarly, Borsari (2004) highlighted the increased risk of experiencing sexual consequences for women who participate in drinking games. Pedersen and LaBrie (2006) also found that non-Caucasian

students indicated less frequency of participation in drinking games, but were more at risk for consequences when participating. With regards to motives, past studies suggest students who are motivated by competition, conformity, sex, and novelty are more likely to engage in such behaviors (Borsari, 2004; Johnson & Sheets, 2004).

Thus, research in the domain of drinking-related protective and risk behaviors has focused mainly on the associations between such behaviors in relation to alcohol use and consequences, as well as correlates of use related to individual differences and psychosocial variables. Yet, despite this research many important empirical questions remain. For example, there is a lack of research examining how protective and risk behaviors operate together, as the above studies focused on only one type of behavior (i.e., protective behaviors *or* risk behaviors). While it is plausible that students who engage in protective behaviors do not engage in risk behaviors, it is also plausible that there are groups of students who engage in both types of behaviors. A recent study conducted by Ray et al. (2011) addressed this question by using Latent Profile Analysis to identify patterns of both risk and protective behaviors within a sample of college freshmen. Results indicated the majority of students fell into a group characterized by the use of both types of behaviors, along with a group of students more likely to use protective behaviors, and a group more likely to use risk behaviors. However, this study is limited by its use of cross-sectional, global data such that it provides insight as to use at only one time point, and behaviors that were assessed in terms of typical behavior over time. Thus, it is unknown whether students engage in both types of behaviors consistently, or engage in mostly protective or mostly risk behaviors. An event-level analysis of both protective and risk behaviors is needed to gain additional information as to how these behaviors operate within individuals over time to extend our knowledge in this area, and ultimately inform and enhance existing prevention efforts.

Advantages of an Event-level Analytic Approach

Neal et al. (2006) note that college alcohol research often utilizes an analysis of constructs in which data is aggregated, or averaged together. Further, questions are often assessed in global way, such that participants are asked to report their typical behavior over time, and the time range varies substantially from one study to the next (e.g., the past two weeks to the past year). However, event-level data collection offers an alternative in which behaviors are assessed on individual occasions, or events, offering a more precise way to assess patterns of behaviors over time, as well as the relationships between different variables over time (Neal & Carey, 2007). This type of approach has been applied to alcohol research and includes studies on alcohol use and consequences, condom use and other sexual behaviors, mood and coping motives, medication adherence, and other contextual factors such as the influence of athletic events (Mohr et al., 2005; Neal & Carey, 2007; Neal & Fromme, 2007a, 2007b; Neal et al., 2006; Simons et al., 2005). However, analyses on drinking-related protective and risk behaviors have focused mainly on models examining global associations between these constructs. Although this research has provided insight into the relationships between these variables, and variables correlated with the use of these behaviors, these approaches have limited our ability to capture the complex patterns that may exist with respect to the use of these actions.

CHAPTER THREE: METHODOLOGY

Sample

Participants were 358 first-year students screened as drinkers at a large, public university in the Northeastern U.S. The mean age of the sample was 18.20 years ($SD = .44$), and 51.7% of participants identified as male. With respect to ethnicity, 31 participants (8.7%) identified as Hispanic. In terms of race, 317 participants (88.5%) identified as Caucasian, 21 (5.9%) as Asian, 8 (2%) as African American, 1 as American Indian, and 10 (2.8%) as multiracial or other. When asked about their participation in fraternities or sororities, 313 (87.4%) were not members at the time of assessment, 47 (11.7%) were pledging, and 3 (.8%) were currently in a fraternity or sorority.

Recruitment and Procedures

A random sample of 700 first-year students was drawn from the university's student database, including students' local contact information and university email address. Students were sent both a pre-notification letter and email invitation describing the study, including the purpose, compensation, and procedures. Participants were informed they would be asked to complete four web-based surveys for which they would be paid \$30 for the first survey, and \$10 each for the remaining three surveys. Information was also included regarding the level of security of the questionnaires, such that participants were informed the software used in the assessments (DatStat Illume) offers the highest level of security supporting 128-bit encryption. Both the letter and email were timed to arrive approximately three days prior to the start of the study. The actual invitation email was sent when it was time to complete the first assessment (on a Sunday) including information on the length of the first survey (45 – 60 minutes), as well as a reminder of compensation for that particular assessment (\$30). The email also included a URL

and personal identification number (PIN) to access the first survey. A reminder email was sent on each of the next three days reminding participants who had not yet completed the assessment of their opportunity to participate.

Upon logging in to the first assessment, students were asked to provide online consent. Those who agreed to participate were then directed to the actual assessment in which they were asked questions about their alcohol use, use of drinking-related protective and risk behaviors, and consequences experienced on both the previous Friday and Saturday. At the end of the survey, students who reported they did not currently drink were thanked for their time and informed this assessment concluded their participation in the study. Those who identified as drinkers were told they were eligible to participate in the remaining surveys, and were informed they would be contacted on the following Sunday to complete the next assessment. Given the time sensitive nature of the study, access to the survey was disabled after four days following the initial invitation. Of the 700 students invited, 476 consented to participate and completed the first survey, yielding a 68% response rate. Of the students who responded, 358 (75%) reported alcohol use within the month prior to the first assessment and were invited to participate in the remainder of the study.

Procedures for the remaining assessments were similar to the first survey as students were sent an email invitation with the URL and PIN to access the surveys on a Sunday, and three daily email reminders if necessary. These questionnaires were shorter than the initial assessment, lasting approximately 10 – 15 minutes. Surveys were conducted over four consecutive weeks in the fall semester of the students' first year. Of the 358 participants who completed the first assessment, 352 completed the second survey, 349 completed the third survey, and 346 completed the fourth survey yielding attrition rates of 98.3%, 97.6%, and 96.6%, respectively.

Measures

Alcohol use. Students were asked to report their alcohol use for the Friday and Saturday prior to the assessment. Specifically, students were provided with the definition of a standard drink (i.e., 12 oz. beer, 10 oz. wine cooler, 4 oz. wine, or 1 oz. 100 proof liquor), and asked to indicate how many drinks they consumed on both days.

Consequences. Five consequences from the Young Adult Alcohol Problems Screening Test (YAAPST; Hurlbut & Sher, 1992) were assessed consistent with the work of Ray et al. (2009, 2011), including vomiting, black outs, drunk driving, regretted sex, and getting into physical fights. These items were chosen as they reflect broad categories of harm relevant to the population including interpersonal, physical, legal, and sexual consequences. Students who indicated alcohol use on previous questions were presented with each item and asked to indicate which consequences, if any, they experienced as a result of their alcohol use on both days.

Drinking-related protective and risk behaviors. Respondents who indicated alcohol use were presented with a list of protective and risk behaviors and asked to indicate if they engaged in each behavior on both days. The list of behaviors was drawn from recent research on college student drinking behaviors (Borsari et al., 2007; LaBrie & Pedersen, 2008; Martens et al., 2005; Ray et al. 2009, 2011) and factored into seven different categories of behaviors. Specific protective behavior factors included pacing, setting limits, social and diluting behaviors, and risk factors included mixing, drinking to get drunk, and mass consumption behaviors. All factors were observed to have pattern matrix loadings greater than .7 and inter-item correlations of .5 or greater.

Demographics. Standard demographic measures were obtained including age, birth sex, weight, gender identity, sexual orientation, ethnicity, race, and fraternity/sorority status.

Analytic Plan

Aim 1: Global assessment of the relationship between protective and risk behaviors, alcohol use, and consequences. For the first aim, both drinking-related protective and risk behaviors were examined in relation to alcohol use and consequences. These relationships were assessed at the global level meaning that each construct represents an average of an individual's behavior over time. Specifically, these variables represent an average of a participant's reported drinking-related protective and risk behaviors, alcohol use, and related consequences experienced over the course of eight measured occasions. As described previously, the eight occasions consisted of Fridays and Saturdays over four consecutive weeks. It is important to note that although eight separate occasions were assessed, not all participants reported alcohol use on every occasion. Thus, global use for each participant is an average of the specified behavior for only occasions in which alcohol use was consumed. For example, some participants may have consumed alcohol on all eight measured occasions, meaning his or her global alcohol use equates to an average of alcohol use across all eight time points. Conversely, for a participant who consumed alcohol use on only four of the eight occasions, global alcohol use equates to an average of alcohol use across only four time points.

Global relationships were tested in two ways (See Figures 3.1 and 3.2), each of which is described in turn. First, one's total use of drinking-related protective and risk behaviors was examined in relation to alcohol use and consequences (Figure 3.1). For protective behaviors, this involved summing the number of behaviors a student reported on each drinking occasion. A total of 14 behaviors were assessed, meaning that on any given drinking occasion, a participant could have a score ranging from 0 (no protective behaviors used) to 14 (all protective behaviors used). As described above, a total protective behaviors score was then calculated, averaging

participants' total use of protective behaviors across drinking occasions (also ranging from 0 to 14). The same procedure was followed for total use of risk behaviors. Specifically, on each drinking occasion participants were asked to report whether or not they engaged in a total of 10 different risk behaviors, meaning total risk scores on any given occasion could range from 0 to 10. An average score was then calculated based on participants' total use of risk behaviors across the eight possible occasions (also ranging from 0 to 10).

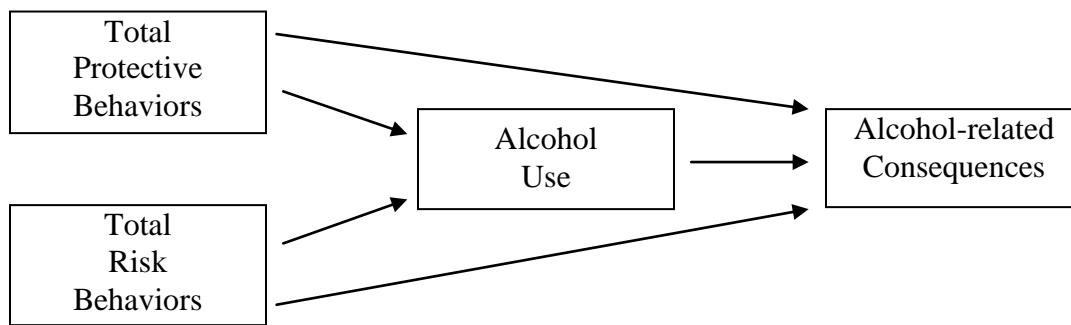


Figure 3.1. Total Protective and Risk Behaviors, Alcohol Use, and Consequences

Second, the global influence of individual categories of both drinking-related protective and risk behaviors was examined in relation to both alcohol use and consequences (Figure 3.2). As described in the methods, the 14 protective behaviors assessed factored into four categories including pacing, setting limits, diluting, and social behaviors. The 10 risk behaviors factored into three categories including drinking to get drunk, mixing, and mass consumption behaviors. Individual protective and risk behavior variables in this model were created in a similar manner to the total protective and risk behavior variables described above. For example, three items factored into the category labeled pacing. Participants were assigned a pacing score on each night he or she reported drinking (up to eight occasions), meaning on any given drinking occasion, one's score could range from 0 to 3. An average pacing score was calculated based on participant's total use of pacing behaviors across the drinking occasions (also ranging from 0 to

3). This same procedure was followed for setting limits (scores from 0 to 4), diluting (scores from 0 to 4), and social protective behaviors (scores from 0 to 3), as well as risk behaviors including those labeled as drinking to get drunk (scores from 0 to 4), mixing (scores from 0 to 2), and mass consumption (scores from 0 to 4).

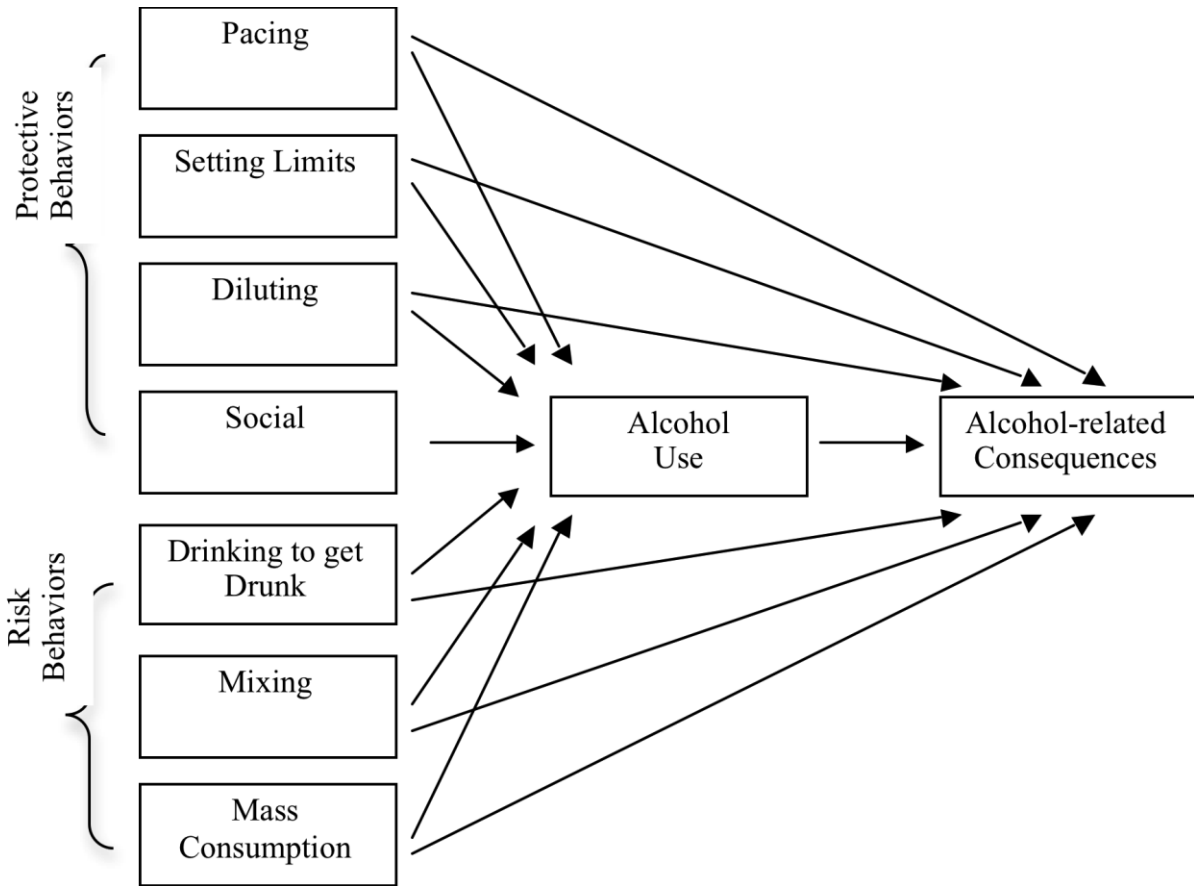


Figure 3.2. Individual Protective and Risk Behaviors, Alcohol Use, and Consequences

Global alcohol use and consequences were included in both models above, and calculated in a manner similar to that of the drinking-related protective and risk variables. Global alcohol use consisted of the average number of drinks participants reported consuming across drinking occasions. Global alcohol-related consequences was captured by averaging the total number of

consequences a participant experienced on each drinking occasion (scores ranging from 0 to 5) including self reports of vomiting, blacking out, regretted sex, physical fights, and drunk driving.

Finally, a covariate was included in each of the two models representing the total number of drinking occasions, or frequency of alcohol use, reported by each participant (scores ranging from 0 to 8). This variable is not included in the models depicted in Figures 3.1 and 3.2 as it does not relate to the overall, conceptual goals of Aim 1, yet is an important variable to control for given that all other variables in the model were based solely on an average of only occasions when a participant reported using alcohol.

Aim 2: Event-level analysis of the relationship between protective and risk behaviors, alcohol use, and consequences. The goals of Aim 2 were 1) to examine the stability of drinking-related protective and risk behaviors across time and 2) to examine the stability of the relationships between protective and risk behaviors, alcohol use, and consequences across time. Relationships were examined in the context of a path model (see Figure 3.3 below) using AMOS 18.0. It is important to note that Figure 3.3 is a heuristic model and for ease of interpretation, only two time points are included. In actuality, four time points representing consecutive weekend drinking events were examined. Further, similar to the second part of Aim 1 described above, individual protective and risk constructs were examined as opposed to looking at a sum of all protective behaviors and all risk behaviors, although they are represented by only one box in the model below. Consistent with Aim 1, protective behavior constructs were pacing, setting limits, diluting, and social behaviors. Risk behavior constructs were drinking to get drunk, mixing, and mass consumption behaviors.

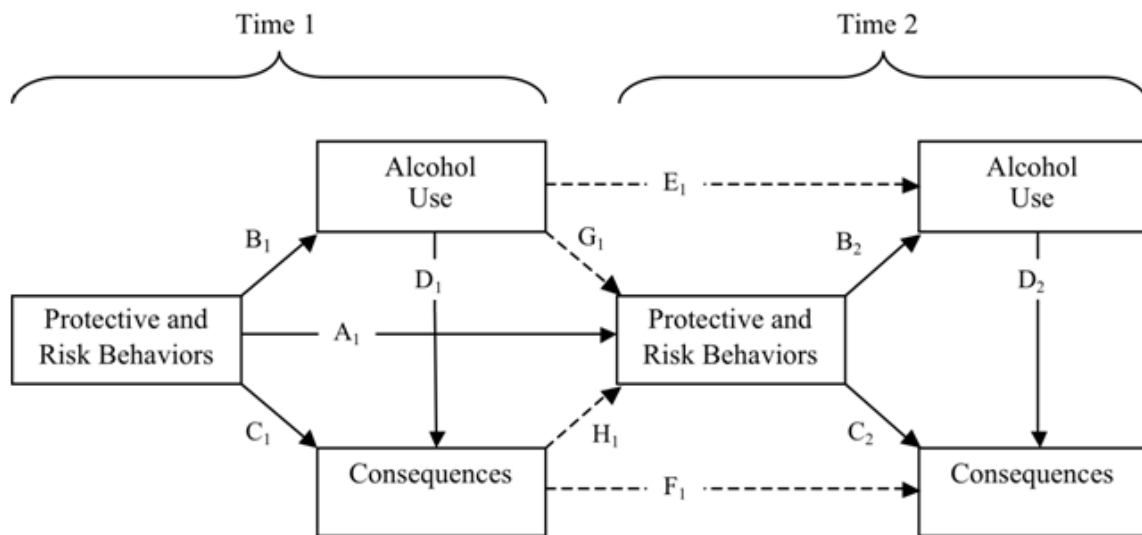


Figure 3.3. Event-level Path Model

Solid lines were used to reflect paths essential to the main goals of Aim 2 and include paths A_1 , B_1 , C_1 , D_1 as well as B_2 , C_2 , and D_2 . Path A_1 , an autoregressive path, represents the influence of protective and risk behavior constructs at Time 1 on use at Time 2. In the actual analysis, paths from use at Time 2 to use at Time 3, as well as use at Time 3 to use at Time 4 were also included. These paths correspond with the first goal of Aim 2 and, taken together, represent the stability of protective and risk behavior constructs over time. Paths B_1 and C_1 , contemporaneous paths, represent the influence of protective and risk behavior constructs on alcohol use and consequences, respectively, at Time 1. Similarly, D_1 represents the influence of alcohol use on consequences at Time 1. These paths were modeled at each time point (e.g., B_2 , C_2 , and D_2 in Figure 3.3), and, taken together, represent the stability of the relationships between protective and risk behavior constructs, alcohol use, and consequences over time.

Additional paths were modeled that were not central to the questions addressed in Aim 2, but that were important conceptually and include paths E_1 , F_1 , G_1 , and H_1 . These paths are represented by the dashed lines in the model above. First, paths E_1 and F_1 represent the influence

of alcohol use at Time 1 on alcohol use at Time 2, and consequences at Time 1 on consequences at Time 2, respectively. Similar to protective and risk behaviors over time, in the actual analysis, additional paths were modeled representing the influence of these variables at Time 2 on Time 3, and Time 3 on Time 4. Second, paths G_1 and H_1 represent the influence alcohol use and consequences at Time 1, respectively, on the use of protective and risk behavior constructs at Time 2. These paths were also modeled from Time 2 to Time 3 and from Time 3 to Time 4.

Finally, it is important to note the measurement of each construct above at each time point. Given that individuals were surveyed on both Friday and Saturday of each weekend, it was actually possible that, within each of the four weekend drinking events, some participants consumed alcohol on both nights and thus had two occasions of data, whereas other participants only consumed alcohol on either Friday or Saturday yielding one occasion of data, and some participants did not consume alcohol on either day and had no data for that weekend event. As the overarching aim was to look at the stability of drinking behaviors over time, only individuals who had at least one occasion of data per each of the four weekends were included ($n = 116$). For individuals with two occasions of data (i.e., they reported alcohol use on both Friday and Saturday), data for the heaviest drinking occasion was used in the analysis. When individuals reported the same amount of alcohol use on both Friday and Saturday nights, data for Saturday night was used in the analysis.

Aim 3: Gender as a moderator of drinking-related protective and risk behavior use.

The goal of Aim 3 was to examine the impact of gender on the use of individual drinking-related protective and risk behaviors over time. For example, this analysis allows us to understand if the relationship between the use of pacing behaviors at Time 1 and Time 2 is equivalent for both males and females. Gender equivalence was tested with the path model described in Aim 2

utilizing AMOS 18.0. First, a two-group model was tested in which relationships between protective and risk variables over time were estimated freely (i.e., unconstrained) for both males and females. Next, a model was tested in which the relationships between pacing behaviors over time (Time 1 to Time 2, Time 2 to Time 3, and Time 3 to Time 4) were constrained to be equal across gender. Fit indices of both models were then compared to determine if the unconstrained model had significantly better fit than the constrained model. If so, this was suggestive of a gender difference in these relationships over time. No significant difference in fit was indicative that the relationships over time were similar for both males and females. This process was repeated for each drinking-related protective and risk construct.

CHAPTER FOUR: RESULTS

Aim 1: Global Assessment of the Relationship between Protective and Risk Behaviors, Alcohol Use, and Consequences

Results for both models examined as a part of Aim 1 are presented below. First, results for the model examining the associations between total drinking-related protective and risk behavior variables in relation to alcohol use and consequences are presented (Part A). Second, results for the model examining the relationships between individual protective and risk behavior variables and alcohol use and consequences are presented (Part B). Within each section, descriptive statistics are presented and results are discussed; correlations for variables included in each model, along with path coefficients for modeled relationships are presented at the end of the results section (Tables 4.1 - 4.5).

A. Total Protective and Risk Behaviors

Correlations and descriptive statistics. Correlations between all variables in this section are presented in Table 4.1. All variables were significantly correlated with each other in the expected direction. Total use of protective behaviors was negatively associated with total use of risk behaviors, alcohol use, and consequences, as well as the overall number of reported drinking occasions. Total use of risk behaviors was positively associated with alcohol use, consequences, and frequency of drinking. Although the correlation between the total protective and risk behavior variables was significant, it was moderate in size (-.38) suggesting these are unique constructs. Participants reported using an average of 5.77 ($SD = 2.43$) protective behaviors and an average of 2.28 ($SD = 1.41$) risk behaviors per occasion. Results also indicated that participants drank an average of 6.18 ($SD = 3.42$) drinks per occasion, experienced .31 ($SD = .40$) consequences per occasion, and drank on 4.01 ($SD = 2.18$) of the eight assessed occasions.

Regression analysis. Results of the influence of total drinking-related protective and risk behaviors in relation to alcohol use are presented in Table 4.2. Results revealed a significant relationship between total protective behavior use and alcohol consumption such that higher use of overall protective behaviors, on average, was associated with less alcohol use. Further, one's total use of risk behaviors was also significantly related to alcohol use in the expected direction. Increased use of risk behaviors was associated with more alcohol consumption, on average. These relationships were observed controlling for the number of drinking occasions one reported, although this variable was also significantly related to quantity of alcohol consumption such that students who drank more often were likely to consume more alcohol when drinking.

Results of the influence of drinking-related protective and risk behaviors in relation to consequences are presented in Table 4.3. Total use of both protective and risk behaviors was significantly related to reported consequences, as expected. As students' reports of drinking-related protective behaviors increased, their reports of consequences decreased, whereas increased reports of drinking-related risk behaviors were associated with increased reports of consequences. These relationships were observed controlling for both quantity and frequency of alcohol use, although alcohol use was also a significant predictor of consequences. As one might expect, increased alcohol consumption was associated with increased reports of related consequences.

B. Individual Protective and Risk Behaviors

Correlations and descriptive statistics. Correlations between individual categories of protective and risk behaviors, alcohol use, and consequences are reported in Table 4.4. Participants reported an average of 1.47 ($SD = .82$) pacing behaviors, 1.02 ($SD = 1.04$) setting limits behaviors, .80 ($SD = .89$) diluting behaviors, and 2.49 ($SD = .66$) social behaviors per

drinking occasion. With respect to risk behavior categories, participants reported an average of 1.63 ($SD = .94$) drinking to get drunk behaviors, .51 ($SD = .52$) mixing behaviors, and .14 ($SD = .43$) mass consumption behaviors per drinking occasion.

Regression analysis. All path coefficients for the influence of individual protective and risk behaviors in relation to alcohol use are presented in Table 4.5. Of the four individual categories of drinking-related protective behaviors including pacing, setting limits, diluting, and social behaviors, only pacing had a significant, unique relationship with alcohol use. This was in the expected direction such that as students reported higher levels of pacing behaviors, they reported lower levels of alcohol use. Of the three categories of drinking-related risk behaviors, drinking to get drunk and mass consumption behaviors had a significant, unique relationship with alcohol use. Similar to protective behaviors, these relationships were in the expected directions. As students reported engaging in drinking to get drunk and mass consumption behaviors, in turn they reported higher levels of alcohol use, on average.

As depicted in Figure 3.2, all variables above were modeled to influence consequences and results are displayed in Table 4.6. Pacing was observed to have a significant, direct influence on consequences over and above what can be explained through alcohol use. As students reported engaging in pacing behaviors, they reported less alcohol consumption. Despite the fact that no relationship between risk behaviors labeled as mixing and alcohol use was observed, behaviors in this risk category were found to have a significant, unique relationship with consequences, such that the more students reported engaging in mixing behaviors, the more consequences they reported experiencing. Drinking to get drunk and mass consumption variables, while a significant predictor of alcohol use, were not observed to have a direct, significant impact on consequences.

Summary

In sum, one's total use of drinking-related protective and risk behaviors was significantly related to his or her alcohol use, on average. Further, a direct association with consequences was also observed, while controlling for both quantity and frequency of alcohol use. An analysis of individual categories of protective and risk behaviors revealed that protective behaviors related to pacing were significantly associated with both alcohol use and consequences in a negative direction. Again, the direct association with consequences was observed beyond what could be explained by alcohol use itself. With regards to risk, drinking to get drunk and mass consumption behaviors were observed to have a direct relationship with alcohol use, but only an indirect relationship with consequences. Risk behaviors related to mixing, although not related to alcohol use, were significantly associated with consequences in a positive direction.

Aim 2: Event-level Analysis of the Relationship between Protective and Risk Behaviors, Alcohol Use, and Consequences

Means and standard deviations for all variables in Aim 2 at each time of measurement are presented in Table 4.7. The results of the path model are presented in three sections. First, results for the stability of protective and risk behavior variables, alcohol use, and consequences over time are presented. Second, results for the stability of protective and risk behaviors in relation to alcohol use and consequences are presented. Third, results for the influence of alcohol use and consequences at one time point on the use of protective and risk behaviors at the next time point are presented.

Stability of protective behavior variables. Path coefficients representing the stability of protective behaviors over time are presented in Table 4.8. Results indicate that use of these behaviors at Time 1 was significantly associated with use at Time 2, such that greater use of

social behaviors, for example, on the first weekend drinking occasion was associated with greater use of social behaviors on the second weekend drinking occasion. Similar associations were observed from Time 2 to Time 3, as well as Time 3 to Time 4. The only exception to this pattern was the use of pacing behaviors from Time 1 to Time 2, in which the relationship between constructs was not significant. However, use of pacing behaviors at Time 2 was significantly associated with use of pacing behaviors at Time 3, and use of pacing behaviors at Time 3 was significantly associated with use at Time 4.

Stability of risk behavior variables. Similar results were observed for risk behaviors and are presented in Table 4.9. Use of drinking to get drunk, mixing, and mass consumption behaviors at Time 1 was significantly and positively associated with use at time 2, use at Time 2 was associated with use at Time 3, and use at Time 3 was associated with use at Time 4. Similar to protective behaviors, one exception was observed such that use of drinking to get drunk behaviors at Time 2 was not significantly associated with use at Time 3. However, use of these behaviors at Time 1 was significantly related to use at Time 2, and use at Time 3 was related to use at Time 4.

Stability of alcohol use and consequences. Although not central to this aim, the stability of alcohol use and consequences over time was also modeled. Alcohol use at Time 1 was significantly associated with alcohol use at Time 2, use at Time 2 was significantly related to use at Time 3, and use at Time 3 was associated with use at Time 4 ($ps < .001$). Contrary to this, and the other drinking behaviors assessed, consequences experienced at one time were not significantly associated with consequences experienced at the next time ($ps > .05$).

Stability of protective and risk behaviors in relation to alcohol and consequences.
The relationships between protective and risk behaviors and alcohol use at each time point are

presented in Table 4.10. Pacing behaviors were significantly associated with alcohol use at each time point such that greater use of these actions was associated with less alcohol consumption. No other significant relationships between protective behaviors and alcohol use were observed any time point. With respect to risk behaviors, drinking to get drunk behaviors were significantly and positively associated with alcohol use at Time 4 only, mixing behaviors were significantly and positively associated with alcohol use at Time 1 only, and mass consumption behaviors were significantly and positively associated with alcohol use at both Time 1 and Time 3.

The relationships between protective and risk behaviors, alcohol use, and consequences at each time point are presented in Table 4.11. Alcohol use was significantly and positively associated with consequences at Time 2 and Time 4. Use of pacing behaviors was associated with consequences at Time 3 such that increased use of these behaviors was related to decreased reports of consequences. Notably, use of diluting behaviors was also associated with consequences at this time, but in the unexpected direction. Increased use of diluting behaviors was associated with an increased use of consequences. In terms of risk, drinking to get drunk behaviors were significantly associated with consequences at Time 3, mixing behaviors were associated with consequences at Times 1 and 2, and mass consumption behaviors were significantly associated with consequences at Time 4. These relationships were all positive such that increased use of the risk behavior constructs was associated with a greater number of reported consequences.

Past alcohol use and consequences influencing future behaviors. Results for the influence of past alcohol use and consequences influencing future use of drinking-related protective and risk behaviors was mixed. With respect to alcohol use, use at Time 1 was significantly and negatively associated with pacing behaviors at Time 2, and use at Time 3 was

significantly and negatively associated with social behaviors at Time 4 ($ps < .05$). Regarding consequences, experiences at Time 2 were significantly and negatively associated with drinking to get drunk and mass consumption behaviors at Time 3.

Summary

In sum, results indicate that use of protective and risk behavior constructs was relatively stable over time, such that past use was significantly and positively associated with future use. With regards to the relationships between individual protective and risk constructs, alcohol use, and consequences, results were mixed. With respect to alcohol use and protective behaviors, pacing behaviors were consistently and positively related to use, whereas the rest of the behaviors were consistently not significantly associated with use. Conversely, the associations with risk behaviors and alcohol use were less stable as different constructs were associated with drinking at different time points. The relationships between protective and risk behaviors, alcohol use, and consequences were also quite variable as no behavior was consistently related to consequences at all time points. Behaviors related to mixing were most frequently observed to be related to consequences, however they were only found to be significant predictors on two of the four weekend drinking occasions.

Aim 3: Gender Differences in Protective and Risk Behavior Use

Descriptive Statistics. Means and standard deviations for drinking-related protective and risk behavior constructs within gender at each time of measurement are presented in Table 4.12.

Two-group analysis. Fit indices for the models used to test for the influence of gender on the use of protective and risk behaviors over time are presented in Table 4.13. First, fit indices are presented for a model in which paths between protective and risk behavior use were estimated freely between both males and females (i.e., the unconstrained model, Model 0). Then,

results for each model in which the use of one category of either protective or risk behaviors was constrained to be equal between males and females (e.g., *padding*, Model 1) is presented, along with the change in fit indices between that model and the unconstrained model (e.g., $\Delta 1 - 0$).

Results suggest that, for the majority of protective and risk behaviors, gender equivalence in relationships over time was observed. However, a significant change in fit indices was observed when constraining the paths between social protective behaviors and mass consumption risk behaviors to be equal across gender over time. This suggests the strength of the relationship between these variables differed for both males and females. Path coefficients for these relationships from the unconstrained model are presented in table 4.14.

When examining the relationships between social protective behaviors over time, results suggest that the relationship between use at Time 1 and Time 2, and use at Time 2 and Time 3 is weaker for males than females. However, this changes at from Time 3 to Time 4, as the relationship is stronger for males than females. However, it is important to note that although the magnitude of the path coefficient is different between genders, all paths were statistically significant. Thus, similar to the findings in Aim 2, the use of social protective behaviors is relatively stable over time for both males and females.

When examining the relationships between mass consumption risk behaviors over time, results suggest that the relationship between use at Time 1 and Time 2, and use at Time 2 and Time 3 is stronger for males than females. However, this changes at from Time 3 to Time 4, as the relationship is stronger for females relative to males. All relationships over time were significant for males, suggesting that males who engage in mass consumption behaviors at one time are likely to engage in them on the next occasion. Some variability in these relationships were observed for females, as use of mass consumption behaviors at Time 1 did not predict use

at Time 2; however, use at Time 2 was significantly associated with use at Time 3, and use at Time 3 was significantly associated with use at Time 4.

Summary

Results of the two-group analysis suggested that path coefficients were not equivalent between males and females for the relationships between social protective behaviors over time, as well as the relationships between mass consumption risk behaviors over time. For social behaviors, although there were some differences in the size of the path coefficient, use at each time point was significantly related to use at the next time point. For mass consumption behaviors, relationships over time were significant for males; for females, some variation was observed, as use of mass consumption behaviors at Time 1 did not significantly predict use at Time 2.

Table 4.1

Correlations for Total Protective and Risk Behaviors Model

	1	2	3	4	5
1. # of Drinking Occasions	--				
2. Total Protective Behaviors	-.38**	--			
3. Total Risk Behaviors	.36**	-.38**	--		
4. Alcohol Use	.41**	-.45**	.59**	--	
5. Consequences	.23**	-.30**	.39**	.39**	--

Note. ** $p < .01$

Table 4.2

Path Coefficients for Total Protective and Risk Behaviors and Alcohol Use

	β	<i>SE</i>	<i>t</i> value
# of Drinking Occasions → Alcohol Use	.29	.09	3.36**
Avg Protective Behaviors Sum → Alcohol Use	-.31	.07	-4.37***
Avg Risk Behaviors Sum → Alcohol Use	1.07	.12	9.13***

Note. ** $p < .01$, *** $p < .001$

Table 4.3

Path Coefficients for Total Protective and Risk Behaviors, Alcohol Use, and Consequences

	β	<i>SE</i>	<i>t</i> value
Alcohol Use → Consequences	.03	.01	3.46**
# of Drinking Occasions → Consequences	.00	.01	<i>ns</i>
Avg Protective Behaviors Sum → Consequences	-.02	.01	-2.06*
Avg Risk Behaviors Sum → Consequences	.06	.02	3.39**

Note. * $p < .05$, ** $p < .01$, *ns* = non significant

Table 4.4

Correlations for Individual Protective and Risk Behaviors Model

	1	2	3	4	5	6	7	8	9	10
1. # of Drinking Occasions	--									
2. Pacing	-.42**	--								
3. Setting Limits	-.25**	.47**	--							
4. Diluting	-.21**	.37**	.35**	--						
5. Social	-.19**	.37**	.28**	.16**	--					
6. Drinking to get Drunk	.34**	-.44**	-.24**	-.23**	-.06**	--				
7. Mixing	.20**	-.38**	-.23**	-.14*	-.29**	.36**	--			
8. Mass Consumption	.21**	-.16**	.06	.08	-.24**	.22**	.28**	--		
9. Alcohol Use	.41**	-.62**	-.26**	-.19**	-.26**	.49**	.39**	.39**	--	
10. Consequences	.23**	-.39**	-.20**	-.07	-.22**	.28**	.36**	.26**	.39**	--

Note. * $p < .05$, ** $p < .01$

Table 4.5

Path Coefficients for Individual Protective and Risk Behaviors and Alcohol Use

	β	<i>SE</i>	<i>t</i> value
# of Drinking Occasions → Alcohol Use	.19	.08	2.42*
P: Pacing → Alcohol Use	-1.96	.22	-8.90**
P: Setting Limits → Alcohol Use	.14	.15	<i>ns</i>
P: Diluting → Alcohol Use	.12	.17	<i>ns</i>
P: Social → Alcohol Use	.05	.23	<i>ns</i>
R: Drinking to get Drunk → Alcohol Use	.56	.17	3.25**
R: Mixing → Alcohol Use	.29	.29	<i>ns</i>
R: Mass Consumption → Alcohol Use	2.80	.41	6.76**

Note. * $p < .05$, ** $p < .01$, *ns* = non significant

Table 4.6

Path Coefficients for Individual Protective and Risk Behaviors, Alcohol Use, and Consequences

	β	<i>SE</i>	<i>t</i> value
# of Drinking Occasions → Consequences	.01	.01	ns
Alcohol Use → Consequences	.02	.01	2.43*
P: Pacing → Consequences	-.07	.04	-2.02*
P: Limits → Consequences	-.02	.02	ns
P: Diluting → Consequences	.03	.02	ns
P: Social → Consequences	-.02	.03	ns
R: Drinking to get Drunk → Consequences	.02	.03	ns
R: Mixing → Consequences	.15	.04	3.47**
R: Mass Consumption → Consequences	.07	.06	ns

Note. * $p < .05$, ** $p < .01$, ns = non significant

Table 4.7

Means and Standard Deviations of Aim 2 Variables

	Time 1		Time 2		Time 3		Time 4	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<i>Protective Behaviors</i>								
Pacing	1.16	1.03	1.06	.96	1.27	1.02	.91	.97
Setting Limits	.90	1.10	.90	1.20	.74	1.00	.73	1.05
Diluting	.73	1.03	.75	1.10	.84	1.15	.49	.84
Social	2.51	.82	2.34	.92	2.25	.99	2.32	.88
<i>Risk Behaviors</i>								
Drinking to get Drunk	2.25	1.36	1.90	1.26	1.60	1.22	1.91	1.29
Mixing	.62	.83	.56	.81	.49	.76	.69	.84
Mass Consumption	.33	.76	.19	.58	.17	.55	.21	.63
<i>Drinking Outcomes</i>								
Alcohol Use	8.65	4.34	8.04	4.04	7.87	5.70	9.35	5.03
Consequence Sum	3.20	2.28	2.66	1.92	2.27	1.88	2.81	2.03

Table 4.8

Stability of Protective Behavior Variables.

	β	<i>SE</i>	<i>t</i> value
<i>Pacing</i>			
T1 → T2	.14	.09	<i>ns</i>
T2 → T3	.32	.11	3.02**
T3 → T4	.38	.10	3.93***
<i>Setting Limits</i>			
T1 → T2	.52	.09	5.86***
T2 → T3	.48	.06	7.43***
T3 → T4	.57	.08	7.18***
<i>Diluting</i>			
T1 → T2	.51	.09	5.74***
T2 → T3	.57	.08	6.90***
T3 → T4	.44	.06	7.93***
<i>Social</i>			
T1 → T2	.55	.09	6.09***
T2 → T3	.42	.09	4.54***
T3 → T4	.36	.08	4.76***

Note. ** $p < .01$, *** $p < .001$, *ns* = non significant

Table 4.9

Stability of Risk Behavior Variables

	β	<i>SE</i>	<i>t</i> value
<i>Drinking to Get Drunk</i>			
T1 → T2	.38	.08	4.57***
T2 → T3	.10	.09	<i>ns</i>
T3 → T4	.36	.09	3.85***
<i>Mixing</i>			
T1 → T2	.42	.09	4.76***
T2 → T3	.27	.09	2.98**
T3 → T4	.45	.09	4.82***
<i>Mass Consumption</i>			
T1 → T2	.38	.06	5.96***
T2 → T3	.65	.07	9.99***
T3 → T4	.40	.11	3.76***

Note. ** $p < .01$, *** $p < .001$, *ns* = non significant

Table 4.10

Stability of Risk and Protective Behaviors in Relation to Alcohol Use

	Time 1		Time 2		Time 3		Time 4	
	β	<i>SE</i>	β	<i>SE</i>	β	<i>SE</i>	β	<i>SE</i>
Pacing	-1.34***	.37	-1.13***	.30	-2.30***	.40	-1.88***	.37
Setting Limits	-.22	.34	.33	.22	.50	.40	-.32	.33
Diluting	.01	.35	.11	.24	.31	.35	.35	.41
Social	-.57	.43	.24	.30	.33	.41	.58	.39
Drinking to Get Drunk	.23	.28	.45	.21	.35	.34	.93***	.26
Mixing	1.04*	.46	.46	.34	-.56	.52	.73	.41
Mass Consumption	1.04*	.49	.76	.47	2.75***	.76	.52	.56

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.11

Stability of Protective Behaviors, Risk Behaviors, and Alcohol Use in Relation to Consequences

	Time 1		Time 2		Time 3		Time 4	
	β	<i>SE</i>	β	<i>SE</i>	β	<i>SE</i>	β	<i>SE</i>
Alcohol	.03	.01	.05**	.02	.01	.01	.04*	.02
Pacing	-.05	.06	-.02	.08	-.23***	.05	-.15	.08
Setting Limits	-.02	.05	-.06	.05	.00	.05	.03	.07
Diluting	-.02	.05	-.09	.06	.12**	.04	.11	.08
Social	-.02	.06	.08	.07	.00	.05	-.04	.08
Drinking to Get Drunk	-.03	.04	-.02	.05	.08*	.04	-.03	.05
Mixing	.20**	.07	.28***	.08	.07	.06	.06	.08
Mass Consumption	.10	.07	-.07	.12	-.08	.09	.46***	.11

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.12

Means and Standard Deviations of Protective and Risk Behaviors by Gender

		Time 1		Time 2		Time 3		Time 4	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<i>Protective Behaviors</i>									
Pacing	M	1.06	.96	1.06	.94	1.09	1.00	.86	.89
	F	1.31	1.12	1.08	1.00	1.53	1.00	1.00	1.07
Setting Limits	M	.81	1.14	.89	1.27	.62	1.03	.56	.99
	F	1.02	1.05	1.04	1.12	.92	.94	.96	1.10
Diluting	M	.69	1.06	.83	1.19	.80	1.18	.42	.81
	F	.76	1.01	.67	.97	.88	1.15	.59	.89
Social	M	2.42	.86	2.14	.93	2.22	.93	2.21	.90
	F	2.67	.66	2.67	.75	2.35	1.03	2.49	.82
<i>Risk Behaviors</i>									
Drinking to get Drunk	M	2.38	1.33	1.95	1.37	1.61	1.30	1.86	1.42
	F	2.13	1.36	1.85	1.11	1.63	1.09	2.00	1.10
Mixing	M	.62	.87	.55	.81	.47	.75	.65	.81
	F	.63	.78	.57	.82	.53	.79	.71	.87
Mass Consumption	M	.47	.93	.23	.68	.21	.67	.26	.73
	F	.14	.41	.12	.39	.10	.31	.10	.37

Note. M = Male, F = Female

Table 4.13

Fit Indices for Unconstrained and Constrained Models

	χ^2	<i>df</i>
<i>Unconstrained Model</i>		
Model 0	1949.34	954
<i>Constrained Models</i>		
Model 1 Pacing	1950.36	957
Δ 1 - 0	1.02	3
Model 2 Setting Limits	1953.91	957
Δ 2 - 0	4.57	3
Model 3 Diluting	1951.72	957
Δ 3 - 0	2.38	3
Model 4 Social	1959.90	957
Δ 4 - 0	10.56*	3
Model 5 Drinking to get Drunk	1954.60	957
Δ 5 - 0	5.26	3
Model 6 Mixing	1951.79	957
Δ 6 - 0	2.45	3
Model 7 Mass Consumption	1962.87	957
Δ 7 - 0	13.53**	3

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

Table 4.14

Path Coefficients for Behaviors not Equivalent for Males and Females

	Time 1 → Time 2		Time 2 → Time 3		Time 3 → Time 4	
	β	<i>SE</i>	β	<i>SE</i>	β	<i>SE</i>
<i>Social Protective Behaviors</i>						
Males	.33**	.13	.35**	.12	.36***	.08
Females	.80***	.12	.59**	.18	.22*	.11
<i>Mass Consumption Risk Behaviors</i>						
Males	.43***	.08	.72***	.08	.33*	.14
Females	.23	.13	.23*	.11	.47**	.14

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

CHAPTER FIVE: DISCUSSION

Previous research has identified drinking-related protective and risk behaviors as predictors of both alcohol use and related consequences among college students. Further, these constructs are often included as components of prevention efforts targeted towards this population. Yet few studies have examined the influence of these behaviors together in relation to drinking outcomes, instead focusing solely on the influence of protective behaviors *or* the influence of risk behaviors. Further, most studies utilizing these constructs have been conducted using a global approach, meaning they examine one's typical use over a period of time (e.g., use of protective and risk behaviors over the past month), versus an event-level approach in which behaviors are examined in the context of specific events (e.g., use of protective and risk behaviors on one drinking occasion). The present study was the first to assess the collective influence of both drinking-related protective and risk behaviors on both alcohol use and consequences at the event-level. Four consecutive weekend drinking events were examined in a random sample of college students during the fall semester of their first year. The discussion of findings from this analysis is organized into the following sections: 1) a summary of results, 2) insights from an event-level approach, 3) implications for prevention, 4) limitations and future directions, and 6) a brief conclusion.

Summary of Results

Global analysis. Protective and risk behaviors were first explored in the context of a global analysis in which variables represented an average of one's use of behaviors over the course of four weekends and including up to eight total drinking occasions (i.e., two per weekend). Two separate models were tested. In the first model, protective and risk behaviors were summed together, and averaged across occasions, to create a total protective behaviors

variable and total risk behaviors variable, respectively. The relationships between these variables, number of drinks consumed on each occasion, and related consequences were examined in a regression model. In a second regression model, individual protective and risk behavior constructs were examined in relation to alcohol use and consequences in order to understand the influence of individual categories of both types of behaviors on drinking outcomes.

The analysis of total protective and risk behaviors revealed both variables to be significantly influential of alcohol use and consequences, on average across multiple drinking events. As expected, as use of protective behaviors increased, alcohol use and consequences decreased, whereas use of risk behaviors was positively associated with drinking and related harm. Notably, the influence of drinking-related protective and risk behaviors on consequences held even with the inclusion of alcohol use in the model. The results from this initial model support previous research findings in which negative associations between protective behaviors and drinking outcomes (Benton et al., 2004; Delva et al., 2004; Lewis et al., 2010; Martens et al., 2004; Ray et al., 2009), and positive associations between risk behaviors and drinking outcomes (Borsari, 2004; Labrie & Pedersen, 2008; Borsari et al., 2007), were observed. Further, studies on the influence of protective behaviors have found a have significant influence on alcohol-related harm, controlling for alcohol use itself (Martens et al., 2004; Ray et al., 2009). This study further underscores this influence.

One important finding from this analysis extends the current literature on this topic. Specifically, this analysis included both protective and risk behavior variables, and both were found to account for significant, unique variance in the use of alcohol and consequences. Although similar findings have emerged when examining the influence of the constructs

separately, no studies have examined their influence collectively. Thus, looking at only protective behaviors or only risk behaviors ignores a key subset of behaviors associated both with alcohol use, and related harm. Further, the significant association between both drinking-related protective and risk behaviors and alcohol-related harm, controlling for the influence of alcohol use itself, is indicative of the notion that style of alcohol use plays an important role beyond that of quantity alone.

Although not part of the key aims of the study, alcohol frequency was included as a variable in the model as number of reported drinking occasion varied across participants. A positive relationship was observed between alcohol frequency and alcohol quantity, controlling for the use of protective and risk behaviors, suggesting that students who drink more frequently are likely to consume more alcohol relative to students who drink less frequently. Notably, this variable was not related to alcohol-related consequences, controlling for alcohol quantity, suggesting it does not account for unique variance in this outcome, but does influence harm indirectly through its association with increased alcohol use.

Results of the second model in the global analysis, in which the influence of individual protective and risk behavior constructs was examined, revealed that not all categories of behaviors accounted for unique variance of alcohol use and related harm. Pacing protective behaviors and drinking to get drunk and mass consumption risk behaviors were significantly associated with alcohol use, which in turn was significantly associated with consequences. Specifically, increased use of pacing behaviors was associated with less consumption, whereas increased use of drinking to get drunk and mass consumption behaviors was associated with more consumption. Beyond the indirect influence these behaviors have on harm through their impact on one's alcohol use, a residual direct effect was found between pacing behaviors and

alcohol-related consequences, suggesting this variable has influence on harm over and above what can be explained through alcohol use. Finally, mixing risk behaviors were significantly associated with alcohol-related harm, but not alcohol consumption itself. Taken together, results suggest that when examining protective and risk behavior constructs individually, all categories of risk play an important role with respect to drinking outcomes, whereas not all categories of protective behaviors do. In particular, setting limits, diluting, and social protective actions did not account for significant variance of alcohol use or consequences when including multiple constructs of both drinking-related protective and risk behaviors. Similar to the first model, number of drinking occasions was included in the model and was found to be positively associated with alcohol use quantity, but not directly related to consequences.

Event-level analysis. Protective and risk behaviors were then explored in the context of an event-level analysis in which variables represented a participant's actual behavior on a given drinking occasion, versus an average over multiple occasions. Four separate occasions were included, and permitted the examination of two separate research questions: 1) Is the use of individual protective and risk behavior constructs stable over time? and 2) Are the associations between protective and risk behaviors, alcohol use, and consequences stable over time? Both questions were studied in the context of one path model in which relationships between variables over time were modeled (e.g., the relationship between pacing behaviors from Time 1 to Time 2, Time 2 to Time 3, etc.), and relationships between variables within in each time point were also modeled (e.g., the relationship between pacing behaviors, alcohol use, and consequences at Time 1, Time 2, etc.).

Contrary to the hypothesis that the use of protective and risk behaviors varies over time, results from the current analysis suggest the use of these behaviors is actually quite stable. With

two exceptions, those who engaged in behaviors at Time 1 were likely to engage in them at Time 2, a pattern that was also observed from Time 2 to Time 3, and Time 3 to Time 4. Further, this pattern held across both protective behavior and risk behavior constructs. Notably, pacing behaviors at Time 1 were not significantly associated with pacing behaviors at Time 2, and drinking to get drunk behaviors at Time 2 were not significantly associated with use at Time 3. However, the relationships from one time to the next were significant at all other time points. For example, use of pacing behaviors at Time 2 was significantly associated with use at Time 3, and use at Time 3 was associated with use at Time 4.

Although the use of protective and risk behaviors was relatively stable over time, findings suggest their relationships with alcohol use and related harm on a given drinking event vary over time. In particular, this was observed for the different risk behavior constructs in relation to alcohol use, including drinking to get drunk, mixing, and mass consumption behaviors. Drinking to get drunk behaviors were significantly associated with alcohol use at Time 4, but not at Times 1, 2, or 3. Mixing behaviors were significantly associated with alcohol use at Time 1, but not at Times 2, 3, or 4. Mass consumption behaviors were significantly associated with alcohol use at Times 1 and 3, but not at Times 2 and 4. Unlike the association between risk behaviors and alcohol use, the association between protective behavior constructs and alcohol use was stable. Pacing behaviors were significantly and negatively associated with alcohol use at all four time points, whereas no significant relationship between setting limits, diluting and social protective behaviors and alcohol use was observed on any of the four drinking occasions. Examination of all protective and risk behaviors and their associations with consequences supports the notion these relationships are, overall, not consistent over time. Pacing and diluting behaviors were associated with consequences at Time 3, but not at Times 1, 2, or 4. Mixing behaviors were

associated with consequences at Times 1 and 2, but not at Times 3 and 4. Finally, mass consumption behaviors were associated with consequences at Time 4, but not at Times 1, 2, or 3. Thus, a test of the relationship between drinking-related protective and risk behavior constructs, alcohol use, and consequences on any one drinking occasion could tell a much different story in terms of what behaviors are most influential of alcohol use and related harm relative to another occasion.

Gender equivalence. Lastly, gender differences in the use of protective and risk behavior constructs were examined through the comparison of a model in which relationships between protective and risk behaviors over time were estimated freely, to ones in which the variables were constrained to be equal across males and females. Overall, results suggest the use of protective and risk behaviors were equivalent between males and females. For example, the relationship between the use of pacing behaviors from Time 1 to 2, Time 2 to 3, and Time 3 to 4 was similar for both groups. Two exceptions to this were revealed in the analysis. A significant decline in model fit was observed when paths for social protective behaviors and mass consumption risk behaviors were constrained to be equal across males and females. Although path coefficients varied in size for relationships between social protective behaviors use over time, they were significant over time for both genders, suggesting that for both males and females, use at Time 1 was associated with use at Time 2, use at Time 2 with Time 3, and use at Time 3 with Time 4. With respect to mass consumption behaviors, similar differences in path coefficients were observed; for males, all paths were significant over time suggesting stability in the use of these actions, whereas for females, use was stable from Time 2 to 3 and Time 3 to 4, but not Time 1 to 2.

Insights from an Event-level Analysis

Stability of protective and risk behavior variables. Understanding the stability of the use of drinking-related protective and risk behaviors over time is an important and previously unanswered question in the college alcohol literature. Ray et al. (2011) found that students are likely to fall into one of three categories: 1) students who engage in mostly protective behaviors and few risk behaviors, 2) students who engage in mostly risk behaviors and few protective actions, and 3) students who engage in both protective and risk behaviors. Yet, this particular study utilized cross-sectional data collected in a global manner such that students were asked to report their behavior on a “typical” night of drinking. Thus, although these might be the typical patterns of use, it is unclear if these behaviors are stable over time. The current study explored the relationships between individual protective and risk behavior constructs at the event-level such that use of behaviors within individual drinking events were examined over time.

Overall, results were supportive of the notion that specific protective and risk behavior actions are consistent over time. As described above, relationships between individual constructs were mostly consistent from one time point to the next suggesting that individuals who engaged in pacing behaviors at one time point, for example, were likely to engage in them at the next time point. An examination of means for each category underscores this relationship and helps provide additional context for use of each individual category of behaviors. Participants reported engaging in approximately one pacing behavior at each time point (.91 to 1.27), just under one setting limits behavior (.73 to .90), just under one diluting behavior (.49 to .84), and just over two social behaviors (2.25 to 2.51). With respect to risk behaviors, participants reported close to two drinking to get drunk behaviors per occasion (1.60 to 2.25), under one mixing behavior per occasion (.49 to .69), and close to zero mass consumption behaviors per occasion (.19 to .33).

Stability of protective and risk behaviors in relation to alcohol use and

consequences. Prior to this study, few researchers had examined the collective influence of drinking-related protective and risk behaviors on alcohol use and related consequences. Further, studying these relationships through both a global and event-level approach allowed for a comparison of relationships from two different methods of assessing behaviors. Through the global assessment, students' use of individual protective and risk behaviors was examined relative to alcohol use and consequences, with each behavioral construct representing an average of these behaviors over time. Through the event-level assessment, students' use of these behaviors was examined in the context of four specific drinking occasions. A comparison of results from both the global and the event-level analysis revealed that relationships between protective behaviors and alcohol use were consistent across both analyses, but the relationships between protective behaviors and consequences, as well as risk behaviors and both alcohol use and consequences, varied from one drinking occasion to the next.

In terms of the relationship between protective behaviors and alcohol use, results of both analyses point to the notion that increased use of pacing behaviors is consistently associated with less alcohol consumption. This includes actions such as pacing one's drinks to one or fewer per hour, drinking slowly rather than gulping or chugging, and keeping track of the number of drinks one consumes. Although pacing protective behaviors are consistently associated with alcohol use, other protective actions, including setting limits, diluting, and social behaviors, are consistently not associated with alcohol use, when analyzed in the context of each other, as well as with risk behaviors. Thus while negative associations exist when looking at correlations between each individual behavior construct and alcohol use, these behaviors do not account for significant variance in alcohol use in the context of multiple types of drinking behaviors.

A comparison of the relationships between risk behaviors and alcohol use across both analyses revealed inconsistent associations between these constructs. In the global analysis, both drinking to get drunk and mass consumption behaviors were associated with consumption, such that an increase in behaviors was linked to an increase in the average number of drinks students reported consuming. Drinking to get drunk behaviors include actions such as pre-gaming, participating in drinking games, and drinking shots. Mass consumption behaviors include using beer funnels, participating in case races and power hours, and doing keg stands. Mixing behaviors, on the other hand did not account for significant variance in alcohol use. At the event-level, drinking to get drunk behaviors were significantly related to alcohol use on only one of four occasions, whereas mass consumption behaviors were significantly related to consumption on two of the four occasions. Mixing behaviors, which were not significantly related to alcohol use in the global analysis, did account for significant, unique variance in alcohol use on one of four occasions.

More inconsistencies existed when comparing the relationships between both protective and risk behaviors and alcohol-related consequences across both global and event-level analyses. Globally, pacing protective actions and mixing risk behaviors were significantly associated with consequences. At the event-level, pacing was significantly associated with consequences use on only one of four occasions, whereas mixing behaviors accounted for significant variance in reported consequences on two of four occasions. Diluting protective behaviors and mass consumption behaviors were each significantly associated with harm on one of the four drinking occasions, but not at the global level. Further, the relationship between diluting behaviors and consequences was unexpected, as increased use of diluting behaviors such as putting extra ice in one's drink and drinking water in between drinks was associated with increased harm.

Taken together, findings indicate that associations between both drinking-related protective and risk behaviors and drinking outcomes vary from one drinking occasion to the next. Although the relationships between protective behaviors and alcohol use were consistent across time, all other relationships were not consistent. It's plausible that other variables not assessed as a part of the current study could provide insight into the inconsistent relationships across drinking events. Such variables could be contextual, such as one's drinking environment (e.g., drinking at a friend's apartment versus a fraternity party), or whether the drinking event occurs on a football weekend. One's peer group may also change from occasion to occasion and influence one's use of drinking-related protective and risk behaviors. Individual variables that are subject to change over time, such as one's mood or motives for drinking on a given occasion, could also provide useful information regarding the use of protective and risk behaviors on a given night.

Another potential reason for the inconsistency in relationships from one occasion to the next could relate to the measurement of the drinking-related protective and risk behavior constructs. For example, a student could report drinking slowly on two separate occasions, but that might not be the same from one occasion to the next, and from one student to the next. Another student could report playing drinking games on multiple occasions, but those games could vary over time in terms of how fast and how much alcohol is consumed. Pre-gaming may consist of having multiple shots before a party one night, and one or two beers the next. Thus, more specific measurement of each behavior could help to determine whether consistency of their relationship to alcohol use and related harm does exist from one drinking event to the next.

Gender equivalence. This was the first study to examine whether the use of protective and risk behaviors over time is different for males and females, and for the most part, findings

suggest use is similar. Specifically, those who engage in protective and risk behaviors on one drinking occasion are likely to engage in them on the next. Although results indicated a significant gender difference for the use of social protective behaviors, this same trend was observed, as relationships were significant for both males and females over time. However, for mass consumption behaviors relationships were consistently significant for males, but not for females. Given biological differences in the impact of alcohol use such that women are more susceptible to intoxication at lower levels of alcohol consumption (Ham & Hope, 2003), it is possible that females who do engage in these behaviors do so in inconsistent manner, given the risks associated with this type of drinking. However, a significant relationship was observed between use at Time 2 and 3, and Time 3 and 4. Additional research with a greater number of time points would help to clarify whether more inconsistencies exist, or these behaviors are stable. Further, although use of protective and risk behaviors was relatively stable, future research would benefit from an examination of gender equivalence in relationships between protective and risk behaviors constructs, alcohol use, and consequences.

Implications for Prevention

Taken together, results of all analyses indicate the importance of continuing to focus on increasing the use of protective behaviors while decreasing the use of risk behaviors in prevention approaches targeted towards the college population. With regards to protective behaviors, results consistently pointed to the notion that pacing behaviors were most influential relative to other categories including setting limits, diluting, and social behaviors. Thus, prevention efforts may benefit from an increased focus on these types of protective actions relative to other behaviors. However, from a practical standpoint it seems unwise to not recommend other strategies (e.g., encouraging students to walk home with friends after

drinking), as even though significant relationships did not emerge when examining all behaviors simultaneously, correlations between these variables and drinking outcomes were significant and negative, indicating there is some association between these constructs. Further, as this was the first study that attempted to disentangle the impact of multiple protective and risk behaviors, more research is clearly needed before clear-cut recommendations can be made. However, if the current findings are replicated in future studies it would suggest that prevention approaches may benefit most from focusing on this small subset of protective actions, relative to providing students with a more comprehensive list.

With respect to risk behaviors, associations between alcohol use and consequences were not as consistent relative to protective actions. In the global analysis, all risk behaviors were important in some way, through either a direct association with alcohol use or consequences. However, despite inconsistencies in these relationships from one occasion to the next, the same argument can be made when examining the findings of the event-level analysis, as all categories of behaviors were significantly associated with either alcohol use or consequences on at least one of the four occasions. Clearly, future research could help to clarify the results, but considering the current findings, it seems important for prevention efforts to focus on discouraging the use of all types of drinking-related risk behaviors including drinking to get drunk, mixing, and mass consumption actions.

The observed stability in the use of behaviors over time may speak to the difficult task of changing such actions (e.g., reducing use of drinking-related risk behaviors) via prevention efforts, as students seem to be consistent with the behaviors they choose to use from one occasion to the next. However, with risk behaviors, one strategy might be to encourage adaptations to these behaviors that serve to limit alcohol use and related harm, without

suggesting students give up the behaviors entirely. For example, if students find themselves in a situation where others are pre-gaming, efforts might focus on small changes such as consuming only one alcoholic drink as a part of this behavior, versus several. Similarly, if students are adamant about playing drinking games, encouraging them to limit the amount of alcohol utilized in such games could be one approach, or altering the rules slightly so that drinking occurs less often. However, such adaptations may not make sense for mass consumption behaviors, as the inherent nature of these actions leads to the consumption of mass quantities of alcohol very quickly.

Two prevention approaches in which the findings could be incorporated include both brief motivational and parent-based interventions (BMIs and PBIs, respectively). As noted in the review of the literature, BMIs have been identified in the literature as one of the most efficacious interventions that exists for college students, yet there is room for improvement (Larimer and Cronce, 2007; 2002). These interventions are guided by personalized feedback, and delivered either in person, or via written, mailed, or computerized feedback. Drinking-related protective behaviors are already often incorporated in the feedback to participants, such that they are presented with a list of behaviors they report using, as well as others that they are encouraged to try in the future (Larimer et al., 2007; Turrisi et al., 2009). However, there are multiple components to the feedback, thus it is unclear to what extent this section of the feedback is emphasized. Interestingly, there is less emphasis on risk behaviors in BMIs. Often, the extent of the focus on risk behaviors is the inclusion of one item in the list of protective behaviors students are provided that encourages them to avoid drinking games. A section of the feedback devoted solely to risk behaviors is one way to incorporate this information. Further, for BMIs delivered in person, professional or peer providers may want to have specific conversations with participants

regarding the role drinking-related risk behaviors play with respect to alcohol use and related harm. In current delivery of BMIs, such connections are routinely made between quantity and frequency of alcohol use with respect to harm, but not with respect to types of drinking-related risk and protective behaviors.

Whereas BMIs are targeted directly to college students, PBIs target their parents. Through this approach, parents are sent a handbook on college student alcohol use and encouraged to read the information and communicate with their teen about this topic (Turrisi et al., 2001, 2009; Wood et al., 2010). This intervention is timed so that parents receive the handbook during the summer prior to their teen's first year in college. Notably absent from these materials is information specific to drinking-related protective and risk behaviors, and inclusion of such a component could serve to improve future efforts.

Limitations and Future Directions

Although the current work extends our knowledge on the use of drinking-related protective and risk behaviors, there are limitations that should be considered with regards to both the interpretation and generalizability of the findings. With regards to the present sample, students were drawn from a single campus. This particular campus environment can be labeled as high risk based on several factors highlighted in the literature including its large presence of fraternities and sororities, as well as the strong athletic culture among students, whether through direct participation in or attendance at sporting events such as football games (Presley, Meilman, & Leichliter, 2002). It is possible, for example, that the use of drinking-related protective and risk behaviors over time is less stable in a less risky environment. This particular campus is also largely homogeneous with respect to ethnic and racial background and it is possible different findings could emerge with a sample that is more heterogeneous in make up. Although

intentional, the study included only first-year students and thus caution should be used when applying the findings to students who are at a later point in their college experience. Future studies could benefit from a multisite data collection with a more diverse sample.

Another potential limitation relates to study design, specifically with respect to the number of drinking occasions included. Four consecutive weekend drinking events were examined within the first semester of students' first year. Although this was the first study to adopt such an approach, confidence in the findings could be gained by the inclusion of additional time points. A study that includes additional data collection points throughout the entire first year of college would serve to provide a broader picture of the stability of both behaviors and relationships over time. For example, relationships between constructs (e.g., risk behaviors and alcohol use) varied from one event to another in the current study, but it is possible this is an artifact observed because only a small number of drinking events were assessed. A study that includes assessments of additional drinking events throughout the year might reveal that relationships are, overall, more stable than what was found in this research. It is also plausible that relationships are more variable early on in one's college experience due to contextual factors (e.g., peer group, drinking location), but as they get older, these factors change less, or simply play less of a role as individuals develop more stable or consistent habits.

Certain aspects of the data analysis itself limit the conclusions that can be drawn, as well as point to the need for future research. As described in the analytic plan for the event-level analysis, only individuals who consumed alcohol on each of the four weekends studied were included in the analysis. This resulted in a much smaller subset of the initial sample, as there were many participants who drank on one, two, or three weekends, as opposed to all four. An alternative approach would be to include all participants. However, those who indicated they did

not drink on a given occasion did not receive questions about their use of protective and risk behaviors on that day, and there is no clear answer as to how to best make use of the data. For example, for a participant who indicates they did not consume any alcohol on a given event, one could impute a score of zero for each protective and risk behavior for that individual because he or she did not engage in either type of behavior. Yet the score of zero for an individual who did not drink is conceptually different than the score of zero for a person who consumed alcohol but chose not to engage in protective behaviors, or conversely, chose not to engage in risk behaviors. To that end, as the event-level analysis included only individuals who did drink at least once on all four weekends, the sample size for this part of the study was relatively small. For future studies in which data of only individuals who consume alcohol is utilized, it is important to not simply screen for alcohol use and expect that all drinkers will be able to be included in analyses. Instead, it is important to increase the sample size as a large percentage of drinkers do not consume alcohol every weekend.

Also noted in the analytic plan, it was possible participants consumed alcohol on either Friday, Saturday, or both weekend days included in the weekly assessment. For participants with multiple drinking occasions per weekend (i.e., they consumed alcohol on both Friday and Saturday), data from their heaviest drinking occasion of that weekend was used. In other words, if a participant drank more on Friday, the data with respect to their protective and risk behavior use, alcohol use, and reported consequences on that occasion was included in the analysis. Conversely, if they drank more on Saturday, data from that occasion was included in the analysis. This decision was guided by previous event-level studies in the college alcohol literature (Neal & Fromme, 2007a) that utilize data from the heaviest drinking event. Yet, an

examination of the event-level analysis using data from the occasion in which less alcohol was consumed, or both occasions for that matter, could add insight to the current findings.

Although results suggest the use of drinking-related protective and risk behaviors is stable over time (e.g., persons who used social protective behaviors at Time 1 were likely to use them at Time 2), it would be interesting to understand what happens on the occasions when individuals do deviate from their typical patterns. Event-level data is appropriate for this type of analysis and other event-level studies in the college alcohol literature have implemented this type of analytic approach (Neal & Carey, 2007; Neal & Fromme, 2007a). However, this has not yet been applied to the specific constructs examined in this study. Another approach that would shed insight on to deviations from typical patterns is Latent Transition Analysis (LTA), which is a person-centered technique for data analysis (Collins & Lanza, 2010). It was discussed previously that previous work by Ray et al. (2011) identified three profiles that describe the use of drinking-related protective behaviors. However, these profiles were identified using cross sectional data, and LTA would extend this work by using data from multiple time points to identify the appropriate number of profiles that best fit the data. Further, LTA would allow us to see the degree to which individuals transition from one profile to the next over time, providing a different type of indication regarding the stability of these behaviors over time.

As mentioned in the discussion surrounding the variation in relationships between constructs from one event to the next, future studies would benefit from the inclusion of contextual variables that could serve to explain such variation. For example, relationships between constructs could vary depending on drinking location, peer environment, as well as other environmental influences. Individual differences that are subject to change over time could also play a role, and include variables such as one's mood on a given occasion and his or her

motivations to drink alcohol. It's also plausible that these variables could serve to influence the use of drinking-related protective and risk behaviors over time.

Lastly, refinement of measures was also discussed as a potential area of importance for future research. More specific measurement of individual protective and risk behaviors might help to eliminate some of the variation in relationships between these constructs and drinking outcomes from one time point to the next. For example, individuals could report engaging in drinking to get drunk or pacing behaviors at multiple time points, but engage in these same behaviors in a different manner from one event to the next. Further, different sets of behaviors are included in different studies (e.g., Ray et al., 2009, Martens et al., 2005, Sugarman & Carey, 2009), and it is unclear as to whether one set of behaviors offers advantages relative to another. Making things more difficult in this area is the evolving nature of the behaviors in question. Although college alcohol use has been an area of study for decades, the different types of behaviors students engage in with respect to alcohol use change. For example, an emerging body of research indicates that mixing alcohol with energy drinks is both popular and incredibly risky among this population (Thombs et al., 2010). Yet, this behavior is not included in the current study, or examined in the context of other risk and protective behaviors.

Conclusion

The current study extends the research on drinking-related protective and risk behaviors through an examination of these constructs in a longitudinal, event-level framework. Findings suggest that when studied simultaneously, pacing behaviors were consistently associated with drinking outcomes relative to other types of protective actions. The influence of risk behaviors is less clear as variation in the relationships between these behaviors and drinking outcomes was observed. The use of drinking-related protective and risk behaviors was found to be quite stable

over time, with few gender differences. Prevention approaches targeting first-year college students should include components that encourage use of protective actions while discouraging use of risk behaviors, or put more emphasis on these components if they already exist.

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