REducing High-Risk College Drinking: Examining the Consumption of Alcohol-Energy Drink Cocktails Among College Students

A Dissertation in
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by
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Abstract

High-risk college drinking continues to be a major health concern affecting campuses nationwide (Ham & Hope, 2003; NIAAA, 2006). A recent trend among college students that has been associated with increased heavy episodic drinking and alcohol-related consequences is the consumption of alcohol-energy drink cocktails (e.g., Red Bull and vodka). Past studies have examined the consumption of alcohol-energy drink cocktails (O’Brien et al., 2008; Thombs et al., 2010; Woolsey et al., 2010); however, there is a lack of research examining the psychosocial variables that explain why students are choosing to engage in this high-risk drinking behavior. The present study examined psychosocial constructs important in the relationship between group membership (those who drink alcohol-energy drink cocktails versus those who drink alcohol only) and decision-making/drinking outcomes using the general unified theory of behavior. Data were collected on 387 first-year college students at a large university in the northeastern United States via a web-based survey at two time points (i.e., spring semester of freshmen year and fall semester of sophomore year). Whereas previous research has demonstrated the risks of consuming alcohol-energy drink cocktails, the current study explored why students might be choosing to participate in this high-risk drinking practice and whether these factors change over time.

There were two aims of the current dissertation: (1) To examine psychosocial constructs for those who consume alcohol-energy drink cocktails and those who consume alcohol only and the effects on decision-making processes/drinking outcomes for college students using a mediation analysis, and (2) To examine developmental changes from freshman to sophomore year affecting alcohol-energy drink cocktail use based on
psychosocial constructs, decision-making/drinking outcomes using a prospective longitudinal design.

Results revealed that the association between alcohol-energy drink cocktail use and decision-making/drinking outcomes was mediated by expectancies, injunctive norms, self-concept, and self-efficacy regarding alcohol-energy drink cocktail use and that these relationships remained stable over time. The implications of the findings are discussed in terms of further informing and developing prevention programs targeted at reducing excessive alcohol use among college students and the associated negative health-consequences.

Key Words: Heavy Drinking, Alcohol-Energy Drink Cocktails, College Students
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Mommy and Daddy – we did it!
Dedication

To Grandfather
Chapter 1: Introduction

Background

The National Institute on Alcohol Abuse and Alcoholism (NIAAA) has identified alcohol misuse as a major health problem among college students (NIAAA, 2006). Research has shown that the highest proportion of individuals diagnosed with alcohol substance disorders are between the ages of 18 and 29 years old, a demographic encompassing over 92% of all enrolled college students (Dawson, Grant, Stinson & Chou, 2004; Jackson, Sher & Park, 2006). According to Healthy People 2010, among students attending college in the US, 87% reported having tried alcohol and 40% reported heavy drinking in the two weeks prior to the survey. Epidemiological studies suggest that a large portion of college students experience alcohol-related consequences, including unplanned sexual activity, criminal mischief, driving-related injuries, physical assaults, sexual assaults and death (Abbey, 2002; Baer, Kivlahan & Marlatt, 1995; Cooper, 2002; Wechsler et al., 1994; Wechsler, Dowdall, Davenport & Rimm, 1995). For example, a study conducted by Hingson, Zha and Weitzman (2009) revealed that annually, 599,000 college students report alcohol-related physical injuries and 696,000 are assaulted by other college students under the influence of alcohol. In addition, 400,000 college students engage in unplanned sex and 97,000 are sexually assaulted. The authors also conservatively estimated that 1,825 students had died the previous year due to alcohol-related incidents. Past studies have shown that such high-risk drinking behaviors are unique to the college population because college students drink more per drinking occasion than their non-college counterparts (Dawson et al., 2004; Jackson et al., 2006). Because research has shown that heavy drinking during the developmental
stages of young adulthood elevates the risk for alcohol dependence later in life (Clark & Bukstein, 1998; Grant & Dawson, 1997), the importance of closely examining specific high-risk drinking behaviors is necessary from a prevention perspective.

A current popular high-risk drinking behavior among college students is combining alcohol with energy drinks (e.g., Red Bull and vodka). In a study surveying 4,271 college students from 10 universities in North Carolina, almost 25% reported consuming alcohol-energy drink cocktails (AECs), resulting in more incidents of heavy episodic drinking (e.g., five or more drinks in a row for males and four or more drinks in a row for females within a two-hour time period) as well as an increase in negative alcohol-related consequences (e.g., being taken advantage of sexually, riding with an intoxicated driver, being physically hurt) (O’Brien, McCoy, Rhodes, Wagoner & Wolfson, 2008).

Furthermore, research indicates that consuming AECs can lead to risky behavior and injury. For example, the effects of co-ingesting alcohol (vodka) and Red Bull were compared to those from ingesting alcohol or energy drinks alone among 26 healthy volunteers (Ferreira, Tulio de Mello, Pompeia & Souza-Formigoni, 2006). The study found that AECs lessen subjective levels of intoxication (i.e., the ability to feel the effects of alcohol); however, breath alcohol concentrations and deficits in objective motor coordination and visual reaction times caused by alcohol consumption are not significantly reduced. Recently, Thombs and colleagues (2010) conducted an alcohol field study and found college bar patrons who drink AECs to be at elevated risk for leaving in highly intoxicated states with intentions to drive. Similarly, Woolsey, Waigandt & Beck (2010) specifically examined intercollegiate student-athletes;
compared to athletes who consume alcohol only, athletes who consume AECs are at increased risk for heavy episodic drinking and negative consequences. Despite these findings, there is a lack of research on the underlying motivations for engaging in this behavior. The following research questions remain unanswered: (1) What are the outcome expectancies (e.g., perceived enhanced “buzz”) associated with AEC use? (2) What are the normative or social influences (e.g., typical college student) associated with AEC use? (3) What are the self-concepts (e.g., favorable perceptions) associated with AEC use? (4) What are the emotional states (e.g., excited, alert) associated with AEC use? (5) What association does self-efficacy (e.g., ability to perform behavior) have with AEC use? (6) What is the relative importance of each psychosocial construct (i.e., items 1-5 above) influencing AEC use? (7) Do the above mediators change over time across the college experience?

Implications

Given the increasing prevalence and popularity of AECs (and the associated negative health-related consequences), more research is needed on this topic. The aim of this dissertation was to examine the use of AECs using theoretical, systematic analysis methods in an effort to distinguish the psychosocial mediators of students who consume AECs versus those who consume alcohol alone. The study seeks to answer the seven questions outlined above in an effort to provide new perspectives that inform interventions and help fill this significant gap in the literature. The public health relevance of this proposal includes identifying psychosocial mediators that influence the decision-making processes of students who may be at elevated risk for alcohol-related harm. The findings will help provide information for universal and targeted educational
interventions aimed at preventing high-risk drinking and alcohol-related consequences experienced by college students.

**Specific Aims**

This study presents an in-depth examination of the reasons why college students who consume AECs tend to drink more (and experience more negative consequences) in an effort to improve prevention and intervention efforts. The specific aims of the research are:

Aim 1. To examine psychosocial mediators for those who consume AECs and those who consume alcohol only and the effects on decision-making processes and drinking outcomes for college students.

Aim 2. To examine developmental changes from freshman to sophomore year affecting AEC use based on psychosocial mediators, decision-making, and drinking outcomes using a prospective longitudinal design.
Chapter 2: Literature Review

This section presents a review of relevant research on the topics of (1) college drinking, (2) energy drink use and the consumption of alcohol-energy drink cocktails among college students, (3) the theoretical framework guiding the study, and (4) proposed hypotheses.

High-Risk Drinking in College

The focus of this section is on the prevalence and magnitude of high-risk drinking behaviors among college students. It can be argued that the pervasiveness of high-risk drinking on college campuses nationwide supports the notion that many students view alcohol misuse as being part of the educational experience or in some way a rite of passage into adulthood. This observation is unsettling because high-risk college drinking continues to be a major public health concern (Ham & Hope, 2003; NIAAA, 2006). Continued research efforts are necessary in order to understand not only the negative effects of such behaviors, but also the motivations behind them. Appropriate interventions can then be designed to ensure the safety of all and restore a healthy and productive learning environment for college students.

Studies conducted over the last decade reveal that the highest proportion of heavy drinkers and individuals with diagnosable alcohol substance disorders are 18 to 25-year-olds, the age range encompassing over 92% of enrolled college students (Dawson et al., 2004; Hingson, Heeren, Winter & Wechsler, 2005; Perkins, 2002; Wechsler et al., 1994a, b). Heavy drinking among college students has been consistently associated with unplanned sexual activity, driving injuries, sexual and physical assaults, criminal
mischief, and injury (Abbey, 2002; Cooper, 2002; Leibsohn, 1994; Wechsler et al., 1994a, 1995; Wechsler, Dowdall, Maenner, Gledhill-Hoyt & Lee, 1998).

Specifically, heavy episodic drinking appears to be the most prevalent high-risk drinking behavior among college students (Wechsler et al., 1995; Hingson, 2009), and this form of alcohol consumption permeates university life (Crundall, 1995; Hingson, 2009). According to the NIAAA (2006), heavy episodic drinking corresponds to five or more drinks for males and four or more drinks for females in a two-hour period. Heavy episodic drinking can be extremely dangerous, potentially leading to negative health outcomes such as alcohol poisoning, aggressive behavior, and several social and psychological problems (Wechsler et al., 1995). Unfortunately, a large number of students who engage in this high-risk drinking behavior do not believe it is a significant problem (Crundall, 1995; Mallet, Bachrach & Turrisi, 2008; Lee, Geisner, Patrick & Neighbors, 2010).

**Pharmacology of Alcohol**

To fully understand the implications of alcohol misuse as a serious long-term health concern, a brief discussion about the pharmacology of alcohol is warranted. Alcohol is a central nervous system depressant and can produce sedative effects. Absorption of alcohol begins in the stomach within 5-10 minutes of oral ingestion. The liver metabolizes 95% of alcohol and 5% is excreted unchanged through the lungs. There is a gender difference in that females have less of the metabolizing enzyme alcohol dehydrogenase. In addition, since males have a greater ratio of muscle to fat, females with more body fat have higher alcohol concentrations in plasma after consumption. The rate of metabolism is independent of blood alcohol level; 10 ml of 100% alcohol is
metabolized per hour. For example, it would take an adult one-hour to metabolize the amount of alcohol contained in four ounces of wine, a one-ounce shot of hard liquor or 12 ounces of light beer (Julien, 2008). Easy elimination occurs when alcohol is broken down into water and carbon dioxide.

**Alcohol Use and Gender Differences**

As stated earlier, females absorb alcohol faster than males and less alcohol is needed to affect females when compared to males. Alcohol is more soluble in water than in fat. Because females tend to have a higher fat content than men, alcohol does not distribute as widely as it does in males whose tissues tend to contain more water. This may help explain why females have higher blood-alcohol concentrations than males after consuming the same amount of alcohol (King & Brucker, 2009).

In addition, alcohol abuse and dependency have strong genetic components, especially in males. Males tend to underestimate their intoxication levels and often, alcohol problems begin at an early age (< 20 years). These are often co-morbid conditions with abuse of other drugs, depression, anxiety, bipolar disorder, impulsive behaviors, and antisocial personality disorders (Deb et al., 2009).

**Alcohol Intoxication**

To meet the definition of intoxication, blood alcohol concentration (BAC) must be 0.08 or higher. At this BAC level, judgment and reaction is less inhibited and the risks of alcohol-related harm (e.g., having an accident while driving) are four times greater. BAC falls about 0.015% every hour (Julien, 2008). Although a lethal dose of alcohol in humans varies, death can occur when BAC is at .40% - .50% (Deb, Sharma & Jain, 2009).
In sum, alcohol misuse among college students is a noteworthy public health concern because such behavior early in life has been associated with higher rates of mental health problems such as anxiety, depression and conduct disorders (Miller & Carroll, 2006). Moreover mental health problems increase the likelihood of continued and oftentimes elevated alcohol use, creating a dangerous cycle. It is therefore important to prevent alcohol misuse among an emerging adult population (e.g., college students) in an effort to reduce the risk of adverse outcomes experienced with the early onset of alcohol use. Interventions specifically targeted at reducing alcohol consumption among college students are especially needed because of the pervasive use of alcohol during the college years resulting in higher rates of harm more so than any other drug (Lubman, Bonomo & Yücel, 2007).

**Energy Drink Consumption among College Students**

An under-studied high-risk behavior that has emerged recently is the phenomenon of energy drink use. Although limited, recent studies have identified college students as being at high-risk for energy drink misuse, especially since such drinks are aggressively marketed to young adults (Malinauskas, Aeby, Overton, Carpenter-Aeby & Barber-Heidal, 2007; Reissig, Strain & Griffiths, 2008). Energy drinks have been shown to improve cognitive and physical performance, and a rising number of students are consuming them in order to maintain the physical and mental stamina needed to meet the demands of college life (Mucignat-Caretta, 1998; Seidl, Pyerl, Nicham & Hauser, 2000; Kennedy & Scholey, 2004). Specifically, many college students report consuming energy drinks when studying for tests or completing important class projects (Malinauskas et al., 2007).
Because college students believe energy drinks improve learning ability, such beverages are growing in popularity on college campuses. As the number of undergraduate students using stimulants to improve physical and mental stamina has increased, there also has been increased scholarly interest in the consumption of energy drinks by this population. Most energy drinks contain caffeine, glucuronolactone, taurine, and B vitamins, all which have been shown to have potential performance-enhancing effects (Mucignat-Caretta, 1998; Seidl et al., 2000; Brice and Smith, 2002; Huskisson, Maggini & Ruf, 2007; Ratamess, Hoffman, Ross, Shanklin, & Faigenbaum, 2007). Energy drinks have been linked to negative health consequences such as strokes, seizures, heart problems, and even deaths (Iyadurai & Chung, 2007; Malinauskas et al., 2007) and the interactions of these ingredients and their effects have been under-studied. Table 1 lists common main ingredients in the most popular energy drinks consumed in the United States. A brief discussion of the studied effects of these key ingredients follows.

<table>
<thead>
<tr>
<th>DRINK (8 oz.)</th>
<th>CAFFEINE</th>
<th>SUGARS</th>
<th>TAURINE</th>
<th>B VITAMINS</th>
<th>GINSENG</th>
<th>GUARANA</th>
<th>GLUCURONOLACTONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED BULL</td>
<td>80mg</td>
<td>27g</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>MONSTER</td>
<td>80mg</td>
<td>26g</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>AMP</td>
<td>71mg</td>
<td>29g</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>ROCKSTAR</td>
<td>80mg</td>
<td>31g</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>NOS ENERGY DOUBLE SHOT ENERGY</td>
<td>130mg</td>
<td>26g</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>FULL THROTTLE</td>
<td>73mg</td>
<td>14g</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>TAB ENERGY SOBE ADRENALINE RUSH</td>
<td>100mg</td>
<td>29g</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>5-HOUR ENERGY</td>
<td>72mg</td>
<td>0g</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>5-HOUR ENERGY (2 oz.)</td>
<td>138mg</td>
<td>0g</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
</tbody>
</table>
Caffeine. Energy drinks such as those listed above derive their energy-boosting effects primarily from large amounts of caffeine (Miller, 2008; Reissig, Strain & Griffiths, 2009) and are often used by college students as ergogenic aids intended to compensate for insufficient sleep and to increase energy and enhance cognitive functioning (Julien, 2008; Miller, 2008).

Pharmacokinetics

Absorption and Distribution. Caffeine taken orally is rapidly and completely absorbed by the gastrointestinal tract (Magkos and Kavouras, 2005). Typically, 99% of the ingested dose is absorbed in approximately 45 minutes with complete absorption occurring over the next 90 minutes. Absorption of caffeine seems to be dose-independent for humans (Fredholm et al., 1999; Magkos and Kavouras, 2005; Julien, 2008). Plasma levels peak at about 2 hours and then begin to decrease (Julien, 2008). In addition, the hydrophobic properties of caffeine allow it to be freely distributed in almost equal concentrations throughout all tissues of the body and brain (Fredholm et al., 1999; Magkos and Kavouras, 2005; Julien, 2008).

Metabolism and Excretion. Caffeine is metabolized by the liver into 25 metabolites before being eliminated by the kidney in urine (Julien, 2008). Like most xenobiotics, caffeine goes through extensive metabolism in the liver by the CYP-1A2 subgroup of hepatic drug-metabolizing enzymes (Magkos and Kavouras, 2005; Julien, 2008) with the two most important metabolites being theophylline and paraxanthine. These two metabolites behave similarly to caffeine suggesting that some metabolites of caffeine have significant pharmacological activity (Fredholm et al., 1999; Julien, 2008).

Pharmacological Effects
Caffeine has several important physiological effects. For example, caffeine is a central nervous system (CNS) stimulant and it has significant cardiac, respiratory, and diuretic effects (Julien, 2008). In particular, caffeine has been shown to be an effective psychostimulant as well as induce the feelings of excitability, increased mental alertness, reduction in fatigue and the need for sleep being delayed. Despite its beneficial effects, caffeine use can also produce unwanted effects such as anxiety, agitation, insomnia, and mood changes (Julien 2008).

Moreover, the effects of caffeine also are not dose-dependent. Researchers examining the effects of caffeine on performance and mood found that caffeine had a significant effect on psychomotor functioning whether the dosage was a large dose or based on a more realistic drinking regime (Brice and Smith, 2002). However, it has also been suggested that additional caffeine is needed to achieve the same effect, possibly resulting in caffeine tolerance that could potentially lead to dependency. Furthermore, evidence of withdrawal has also shown the dependence producing effects (Juliano and Griffiths, 2004).

**Pharmacodynamics**

The mechanisms of action for caffeine are still not completely understood. Several hypotheses have been presented 1) intracellular mobilization of calcium 2) inhibition of phosphodiesterases and 3) antagonism at the level of adenosine receptors (Nehlig, et al., 1992). However, action at the adenosine receptors seems to be the most understood and widely accepted hypothesis (Fredholm, et al. 1999). In fact, the structure of caffeine closely resembles adenosine an inhibitory neurotransmitter thought to be involved in sleep and suppressing arousal (Julien, 2008). It is believed that caffeine
blocks the actions of endogenous adenosine receptors (Fredholm et al., 1999; Magkos and Kavouras, 2005).

Furthermore, Julien (2008) described the positive stimulating effects of caffeine as being in large part due to the blocking of adenosine receptors that stimulate GABA and dopamine receptors. Although caffeine does not induce dopamine release, it does indirectly stimulate dopamine activity by eliminating the negative modulatory effects of adenosine from dopamine receptors (Julien, 2008). This explains caffeine’s effect on feelings of alertness and well-being (Julien, 2008).

Although research has consistently shown that high doses of caffeine can have adverse health consequences (Griffiths & Woodson, 1988a, b; James, 1997), more work continues to be needed regarding the overall risks (e.g., cardiovascular disease) of caffeine consumption (Rodrigues & Klein, 2006). The United States Food and Drug Administration (FDA) recommended daily allowance of caffeine is 300 mg (about three 8 ounce cups of coffee), however the FDA does not regulate energy drinks, and the varying levels of caffeine in these drinks makes it easy to exceed the maximum allowance. Nearly 90% of adults report regular caffeine use, with an average daily intake of about 227 mg (Frary, Johnson & Wang, 2005). The FDA classified caffeine Generally Recognized As Safe (GRAS) in 1958. The three most popular sources of caffeine among adults are coffee (70%), soda (16%), and tea (12%) (Frary et al., 2005).

**Taurine.** An amino acid that is distributed throughout the brain, taurine’s exact role and mode of action in the central nervous system is still unknown. It is widely accepted that taurine plays a significant role in physiological processes such as osmoregulation, neuroprotection and neuromodulation (Salimaki, Scriba, Piepponen &
Rautolahti, 2003). Moreover, taurine interacts with GABAergic, glycnergic, cholinergic and adrenergic neurotransmitter systems (Ramanathan, Chung, Giacomini & Brett, 1997), which may possibly explain its believed ergogenic effect. Most studies examining the effects of taurine on psychomotor performance do so in combination with caffeine (Geiss, Jester, Falke, Hamm & Wagg, 1994); Seidl et al., 2000; Scholey & Kennedy, 2004). Although it has been hypothesized that taurine may in fact improve cognitive functioning, no definitive study has shown these effects without the presence of caffeine.

**B-Vitamins.** B-vitamins are often used in energy drinks for their energy boosting qualities. B-vitamins are a group of eight water-soluble vitamins. They are involved in cell metabolism, enhancing immune and nervous system functioning as well as promoting cell growth and division (Tracy, 2010). Research studies have shown B-vitamins to be efficacious for relieving symptoms and causes of stress (Connor, 2004) and depression (Almeida et al., 2010; Roberts, Bedson, & Tranter, 2010), and improving cardiovascular health (Gaby, 2010). Any excess in the body is excreted in urine, so their use as a nutritional supplement is considered to be generally safe (Tracy, 2010).

**Ginseng.** Ginseng is a plant in the Araliaceae family and is used for increasing energy and blood supply, improving circulation, and accelerating recovery after illness (energysip.com, 2010). Overall, it is known for its stimulant effects on the body (energysip.com, 2010). The main active compounds are ginsenosides and saptonin glycosides (Court, 2000), and research has shown ginseng to be an adaptogen (Chen, Liou & Chang, 2008). However, in an extensive review of 16 randomized clinical trials examining the efficacy of ginseng, Vogler, Pittler and Ernst (1999) found that the
evidence supporting the health benefits of ginseng remain inconclusive and more rigorous investigations are warranted.

**Guarana.** Guarana is another active ingredient commonly found in energy drinks. It is a berry found in South America and the seeds of the plants contain caffeine. Previous research has suggested that guarana acts as a stimulant and may increase alertness, fight fatigue, and improve memory (Haskell, Kennedy, Wesnes, Milne & Scholey, 2007). Guarana is almost twice as potent as standard caffeine – a factor often overlooked or even ignored in caffeine content calculations with regards to energy drinks. Compared to standard caffeine, the stimulant and euphoric effects of guarana last almost twice as long, and it is often used for its thermogenic and diuretic effects (energysip.com, 2010). In a study exploring reasons behind adolescent consumption of nutritional supplements such as guarana, “energy creation” beliefs were most commonly reported (O’Dea, 2003). Similar to other herbal remedies, there are no regulated manufacturing standards; two energy drinks may contain different amounts of guarana, depending on the manufacturer.

**Glucuronolactone.** A natural compound produced by the metabolism of glucose in the liver, glucuronolactone regulates the formation of glycogen, is a main structural part of most connective tissues, and aids in the detoxification of the body (O’Neil, 2006). Although there is relatively little information known about glucuronolactone, it has been suggested that it may fight physical fatigue while having positive effects on mental performance and mood (Geiss et al., 1994; Seidl et al., 2000). However, these ergogenic claims have not been proven in a definitive study.
Alcohol-Energy Drink Cocktails

As mentioned earlier, research exploring the effects of combining alcohol with energy drinks is nascent. Approximately 10 peer-reviewed articles have been published on the topic, all within the last five years. These studies typically focused on college students’ consumption patterns and the negative associated consequences. Primarily random samples ranged from 12 to 4,271 participants and relied on self-report measures. However, more research in this domain is warranted, as there are severe risks involved with this behavior, especially for the young adult population – the target market for alcoholic-energy drinks. O’Brien and colleagues (2008) showed that students who drink AECs report a higher prevalence of heavy episodic drinking and alcohol-related consequences, including: being taken advantage of sexually, taking advantage of others sexually, riding with intoxicated drivers, driving while intoxicated, being physically hurt or injured, and requiring medical attention. Past studies have shown consuming AECs can reduce subjective perceptions of intoxication, even though these effects are not detected in objective measures or blood alcohol content (Ferreira et al., 2006; Marczinski & Fillmore, 2006; Oteri, Francesco, Caputi & Calapai, 2007). Closely examining the relationship between AEC use and increased alcohol use is important because it has been shown that college students often underestimate their intoxication levels when consuming large quantities of alcohol, increasing the likelihood experiencing alcohol-related harm (Mallet, Turrisi, Larimer & Mastroleo, 2009). Therefore, it is essential to address the use of AECs, not only because of the significant health risks, but also due to the potential amplification of high-risk drinking behaviors and alcohol-related consequences.
Theoretical Model Guiding the Research

The primary purpose of this study is to examine the differences between college students who consume AECs and those who consume alcohol only in terms of mediators affecting associated decision-making processes and behavioral outcomes. The theoretical model guiding this study and Aim 1 is the general unified theory, which is (as the name implies) comprised of five widely-accepted theories in the field of psychological research. Examining research from several decades, officials at the National Institute of Mental Health (NIMH) noted that a majority of studies in the field of psychology relied on just a few influential theories: (1) social learning theory (Bandura, 1975), (2) the theory of reasoned action (Ajzen & Fishbein, 1981), (3) self-regulation theory (Kanfer, 1975), (4) the theory of subjective culture (Triandis, 1972), and (5) the health belief model (Rosenstock, 1974). The NIMH sponsored a workshop in which Bandura, Becker, Fishbein, Kanfer and Triandis were asked to develop a framework integrating mediators from these influential theories (described in detail below), and a general unified theoretical framework emerged (Guilamo-Ramos, Jaccard, Dittus, Gonzalez & Bouris, 2008).

Bandura (1975) developed social learning theory by arguing that people can learn new information and behaviors by observing others. Ajzen and Fishbein’s (1981) theory of reasoned action relies on three general mediators: behavioral intentions, attitudes and social norms. They purported that behavioral intentions could be predicted by attitudes and beliefs about potential external perceptions if they performed the behavior. Kanfer (1975) described the process by which a person monitors his or her own behavior in self-regulation theory. According to the theory, a person will evaluate the desired effect of a behavior; if it is met, he will continue the behavior and if not, he will discontinue it. Triandis (1972) argued that a
person’s subjective culture (e.g., shared beliefs, attitudes, knowledge, ability), past experiences, and environment all influence behavior. Although there are several versions of the health belief model, generally it attempts to predict an individual’s behavior by focusing on her attitudes and beliefs. Later versions of the health belief model examined mediators such as perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy (Glanz, Rimer & Lewis, 2002).

The above theories led to the development of a theoretical framework (i.e., the general unified theory) that emphasized the commonalities of the theories such as behavioral intentions and other psychosocial factors that impact behaviors (Blanton & Jaccard, 2006; Guilamo-Ramos et al., 2008). The present study used the general unified theory to guide the selection of mediators and provide a framework for examining the relationships among AEC consumption, psychosocial mediators, decision-making outcomes and heavy drinking behaviors, as shown in Figure 1. The far left box identifies the predictor groups (i.e., AEC users and alcohol only users) and the middle box highlights the psychosocial mediators. The box to the far right shows outcomes including decision-making processes (i.e., behavioral willingness and intention) and drinking outcomes (i.e., heavy episodic drinking and frequency of drunkenness). Figure 1 also contains two arrows: 1) the $\alpha$ path, which represents the relationship between the predictor groups and mediators; and 2) the $\beta$ path, which represents the relationship between mediators and the outcomes. The unified theory aspect of the model is reflected in the relationship between mediators and outcomes.
Longitudinal Focus

The second purpose of this study is to examine developmental changes in the relationships among the consumption of AECs, psychosocial mediators, decision-making outcomes, and high-risk drinking behavioral outcomes from freshman to sophomore year using a prospective longitudinal design (Figure 2). This design is important, especially from a prevention standpoint, because it has not been shown if AEC use remains stable over time. Given that there are developmental changes experienced by college students (e.g., moving from on-campus housing to off-campus housing with less adult supervision and regulations, and increased curriculum and social life demands) students may seek ways to boost their energy levels.

The general unified theory was also used to determine if there were changes in the relationship between AEC use and drinking outcomes over time. Figure 2 illustrates an example of the relationship between expectancies regarding the consumption of AECs, decision-making and drinking outcomes. The notation in Figure 2 specifies time 1 and time 2 after the construct to designate the specific time point. Paths d1, e1 and d2, e2 in the model reflect contemporaneous effects (i.e., examining effects/relationships within a
time period) of expectancies, decision-making and drinking at each time point. Paths a1, b1, and c1 reflect autoregressive effects (i.e., using past data to predict future results on the same measure or to examine the effects within a repeated measure). Analyzing these paths assesses whether mediators tend to be stable over time and whether individual orientations or behaviors at time 1 influence outcomes at time 2, over and above any contemporaneous effects.

Figure 2: Example of conceptual model of longitudinal relationships among AEC use, expectancies, decision-making/ drinking outcomes.

Examining High-Risk Drinking: Psychosocial Mediators

There has been considerable interest in determining why college students drink; specifically, how specific psychosocial factors predict alcohol use and related consequences. This section discusses a subset of the variables of interest, which helped guide the selection of the theoretical framework (i.e., the general unified theory). These
psychosocial mediators have been thoroughly investigated in the general college drinking literature, but have yet to be explored in research related to AEC consumption. The proposed study seeks to identify these mediators for students who may be at risk for alcohol-related harm due to consumption of AECs.

**Alcohol expectancies.** Perceived benefits or negative consequences associated with alcohol consumption are alcohol expectancies. To date, numerous studies have examined alcohol expectancies of college students in an effort to understand their drinking behaviors. In a highly influential study, Brown (1985) found that alcohol expectancies increased the predictability of college drinking patterns over and above demographic variables. In addition, Brown showed that social drinkers expect social enhancement from drinking alcohol, whereas heavy drinkers expect tension reduction. Thus, alcohol expectancies are differentially related to problematic and non-problematic patterns of college drinking.

Another study conducted by Leigh and Stacy (1993) found that positive expectancies are a strong predictor of alcohol use. These findings are supported by a study conducted by Wood, Sher and Strathman (1996), who examined self-generated outcome expectancies of college students. Consistent with Brown, their findings show positive subjective ratings of expectancies to be related to alcohol use.

Lastly, a longitudinal study examined the relationship between alcohol outcome expectancies and alcohol consumption (Sher, Wood, Wood & Raskin, 1996). Results suggest that alcohol use remains stable over time while expectancies decrease. In other words, expectancies play a role in predicting future alcohol use, but alcohol consumption may also influence the development and maintenance of expectancies. In sum, the
construct of expectancy has been researched extensively to help explain alcohol use among college students and the proposed study seeks to use this construct to examine AEC use.

**Social norms.** Social norms, which help explain social pressures to perform behaviors, are categorized into two types: injunctive norms and descriptive norms (Cialdini, 2003). An injunctive norm is the perceived level of external approval for a particular behavior, and a descriptive norm is its perceived prevalence (e.g., the perceived number of drinks per week consumed by a typical college student). There has been great interest in investigating social norms related to alcohol use on college campuses. Past research has shown that students who report higher descriptive norms also report heavier alcohol consumption (Borsari & Carey, 1999; Cashin, Presley & Meilman, 1998; Larimer, Anderson, Baer & Marlatt, 2000). In addition, research has shown that injunctive norms are predictive of heavy drinking among college students, but this relationship is dependent on the reference group being examined (Borsari & Carey, 2003).

Other scholars examined how social norms, demographics, drinking motives, and alcohol expectancies predict alcohol use and related problems among heavy drinking college students, and found social norms to be one of the best predictors of alcohol consumption for this population (Neighbors, Lee, Lewis, Fossos & Larimer, 2007). Most recently, Lee and colleagues (2010) examined whether social norms predict alcohol-related consequences. Their findings suggest that students overestimate how often typical college students experience negative consequences and underestimate the extent to which other students evaluate those consequences negatively. In sum, the construct of
social norms is important when explaining heavy alcohol consumption among college students; the proposed study seeks to explore the relationship of social norms to AEC consumption and subsequent decision-making, as well as heavy drinking outcomes.

**Self-concept.** It is reasonable to state that most college students are concerned about how they are perceived by others and that self-concept influences their behavior. Markus and Nurius (1986) examined the various definitions of self-concept and suggested that it represents individuals’ ideas of what they might become, what they would like to become, and what they are afraid of becoming, in turn providing a conceptual link between cognition and motivation to perform a behavior. That being said, self-concept has been shown to be an important predictor of future behavior. Over two decades ago, Brennan and AuBuchon (1986) completed a comprehensive review of the college alcohol literature; many studies concluded that heavy drinking was related to self-esteem (a core facet of self-concept). The relationship between self-concept and alcohol consumption also was influenced by gender and race. For example, for females and upper-socioeconomic-status (SES) black males (compared to lower-SES black males) self-concept was a stronger predictor of alcohol use.

In addition, Quinlan, Jaccard & Blanton (2006) explored a framework defining self-concept mediators in order to predict behavior. Their study of 305 college students suggested that self-concept mediators are associated with negative attributes of both binge drinkers and non-binge drinkers, and are predictive of behavior. These findings were confirmed by Moeller and Crocker (2009) in a study examining the relationship between self-concept goals (i.e., constructing and defending desired self-views), heavy episodic drinking and alcohol problems. They found that self-concept goals were a
strong predictor of heavy episodic drinking and alcohol problems. Thus, in exploring AEC use among college students, the self-concept construct is important to examine.

**Emotions.** The construct of emotions differs from the other mediators in that it emphasizes the affective states of decision-making over the cognitive (Guilamo-Ramos et al., 2008). Past studies have examined emotions through measures of anxiety, neuroticism, depression, and other indices of emotional distress (McCarty & Kaye, 1984; Kushner & Sher, 1993). Specifically, a significant focus in the college drinking literature has been on drinking to cope and negative mood states. A significant relationship was found among drinking to cope motives, negative moods, and weekly drinking (Armeli, Todd, Conner & Tennen, 2007). Although it can be argued that emotions tend to be short-lived (especially among an emerging adult population), they still impact behavior significantly (Guilamo-Ramos et al., 2008). The present dissertation explores the degree and direction (i.e., positive or negative) of emotional arousal with regards to AEC use. For example, college students with strong emotional responses are more likely to engage in AEC use when compared to other students who have negative emotional responses.

**Self-efficacy.** The remaining variable that is generally examined in behavioral decision-making processes is self-efficacy. Self-efficacy is defined as the extent to which individuals believe they will be successful at performing a particular behavior (Bandura, 1986) and continues to be examined in the alcohol literature (Ray, Turrisi, Abar & Peters, 2009). In most cases, people are more likely to perform a behavior if they think they have the ability and means to do so. One possibility is that college students want to enhance their party experiences and feel self-efficacious by consuming AECs. Along
those lines, this feeling of self-efficacy is tied into a perceived ability to achieve a desired outcome through a specifically chosen behavior (e.g., consuming AECs).

**Hypotheses**

The present study builds on previous studies (Marzell & Turrisi, 2009; Marzell, Turrisi, Mallett & Dodge, 2010; Marzell, Turrisi & Mallett, 2010) examining variables that are more likely to change through brief interventions (e.g., drinking expectancies, motives, norms, and affect), and subgroups of alcohol-energy drink cocktail users (e.g., heavy frequent users versus lighter infrequent users). For instance, analyses were conducted on an all-male sample in a larger National Institute on Drug Abuse-funded study where part of the general unified theory (expectancies, emotional states, and social norms) and motives were examined. The current study contributes to previous studies by incorporating important variables previously neglected (e.g., self-concept and self-efficacy) and exploring gender differences. Additionally, previous findings in both the college alcohol literature and our preliminary AEC studies have examined construct reliability and validity, allowing the hypotheses listed in Table 2 to be developed.
Table 2: Hypotheses about AEC Consumption

<table>
<thead>
<tr>
<th>Psychosocial Mediator</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectancies</td>
<td>AEC users expect to feel an enhanced buzz that allows them to party longer and feel less drunk/more energized, which in turn will be associated with a greater willingness and intention to consume AECs as well as increase alcohol use.</td>
</tr>
<tr>
<td>Social Norms</td>
<td>AEC users believe their friends approve of their drinking behavior (injunctive norms) and their friends and other college students are engaging in the same or very similar drinking behaviors (descriptive norms), which in turn will be associated with a greater willingness and intention to consume AECs as well as increase alcohol use.</td>
</tr>
<tr>
<td>Self-Concept</td>
<td>AEC users feel more favorable consuming AECs, which in turn will be associated with a greater willingness and intention to consume AECs as well as increase alcohol use.</td>
</tr>
<tr>
<td>Emotions</td>
<td>AEC users indicate perceived benefits of emotional arousal when consuming AECs, which in turn will be associated with a greater willingness and intention to consume AECs as well as increase alcohol use.</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>AEC users feel they will be successful at achieving desired effects (e.g., able to party longer, enhanced buzz) if they consume AECs, which in turn will be associated with a greater willingness and intention to consume AECs as well as increase alcohol use.</td>
</tr>
<tr>
<td>Longitudinal Focus</td>
<td>Because of the developmental changes experienced by college students (e.g. moving off-campus, increased curriculum load) AEC use will not remain stable over time, which in turn will be associated with a greater willingness and intention to consume AECs as well as increase alcohol use.</td>
</tr>
</tbody>
</table>
Chapter 3: Methods

The data collection for the current study was a part of a larger R01-funded project called Project Act. (Support for this project was provided by the R01 AA015737 supplement). Project Act was designed to reduce the onset and extent of high-risk drinking tendencies by implementing efficacious parent-based interventions based on previous work (Turrisi, Wiersma, Hughes & Grimes, 1999; Turrisi, Wiersma & Hughes, 2000). The focus was on reducing student drinking behaviors during the first year of college. The present study created additional measures for the mediators outlined in Figures 1 and 2 for the last two waves of data collection on approximately 500 college students in the control group. The assessments were given as part of the normal data collection process, and took place in the spring and fall of 2010. These assessments permitted an in-depth examination of why college students who consume AECs tend to drink more and experience more consequences. This study significantly contributed to the Project Act grant because it examined a high-risk drinking behavior (i.e., combining alcohol and energy drinks) to identify decision-making mediators of students who may be at elevated risk for alcohol-related harm.

Sample

Participants were randomly-selected from an incoming freshmen class at a large, public university in the northeastern United States. Participants were 387 undergraduate students [mean age = 18.72, SD = 0.45] invited from a student database. Over half of the participants were female [n = 229 (59.2%)]. Racial characteristics were as follows: 90.7% White/Caucasian, 3.4% Black or African American, 2.1% Asian, 2.1% American Indian/Alaskan Native, and 1.7% other. Other demographic characteristics of
participants are presented below in Table 3. The distributions of the sample demographic variables were similar to those of the campus population as a whole suggesting little evidence of sample bias.

**Screening and Recruitment Procedure**

Participants were randomly selected from the university registrar’s database of incoming freshmen. Invitation letters explaining the study, procedures, and compensation were mailed to all potential participants along with a URL and Personal Identification Number (PIN) for accessing the survey. Additionally, invitations were emailed to participants’ university email addresses and reminder emails and postcards were also sent. Participants were compensated for completing surveys in both the spring and the fall semesters. Procedures reviewed and approved by Penn State University Institutional Review Board - IRB #22262.

**Measures**

The selected measures have been used widely in published literature and have been shown to have good reliability and validity. Most of the measures evaluating AEC use were developed and modified through preliminary studies (Marzell & Turrisi, 2009; Marzell et al., 2010). Measures were organized according to the theoretical model (Figure 1), and are provided for review in Appendix A.

**Predictor Groups**

**AEC Users.** AEC use was measured by asking participants, “Do you drink alcohol mixed with energy drinks (e.g., Red Bull and vodka or Jagerbombs)?” The response options were “yes” or “no.”
Alcohol only users. Alcohol use was measured by participants indicating current alcohol use. The instructions asked students to please describe their current alcohol usage. Participants chose from the following response options: “I have never tried alcohol;” “I have tried alcohol, but currently don’t drink;” “I am a light, social, non-problem drinker;” “I am a moderate, social, non-problem drinker;” “I am a heavy, non-problem drinker;” and “I am a heavy, problem drinker.” Participants indicating no current alcohol use (i.e., I have never tried alcohol or I have tried alcohol, but currently don’t drink) were excluded from the analyses.
### Table 3: Baseline Demographic and Drinking Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>158</td>
<td>40.8</td>
</tr>
<tr>
<td>Female</td>
<td>229</td>
<td>59.2</td>
</tr>
<tr>
<td>Racial Background</td>
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<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>351</td>
<td>90.7</td>
</tr>
<tr>
<td>Black or African American</td>
<td>13</td>
<td>3.4</td>
</tr>
<tr>
<td>Asian</td>
<td>8</td>
<td>2.1</td>
</tr>
<tr>
<td>American Indian/Alaskan Native</td>
<td>8</td>
<td>2.1</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>1.7</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>107</td>
<td>27.8</td>
</tr>
<tr>
<td>19</td>
<td>278</td>
<td>71.8</td>
</tr>
<tr>
<td>GPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0 – 0.9</td>
<td>1</td>
<td>.3</td>
</tr>
<tr>
<td>1.0 – 1.9</td>
<td>4</td>
<td>1.1</td>
</tr>
<tr>
<td>2.0 – 2.9</td>
<td>65</td>
<td>16.8</td>
</tr>
<tr>
<td>3.0 – 4.0</td>
<td>317</td>
<td>81.9</td>
</tr>
<tr>
<td>Alcohol Usage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am a light, social, non-problem drinker.</td>
<td>143</td>
<td>37.0</td>
</tr>
<tr>
<td>I am a moderate, social, non-problem drinker.</td>
<td>218</td>
<td>56.3</td>
</tr>
<tr>
<td>I am a heavy, non-problem drinker.</td>
<td>25</td>
<td>6.5</td>
</tr>
<tr>
<td>I am a heavy, problem drinker.</td>
<td>1</td>
<td>.3</td>
</tr>
<tr>
<td>Alcohol-Energy Drink Cocktail Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>106</td>
<td>27.4</td>
</tr>
<tr>
<td>No</td>
<td>281</td>
<td>72.6</td>
</tr>
</tbody>
</table>
Mediators

**Expectancies.** Participant expectancies about the effects of AECs were assessed with one item based on previous research (Marzell & Turrisi, 2009, 2010; Woolsey, Waigant & Beck, 2010). The specific item was “I expect to feel an enhanced ‘buzz’ (energy and less drowsiness) when I consume alcohol mixed with energy drinks.” Participants were asked to indicate their levels of agreement with a statement about alcohol-energy drink cocktails on a five-point scale from *strongly disagree* (-2) to *strongly agree* (2).

**Social norms.** Social norms were measured using both descriptive and injunctive peer norm measures. To assess descriptive peer norms, participants were asked the number of AECs they believe their closest friends consumed on each day of a typical week within the past 30 days using the Daily Drinking Questionnaire (Collins, Parks & Marlatt, 1985). Survey responses for Monday, Tuesday, Wednesday, Thursday, Friday, Saturday and Sunday were summed resulting in the total number of AECs consumed by participants’ closest friends during a typical week. To assess injunctive norms, participants were asked the degree to which their closest friends approve of their AEC use. Participants indicated, on a five-point scale ranging from *strongly disagree* (-2) to *strongly agree* (2), how their closest friends would respond if they consumed such drinks.

**Self-concept.** Participant self-concept about AECs was assessed with two items based on previous research (Marzell & Turrisi, 2009, 2010; Woolsey et al., 2010). Participants were asked to indicate their levels of agreement with statements regarding energy drink cocktails on a five-point scale ranging from *strongly disagree* (-2) to *strongly agree* (2). The specific items were: “I like the way combining alcohol and
energy drinks makes me feel” and “I feel favorably about consuming alcohol mixed with energy drinks.” These two items were summed to create a composite frequency score for self-concept. (The coefficient alpha = .82).

**Emotions.** Emotions associated with the consumption of AECs were assessed using items identified in previous research (Marzell & Turrisi, 2010; Woolsey et al., 2010). The instructions were as follows: “The following scale consists of a number of words which describe different feelings and emotions. Read each item, and then select the appropriate answer. Indicate to what extent you would feel this way when drinking energy drinks mixed with alcohol.” Participants responded using a five-point scale ranging from not at all (0) to extremely (4). Responses included the following feelings: excited, upset, aggressive, strong, courageous, guilty, clumsy, brave and daring, nervous, determined, irritable, active, jittery, alert, enthusiastic, moody, scared, dizzy, the inability to sleep, the ability to take more risks, and more likely to fight. The items were subjected to an exploratory factor analysis, using criterion pattern matrix loadings greater than .7 and inter-item correlations of .5 or greater. Items were then combined to create a single item index of self-assured emotions (α = .92), a single item index of negative emotions (α = .9) and a single item index of stimulating emotions (α = .88). Self-assured emotions included feeling aggressive, strong, courageous, brave and daring, determined, the ability to take more risks, and more likely to fight. Negative emotions included feeling upset, guilty, nervous, irritable, moody and scared. Stimulating emotions included feelings of being active, jittery, alert, enthusiastic, and the inability to sleep.

**Self-efficacy.** Self-efficacy about AEC use was assessed based on previous research (Marzell & Turrisi, 2009, 2010; Woolsey et al., 2010). The specific items were:
“I can consume more alcohol when I choose to combine alcohol and energy drinks,” “I can party longer when I choose to mix alcohol with energy drinks,” and “It would be easy for me to get alcohol mixed with energy drinks at a party.” In addition, participants were asked to indicate their levels of agreement with a series of statements in which the stem read, “I would drink energy cocktails...” The specific statement endings were: “because it makes partying better,” “because it allows me to drink more and feel less drunk (i.e., less drowsy),” “because it allows me to party longer when I have had a tiring day (e.g., studying, working, and tailgating),” and “because I have less of a hangover the next day.” Participants were asked to indicate their levels of agreement with the above statements using a five-point scale ranging from strongly disagree (-2) to strongly agree (2). These items were subjected to an exploratory factor analysis, using criterion pattern matrix loadings greater than .7 and inter-item correlations of .5 or greater. The items that met the established criteria for inclusion in the analyses included “I would drink energy cocktails: because it makes partying better; because it allows me to drink more and feel less drunk (i.e., less drowsy); because it allows me to party longer when I have had a tiring day (e.g., studying, working, and tailgating); and because I have less of a hangover the next day.” Items were summed to create a composite frequency score for self-efficacy. (The coefficient alpha = .9).

Outcomes

Decision-making. To assess behavioral willingness, participants indicated willingness to consume alcohol mixed with energy drinks in the following 30 days. The response scale ranged from not willing (0) to extremely willing (3). To assess behavioral intent, participants indicated intent to consume alcohol mixed with energy drinks in the
following 30 days. Responses included a five-point scale ranging from strongly disagree (-2) to strongly agree (2).

**Drinking.** Heavy episodic drinking was measured by asking participants how often in the past two weeks they consumed four or more drinks if female, or five or more drinks if male, in a given two-hour period (Wechsler et al., 1994a, 1998). This method of measuring heavy episodic drinking is in accordance with NIAAA guidelines for measuring this construct (NIAAA, 2006). Frequency of drunkenness (Wechsler et al., 2002) was measured using a single item asking students, “During the past 30 days, how many times have you gotten drunk or very high from alcohol?” The answer scale was never (0), 1-2 times (1), 3-4 times (2), 5-6 times (3), 7-8 times (4), 9 or more times (5). A standard drink definition was included for all measures (i.e., 12 oz. beer, 10 oz. wine cooler, 4 oz. wine, 1 oz. 100 proof (1 ¼ oz. 80 proof) liquor).

**Statistical Analysis of Aim 1**

The mediation analyses were guided by the theoretical model in Figure 1, focusing on psychosocial variables as mediators of the effect group (AECs vs. alcohol only) on decision-making and drinking outcomes. The joint significance mediation approach ($\alpha \times \beta$) based on the Monte Carlo study (MacKinnon, Lockwood, Hoffman, West & Sheets, 2002) was adopted in the analysis phase. The study demonstrated that the joint significance test has both the most power and the most accurate Type I error rates relative to 14 other mediation techniques. The approach uses regression in AMOS 18.0 to test the $\alpha$ path (the relationships between the group, hypothesized mediators and psychosocial variables) and the $\beta$ path (the relationships between mediators and the outcome variable of drinking outcomes) for statistical significance. If both the $\alpha$ and $\beta$
paths show statistical significance at the $p = .05$ level there is evidence for a mediating relationship. The mediated effect is the product of the $\alpha$ and $\beta$ paths ($\alpha\beta$) and provides an estimate of the relative strength between the mediated effects (MacKinnon et al., 2002). When there is evidence for mediation (e.g., the $\alpha$ and $\beta$ paths are jointly significant), 95% confidence intervals can be calculated using the bootstrap procedures in AMOS 18.0 (SPSS) to provide a range of estimates for the actual mediated effect values. Because the regression coefficient provides an estimate for the actual mediated effect ($\alpha\beta$), evidence of a statistically and clinically significant mediating effect is said to exist when the confidence intervals around the regression coefficient do not contain the value zero. The same approach was used to examine mediation effects on decision-making and drinking outcomes. The amount of missing data was trivial as there were only two individuals. Thus, these two cases were eliminated for future analyses.

**Statistical Analysis of Aim 2**

The second aim was to examine developmental changes in the relationships among the consumption of AECs, psychosocial mediators, decision-making outcomes, and high-risk drinking behavioral outcomes from freshman to sophomore year using a prospective longitudinal design. First, AEC users and alcohol only users were examined independently. Because no difference was found between groups, results were reported for the entire sample. Next, the ways in which mean levels of a variable changed from time 1 to time 2 were examined. A simple method for exploring this involved conducting a 2X2 mixed analysis of variance on each of the continuous variables. The first factor was a grouping variable (AECs vs. alcohol only); the second factor was a repeated variable (time of assessment). Lastly, structural equation modeling (SEM) in AMOS was
used to test the model in Figure 2 using the bootstrap option to get unbiased confidence intervals. Paths a1, b1, and c1 were examined for significance in order to determine stability of the mediators over time. Similarly, the paths d1 and d2, and paths e1 and e2 were examined for significance to determine the stability of the relationships across time.
Chapter 4: Results

Aim 1: Relationship between Group and Decision-Making Outcomes

First, each decision-making (i.e., behavioral intention and behavioral willingness) and drinking outcome (i.e., heavy episodic drinking and frequency of drunkenness) was regressed onto a group (means are reported in Tables 4 and 5). The findings for each outcome follow below.

Behavioral intention and willingness. The relationship between group (AEC = 2 and alcohol only = 1) and behavioral intention was statistically significant ($b = 1.39$, $s.e. = .11$, $t = 13.11$, $p < .001$, $\eta^2 = .30$). Individuals who identified themselves as users of AECs reported greater intentions to consume alcohol and energy drinks relative to individuals who reported drinking alcohol only. The relationship between group and behavioral willingness was also statistically significant ($b = .79$, $s.e. = .09$, $t = 14.22$, $p < .001$, $\eta^2 = .30$). Similar to behavioral intention, individuals who identified themselves as users of AECs reported greater willingness to consume alcohol and energy drinks relative to individuals who reported drinking alcohol only.

**Table 4: Means and Standard Deviations for Decision-Making Outcomes**

<table>
<thead>
<tr>
<th>Variable</th>
<th>AEC Group Mean (N = 106)</th>
<th>Alcohol Only Group Mean (N = 281)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Intention</td>
<td>.08 (1.06)</td>
<td>-1.31 (.88)</td>
</tr>
<tr>
<td>Behavioral Willingness</td>
<td>1.71 (.49)</td>
<td>.92 (.68)</td>
</tr>
</tbody>
</table>

Drinking. The relationship between group and heavy episodic drinking was significant ($b = 1.84$, $s.e. = .59$, $t = 3.11$, $p < .01$, $\eta^2 = .02$). Individuals who identified themselves as users of AECs reported more heavy episodic drinking experiences relative
to individuals who reported drinking alcohol only. Finally, the relationship between
group and frequency of drunkenness was significant (\( b = .87, \text{s.e.} = .16, t = 5.48, p < .001, \eta^2 = .07 \)). Similar to heavy episodic drinking, individuals who identified
themselves as users of AECs reported increased frequency of drunkenness relative to
individuals who reported drinking alcohol only.

**Table 5: Means and Standard Deviations for Drinking**

<table>
<thead>
<tr>
<th>Variable</th>
<th>AEC Group Mean (N = 106)</th>
<th>Alcohol Only Group Mean (N = 281)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Episodic Drinking</td>
<td>8.60 (5.08)</td>
<td>6.77 (5.25)</td>
</tr>
<tr>
<td>Frequency of Drunkenness</td>
<td>2.40 (1.61)</td>
<td>1.52 (1.31)</td>
</tr>
</tbody>
</table>

In sum, individuals shifted toward riskier behaviors as they shifted from the
alcohol only group to the AEC group for all of the outcomes.

**Mediation**

The next focus was to explain the relationships between group (i.e., AEC use vs.
alcohol only), psychosocial mediators (e.g., expectancies), and decision-making/drinking
outcomes. The group means for all mediators are shown in Table 6. Results from the
mediation analyses are shown in Tables 7-14.
Table 6: Means and Standard Deviations for Psychosocial Mediators

<table>
<thead>
<tr>
<th>Variable</th>
<th>AEC Group Mean (N = 106)</th>
<th>Alcohol Only Group Mean (N = 281)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectancies</td>
<td>0.63 (0.96)</td>
<td>0.24 (1.13)</td>
</tr>
<tr>
<td>Social Norms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descriptive</td>
<td>5.16 (6.34)</td>
<td>2.77 (5.54)</td>
</tr>
<tr>
<td>Injunctive</td>
<td>0.74 (0.81)</td>
<td>-0.09 (1.03)</td>
</tr>
<tr>
<td>Self-concept</td>
<td>0.32 (1.70)</td>
<td>-1.44 (1.77)</td>
</tr>
<tr>
<td>Emotions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-assured</td>
<td>8.27 (6.58)</td>
<td>7.01 (6.42)</td>
</tr>
<tr>
<td>Negative emotions</td>
<td>3.53 (4.62)</td>
<td>3.47 (4.60)</td>
</tr>
<tr>
<td>Stimulated</td>
<td>8.59 (4.39)</td>
<td>8.06 (5.26)</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>-1.22 (3.55)</td>
<td>-3.38 (3.81)</td>
</tr>
</tbody>
</table>

**Expectancies.** Expectancies were the first mediator examined in the relationship between group and all outcomes (i.e., behavioral intention and willingness, heavy episodic drinking, and frequency of drunkenness), shown in Table 7. The relationship between group and expectancies (path α in Figure 1) was positive and significant (α = .39, CI\(_{L95}\) = .17, CI\(_{U95}\) = .63). For example, individuals who consumed AECs had more positive expectancies related to AEC use. Findings further reveal that all the β paths were significant between expectancies and decision-making/drinking outcomes (behavioral intention β = .24, CI\(_{L95}\) = .14, CI\(_{U95}\) = .34; behavioral willingness β = .20, CI\(_{L95}\) = .11, CI\(_{U95}\) = .28; heavy episodic drinking β = .53, CI\(_{L95}\) = .12, CI\(_{U95}\) = .92; frequency of drunkenness β = .15, CI\(_{L95}\) = .02, CI\(_{U95}\) = .28). For example, as expectancies about AEC use became more positive, behavioral intentions to use AECs increased, as
did behavioral willingness, heavy episodic drinking and frequency of drunkenness.

Given that the $\alpha$ and $\beta$ paths were all significant and the confidence intervals around the $\alpha\beta$ coefficient (mediated path) did not contain the value zero (see Table 7), these findings provide consistent evidence that expectancies were a significant mediator in the relationship between group and decision-making/drinking outcomes.

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>(α) Group (AEC use vs. Alcohol only) Effect on Expectancies</th>
<th>(β) Effect of Expectancies on outcomes</th>
<th>(αβ) Mediated Effect</th>
<th>Lower C.I. of Mediated Effect</th>
<th>Upper C.I. of Mediated Effect</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Intentions</td>
<td>.39 (.12)</td>
<td>.24 (.05)</td>
<td>.09</td>
<td>.03</td>
<td>.19</td>
<td>.001</td>
</tr>
<tr>
<td>Behavioral Willingness</td>
<td>.39 (.12)</td>
<td>.20 (.04)</td>
<td>.08</td>
<td>.02</td>
<td>.47</td>
<td>.001</td>
</tr>
<tr>
<td>Heavy Episodic Drinking</td>
<td>.39 (.12)</td>
<td>.53 (.24)</td>
<td>.21</td>
<td>.03</td>
<td>.47</td>
<td>.05</td>
</tr>
<tr>
<td>Frequency of Drunkenness</td>
<td>.39 (.12)</td>
<td>.15 (.07)</td>
<td>.06</td>
<td>.03</td>
<td>.14</td>
<td>.05</td>
</tr>
</tbody>
</table>

**Social norms.** Social norms (i.e., descriptive and injunctive norms) were the next mediator examined. The relationship between group and social norms was positive and significant (descriptive norms $\alpha = 2.40$, CI$_{L95} = 1.04$, CI$_{U95} = 3.93$; injunctive norms $\alpha = .82$, CI$_{L95} = 1.03$, CI$_{U95} = .63$). For instance, individuals who consumed AECs had social normative beliefs of approval related AEC use (e.g., they believed their friends approved of AEC use).

**Injunctive norms.** Results further reveal that for injunctive norms, all the $\beta$ paths were significant for decision-making and drinking outcomes (behavioral intention $\beta = .48$, CI$_{L95} = .14$, CI$_{U95} = .57$; behavioral willingness $\beta = .44$, CI$_{L95} = .37$, CI$_{U95} = .50$;
heavy episodic drinking $\beta = 1.10$, CI$_{1.95} = .63$, CI$_{1.95} = 1.57$; frequency of drunkenness $\beta = .33$, CI$_{1.95} = .20$, CI$_{1.95} = .46$. Again, these findings suggest that as injunctive norms (e.g., more social approval) about AEC use became more positive, behavioral intentions to use AECs increased, as did behavioral willingness, heavy episodic drinking and frequency of drunkenness. The column labeled $\alpha\beta$ in Table 8 shows the magnitude of the mediated effect for each of the decision-making/drinking outcomes. These findings suggest that injunctive norms were a significant mediator in the relationship between AEC use and behavioral intention, behavioral willingness, and heavy drinking outcomes.

**Table 8: Group Effects on Injunctive Norms, the Effects of Injunctive Norms on Decision-Making/Drinking Outcomes, Mediated Effects and 95% Confidence Intervals**

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>(α) Group (AEC use vs. Alcohol only) Effect on Injunctive Norms</th>
<th>(β) Effect of Injunctive Norms on Outcomes</th>
<th>($\alpha\beta$) Mediated Effect</th>
<th>Lower C.I. of Mediated Effect</th>
<th>Upper C.I. of Mediated Effect</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Intentions</td>
<td>.82 (.11)</td>
<td>.48 (.04)</td>
<td>.36</td>
<td>.28</td>
<td>.52</td>
<td>.001</td>
</tr>
<tr>
<td>Behavioral Willingness</td>
<td>.82 (.11)</td>
<td>.44 (.04)</td>
<td>.36</td>
<td>.28</td>
<td>.52</td>
<td>.001</td>
</tr>
<tr>
<td>Heavy Episodic Drinking</td>
<td>.82 (.11)</td>
<td>1.10 (.25)</td>
<td>.90</td>
<td>.50</td>
<td>1.44</td>
<td>.001</td>
</tr>
<tr>
<td>Frequency of Drunkenness</td>
<td>.82 (.11)</td>
<td>.33 (.07)</td>
<td>.27</td>
<td>.17</td>
<td>.45</td>
<td>.001</td>
</tr>
</tbody>
</table>

**Descriptive norms.** For descriptive norms, there were no significant mediating effects observed ($p > .05$). Although the $\alpha$ path for descriptive norms was significant and the confidence intervals surrounding the mediating effect did not contain the value zero, the $\beta$ paths were not significant, making the $\alpha\beta$ path non-significant.
Table 9: Group Effects on Descriptive Norms, the Effects of Descriptive Norms on Decision-Making/Drinking Outcomes, Mediated Effects and 95% Confidence Intervals

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>(α) Group (AEC use vs. Alcohol only) Effect on Descriptive Norms</th>
<th>(β) Effect of Descriptive Norms on Outcomes</th>
<th>(αβ) Mediated Effect</th>
<th>Lower C.I. of Mediated Effect</th>
<th>Upper C.I. of Mediated Effect</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Intentions</td>
<td>2.4 (.66)</td>
<td>.01 (.01)</td>
<td>.02</td>
<td>.29</td>
<td>.58</td>
<td>ns</td>
</tr>
<tr>
<td>Behavioral Willingness</td>
<td>2.4 (.66)</td>
<td>.02 (.01)</td>
<td>.05</td>
<td>.28</td>
<td>.52</td>
<td>ns</td>
</tr>
<tr>
<td>Heavy Episodic Drinking</td>
<td>2.4 (.66)</td>
<td>.02 (.05)</td>
<td>.05</td>
<td>.50</td>
<td>1.44</td>
<td>ns</td>
</tr>
<tr>
<td>Frequency of Drunkenness</td>
<td>2.4 (.66)</td>
<td>.01 (.01)</td>
<td>.02</td>
<td>.17</td>
<td>.45</td>
<td>ns</td>
</tr>
</tbody>
</table>

**Self-concept.** The relationship between group and self-concept was positive and significant (α = .177, CI_{L95} = 1.38, CI_{U95} = 2.15). For example, individuals who consumed AECs had a more positive self-concept related to AEC use (e.g., feeling more favorable to consuming AECs). Results reveal that all the β paths were significant for decision-making and drinking outcomes (behavioral intention β = .38, CI_{L95} = .33, CI_{U95} = .42; behavioral willingness β = .29, CI_{L95} = .25, CI_{U95} = .33; heavy episodic drinking β = .35, CI_{L95} = .07, CI_{U95} = .63; frequency of drunkenness β = .12, CI_{L95} = .04, CI_{U95} = .20). For example, as self-concept about AEC use became more positive, behavioral intentions to use AECs increased, as did behavioral willingness, heavy episodic drinking and frequency of drunkenness. The column labeled αβ in Table 10 shows the magnitude of the mediated effect for each of the decision-making/drinking outcomes. These findings suggest that self-concept was a significant mediator for behavioral intention and willingness as well as heavy drinking outcomes.
### Table 10: Group Effects on Self-concept, the Effects of Self-concept on Decision-Making/Drinking Outcomes, Mediated Effects and 95% Confidence Intervals

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>(α) Group (AEC use vs. Alcohol only) Effect on Self-concept</th>
<th>(β) Effect of Self-concept on Outcomes</th>
<th>(αβ) Mediated Effect</th>
<th>Lower C.I. of Mediated Effect</th>
<th>Upper C.I. of Mediated Effect</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Intentions</td>
<td>1.77 (.20)</td>
<td>.38 (.02)</td>
<td>.67</td>
<td>.49</td>
<td>.87</td>
<td>.001</td>
</tr>
<tr>
<td>Behavioral Willingness</td>
<td>1.77 (.20)</td>
<td>.29 (.02)</td>
<td>.51</td>
<td>.36</td>
<td>.67</td>
<td>.001</td>
</tr>
<tr>
<td>Heavy Episodic Drinking</td>
<td>1.77 (.20)</td>
<td>.35 (.14)</td>
<td>.62</td>
<td>.12</td>
<td>1.17</td>
<td>.05</td>
</tr>
<tr>
<td>Frequency of Drunkenness</td>
<td>1.77 (.20)</td>
<td>.12 (.04)</td>
<td>.21</td>
<td>.07</td>
<td>.38</td>
<td>.05</td>
</tr>
</tbody>
</table>

**Emotions.** The three indices for emotions (i.e., self-assured, negative emotions, and stimulated) were examined as potential mediators explaining the relationship between group and decision-making/drinking outcomes. As observed in Tables 11-13, the α paths for all three indices were not significant (p > .05). Although the findings reveal that for the self-assured index, the β paths were significant for both decision-making outcomes (behavioral intention β = .04, CI_{L95} = .01, CI_{U95} = .07; behavioral willingness β = .03, CI_{L95} = .01, CI_{U95} = .06), and for the index of negative emotions (see Table 12) where the β path was significant for behavioral willingness (β = -.04, CI_{L95} = -.07, CI_{U95} = -.02), the analyses reveal no significant mediating effect for any of the emotion indices.
Table 11: Group Effects on Self-Assured Emotions, the Effects of Self-Assured Emotions on Decision-Making/Drinking Outcomes, Mediated Effects and 95% Confidence Intervals

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>(α) Group (AEC use vs. Alcohol only) Effect on Self-Assured Emotions</th>
<th>(β) Effect of Self-Assured Emotions on Outcomes</th>
<th>(αβ) Mediated Effect</th>
<th>Lower C.I. of Mediated Effect</th>
<th>Upper C.I. of Mediated Effect</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Intentions</td>
<td>1.26 (.74)</td>
<td>.04 (.01)</td>
<td>.05</td>
<td>.00</td>
<td>.12</td>
<td>ns</td>
</tr>
<tr>
<td>Behavioral Willingness</td>
<td>1.26 (.74)</td>
<td>.04 (.01)</td>
<td>.05</td>
<td>.00</td>
<td>.11</td>
<td>ns</td>
</tr>
<tr>
<td>Heavy Episodic Drinking</td>
<td>1.26 (.74)</td>
<td>.04 (.01)</td>
<td>.05</td>
<td>.07</td>
<td>.28</td>
<td>ns</td>
</tr>
<tr>
<td>Frequency of Drunkenness</td>
<td>1.26 (.74)</td>
<td>.04 (.01)</td>
<td>.05</td>
<td>.01</td>
<td>.10</td>
<td>ns</td>
</tr>
</tbody>
</table>

Table 12: Group Effects on Negative Emotions, the Effects of Negative Emotions on Decision-Making/Drinking Outcomes, Mediated Effects and 95% Confidence Intervals

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>(α) Group (AEC use vs. Alcohol only) Effect on Negative Emotions</th>
<th>(β) Effect of Negative Emotions on Outcomes</th>
<th>(αβ) Mediated Effect</th>
<th>Lower C.I. of Mediated Effect</th>
<th>Upper C.I. of Mediated Effect</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Intentions</td>
<td>.06 (.53)</td>
<td>.03 (.01)</td>
<td>.00</td>
<td>.00</td>
<td>.12</td>
<td>ns</td>
</tr>
<tr>
<td>Behavioral Willingness</td>
<td>.06 (.53)</td>
<td>.05 (.01)</td>
<td>.00</td>
<td>.00</td>
<td>.11</td>
<td>ns</td>
</tr>
<tr>
<td>Heavy Episodic Drinking</td>
<td>.06 (.53)</td>
<td>.00 (.06)</td>
<td>.00</td>
<td>.07</td>
<td>.28</td>
<td>ns</td>
</tr>
<tr>
<td>Frequency of Drunkenness</td>
<td>.06 (.53)</td>
<td>.02 (.02)</td>
<td>.00</td>
<td>.01</td>
<td>.10</td>
<td>ns</td>
</tr>
<tr>
<td>Outcomes</td>
<td>(α) Group (AEC use vs. Alcohol only) Effect on Stimulated Emotions</td>
<td>(β) Effect of Stimulated Emotions on Outcomes</td>
<td>(αβ) Mediated Effect</td>
<td>Lower C.I. of Mediated Effect</td>
<td>Upper C.I. of Mediated Effect</td>
<td>P-value</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>----------------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Behavioral Intentions</td>
<td>.53 (.57)</td>
<td>.03 (.01)</td>
<td>.02</td>
<td>.00</td>
<td>.12</td>
<td>ns</td>
</tr>
<tr>
<td>Behavioral Willingness</td>
<td>.53 (.57)</td>
<td>.01 (.01)</td>
<td>.01</td>
<td>.00</td>
<td>.11</td>
<td>ns</td>
</tr>
<tr>
<td>Heavy Episodic Drinking</td>
<td>.53 (.57)</td>
<td>.02 (.015)</td>
<td>.00</td>
<td>.07</td>
<td>.28</td>
<td>ns</td>
</tr>
<tr>
<td>Frequency of Drunkenness</td>
<td>.53 (.57)</td>
<td>.01 (.01)</td>
<td>.01</td>
<td>.01</td>
<td>.10</td>
<td>ns</td>
</tr>
</tbody>
</table>

**Self-efficacy.** The relationship between group and self-efficacy was positive and significant (α = 2.17, CI_{L95} = 1.37, CI_{U95} = 2.95). Individuals who consumed AECs had more self-efficacy related to AEC use (e.g., could party longer when they consumed AECs). Findings further reveal that all the β paths between self-efficacy and decision-making and drinking outcomes were significant (behavioral intention β = .15, CI_{L95} = .12, CI_{U95} = .18; behavioral willingness β = .10, CI_{L95} = .08, CI_{U95} = .12; heavy episodic drinking β = .15, CI_{L95} = .01, CI_{U95} = .28; frequency of drunkenness β = .06, CI_{L95} = .03, CI_{U95} = .10). Again, the column labeled αβ in Table 14 shows the magnitude of the mediated effect for each of the decision-making/drinking outcomes. These findings reveal that self-efficacy was a significant mediator in the relationship between AEC use and behavioral intention, as well as behavioral willingness and heavy drinking outcomes.
### Table 14: Group Effects on Self-Efficacy, the Effects of Self-Efficacy on Decision-Making/Drinking Outcomes, Mediated Effects and 95% Confidence Intervals

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>(α) Group (AEC use vs. Alcohol only) Effect on Self-Efficacy</th>
<th>(β) Effect of Self-Efficacy on Outcomes</th>
<th>(αβ) Mediated Effect</th>
<th>Lower C.I. of Mediated Effect</th>
<th>Upper C.I. of Mediated Effect</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Intentions</td>
<td>2.17 (.43)</td>
<td>.15 (.01)</td>
<td>.33</td>
<td>.18</td>
<td>.49</td>
<td>.001</td>
</tr>
<tr>
<td>Behavioral Willingness</td>
<td>2.17 (.43)</td>
<td>.10 (.01)</td>
<td>.02</td>
<td>.12</td>
<td>.34</td>
<td>.01</td>
</tr>
<tr>
<td>Heavy Episodic Drinking</td>
<td>2.17 (.43)</td>
<td>.15 (.07)</td>
<td>.33</td>
<td>.03</td>
<td>.71</td>
<td>.05</td>
</tr>
<tr>
<td>Frequency of Drunkenness</td>
<td>2.17 (.43)</td>
<td>.06 (.02)</td>
<td>.13</td>
<td>.05</td>
<td>.27</td>
<td>.05</td>
</tr>
</tbody>
</table>

In sum, after examining the results of the individual models, findings reveal significant mediated effects (αβ) for all hypothesized psychosocial mediators between AEC use and decision-making/drinking outcomes except for descriptive norms and emotions. Thus, these findings suggest that AEC use changes the theoretical psychosocial mediators (i.e., expectancies, injunctive norms, self-concept, and self-efficacy), which, in turn, change decision-making/drinking outcomes.

**Full Model**

Finally, a full model (see Figure 3) was used to determine the importance of a psychosocial mediator relative to other possible mediators by examining all mediators simultaneously. The results of the full model mediation analysis are reported in Tables 15-18.
Figure 3: Full model examining mediators of the relationship between group decision-making/drinking outcomes.

**Behavioral intention.** Significant mediating effects ($\alpha \beta$, $p < .05$) were only observed for injunctive norms, self-concept, and self-efficacy. In addition, the last three columns of Table 15 reveal that the confidence intervals around the mediating effects were statistically significant, providing further evidence of mediation.
### Table 15: Group Effects on Mediators, Mediator Effects on Behavioral Intention, Mediated Effects and 95% Confidence Intervals

<table>
<thead>
<tr>
<th>Mediators</th>
<th>(α) Group (AEC use vs. Alcohol only) Effect on Mediator</th>
<th>(β) Mediator Effect on Behavioral Intention</th>
<th>(αβ) Mediated Effect</th>
<th>Lower C.I. of Mediated Effect</th>
<th>Upper C.I. of Mediated Effect</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectancies</td>
<td>.39 (.12)</td>
<td>.02 (.04)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Descriptive Norms</td>
<td>2.4 (.66)</td>
<td>.01 (.01)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Injunctive Norms</td>
<td>.82* (.11)</td>
<td>.21* (.04)</td>
<td>.17</td>
<td>.58</td>
<td>.97</td>
<td>.001</td>
</tr>
<tr>
<td>Self-concept</td>
<td>1.77* (.20)</td>
<td>.28* (.02)</td>
<td>.67</td>
<td>.58</td>
<td>.97</td>
<td>.001</td>
</tr>
<tr>
<td>Self-Assured Emotions</td>
<td>1.26 (.74)</td>
<td>.04 (.01)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Negative Emotions</td>
<td>.06 (.53)</td>
<td>.03 (.01)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Stimulated Emotions</td>
<td>.53 (.57)</td>
<td>.03 (.01)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>2.17* (.43)</td>
<td>.05* (.01)</td>
<td>.11</td>
<td>.58</td>
<td>.97</td>
<td>.001</td>
</tr>
</tbody>
</table>

* p < .05

**Behavioral willingness.** Significant mediating effects ($αβ$, $p < .05$) were observed for descriptive and injunctive norms, self-concept, and stimulated emotions. In addition, the last three columns of Table 16 reveal that the confidence intervals around the mediating effects were statistically significant, providing further evidence of mediation.
Table 16: Group Effects on Mediators, Mediator Effects on Behavioral Willingness, Mediated Effects and 95% Confidence Intervals

<table>
<thead>
<tr>
<th>Mediators</th>
<th>(α) Group (AEC use vs. Alcohol only) Effect on Mediator</th>
<th>(β) Mediator Effect on Behavioral Willingness</th>
<th>(αβ) Mediated Effect</th>
<th>Lower C.I. of Mediated Effect</th>
<th>Upper C.I. of Mediated Effect</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectancies</td>
<td>.39 (.12)</td>
<td>.00 (.03)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Descriptive Norms</td>
<td>2.4* (.66)</td>
<td>.01* (.01)</td>
<td>.02</td>
<td>.48</td>
<td>.78</td>
<td>.05</td>
</tr>
<tr>
<td>Injunctive Norms</td>
<td>.82* (.11)</td>
<td>.23* (.04)</td>
<td>.19</td>
<td>.48</td>
<td>.78</td>
<td>.001</td>
</tr>
<tr>
<td>Self-concept</td>
<td>1.77* (.20)</td>
<td>.22* (.02)</td>
<td>.39</td>
<td>.48</td>
<td>.78</td>
<td>.001</td>
</tr>
<tr>
<td>Self-Assured Emotions</td>
<td>1.26 (.74)</td>
<td>.00 (.01)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Negative Emotions</td>
<td>.06 (.53)</td>
<td>.00 (.01)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Stimulated Emotions</td>
<td>.53* (.57)</td>
<td>.02* (.01)</td>
<td>.01</td>
<td>.48</td>
<td>.78</td>
<td>.05</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>2.17 (.43)</td>
<td>.01 (.01)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
</tbody>
</table>

* p < .05

Heavy episodic drinking. A significant mediating effect (αβ, p < .05) was observed for injunctive norms only. The last three columns of Table 17 reveal that the confidence intervals around the mediating effects are also statistically significant, providing further evidence of mediation.
Table 17: Group Effects on Mediators, Mediator Effects on Heavy Episodic Drinking, Mediated Effects and 95% Confidence Intervals

<table>
<thead>
<tr>
<th>Mediators</th>
<th>(α) Group (AEC use vs. Alcohol only) Effect on Mediator</th>
<th>(β) Mediator Effect on Heavy Episodic Drinking</th>
<th>(αβ) Mediated Effect</th>
<th>Lower C.I. of Mediated Effect</th>
<th>Upper C.I. of Mediated Effect</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectancies</td>
<td>.39 (12)</td>
<td>.26 (24)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Descriptive Norms</td>
<td>2.4 (66)</td>
<td>.07 (24)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Injunctive Norms</td>
<td>.82* (11)</td>
<td>1.12* (25)</td>
<td>.19</td>
<td>.92</td>
<td>1.62</td>
<td>.001</td>
</tr>
<tr>
<td>Self-concept</td>
<td>1.77 (20)</td>
<td>.03 (14)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Self-Assured Emotions</td>
<td>1.26 (74)</td>
<td>.02 (04)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Negative Emotions</td>
<td>.06 (53)</td>
<td>.10 (06)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Stimulated Emotions</td>
<td>.53 (57)</td>
<td>.02 (05)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>2.17 (43)</td>
<td>.03 (07)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
</tbody>
</table>

* p < .05

**Frequency of drunkenness.** Significant mediating effects (αβ, p < .05) were observed for injunctive norms and self-efficacy. In addition, the last three columns of Table 18 reveal that the confidence intervals around the mediating effects are statistically significant, providing further evidence of mediation.
Table 18: Group Effects on Mediators, Mediator Effects on Frequency of Drunkenness, Mediated Effects and 95% Confidence Intervals

<table>
<thead>
<tr>
<th>Mediators</th>
<th>(α) Group (AEC use vs. Alcohol only) Effect on Mediator</th>
<th>(β) Mediator Effect on Frequency of Drunkenness</th>
<th>(αβ) Mediated Effect</th>
<th>Lower C.I. of Mediated Effect</th>
<th>Upper C.I. of Mediated Effect</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectancies</td>
<td>.39 (.12)</td>
<td>.06 (.07)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Descriptive Norms</td>
<td>2.4 (.66)</td>
<td>.01 (.01)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Injunctive Norms</td>
<td>.82 (.11)</td>
<td>.31 (.07)</td>
<td>.25</td>
<td>.18</td>
<td>.52</td>
<td>.001</td>
</tr>
<tr>
<td>Self-concept</td>
<td>1.77 (.20)</td>
<td>.02 (.04)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Self-Assured Emotions</td>
<td>1.26 (.74)</td>
<td>.01 (.01)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Negative Emotions</td>
<td>.06 (.53)</td>
<td>.01 (.02)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Stimulated Emotions</td>
<td>.53 (.57)</td>
<td>.02 (.01)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>2.17 (.43)</td>
<td>.04 (.02)</td>
<td>.09</td>
<td>.18</td>
<td>.52</td>
<td>.001</td>
</tr>
</tbody>
</table>

* p < .05

In sum, injunctive norms were a significant mediator for all outcomes. Descriptive norms, self-concept, stimulated emotions, and self-efficacy were significant mediators for decision-making. Lastly, self-efficacy proved to be the only other mediator besides injunctive norms to mediate the relationship between group and drinking.

**Aim 2: Longitudinal Analyses**

**Examination of means.** In the longitudinal analysis, means differences between times (i.e., time 1 and time 2) and outcomes (i.e., psychosocial mediators, decision-making and drinking) were analyzed for the different groups. The F ratios from a mixed 2 X 2 ANOVA are presented in Table 19 along with means and standard deviations. A Bonferroni correction was applied to control for the increased possibility of a Type 1 error because of the number of ANOVAS conducted (i.e., .05/12 = .004). Results indicate statistically significant interactions for only behavioral intention and injunctive...
norms. Examination of the means suggests that AEC users were at greater risk at time 1 than time 2 and the alcohol only group remained consistent over time.

Table 19: Group Differences between Time 1 and Time 2

| Variable                  | AEC Use Time 1 | Alcohol Only Time 1 | AEC Use Time 2 | Alcohol Only Time 2 | F Value  
|---------------------------|---------------|--------------------|----------------|---------------------|---------  
| Behavioral Intention      | .10 (1.07)    | -1.32 (.88)        | -.16 (1.28)    | -.89 (1.17)         | 19.72*   
| Behavioral Willingness    | 1.72 (.91)    | .48 (.66)          | 1.28 (1.03)    | .62 (.80)           | 27.24   
| Heavy Episodic Drinking  | 8.68 (5.18)   | 6.80 (5.26)        | 9.23 (5.22)    | 6.98 (4.31)         | .45     
| Frequency of Drunkenness  | 2.35 (1.62)   | 1.53 (1.29)        | 2.55 (1.46)    | 1.86 (1.42)         | .83     
| Expectancies              | .63 (.96)     | .26 (1.13)         | .27 (1.25)     | .26 (1.21)          | 5.21    
| Descriptive Norms         | 5.00 (6.28)   | 2.64 (5.30)        | 2.63 (3.56)    | 1.57 (2.91)         | 3.56    
| Injunctive Norms          | .73 (.82)     | -.09 (1.03)        | .23 (1.20)     | -.11 (1.08)         | 10.61*  
| Self-concept              | 3.19 (1.77)   | -1.47 (1.73)       | -.37 (2.25)    | -1.46 (2.02)        | 6.77    
| Self-Assured Emotions     | 7.96 (6.37)   | 7.06 (6.41)        | 6.90 (6.84)    | 5.83 (6.38)         | .04     
| Negative Emotions         | 3.36 (4.55)   | 3.52 (4.60)        | 3.87 (5.24)    | 2.93 (4.70)         | 3.29    
| Stimulated Emotions       | 8.63 (4.33)   | 8.11 (5.25)        | 8.55 (5.00)    | 7.00 (5.43)         | 2.34    
| Self-Efficacy             | -1.16 (3.56)  | -3.41 (3.80)       | -2.07 (3.94)   | -3.76 (4.01)        | 6.03    

* p < .004

Path models. The conceptual path model is shown in Figure 2. In addition, the actual analytic model can be found in Appendix B. In the analytic model, decision-making is a latent variable with two indicators – one for behavioral intention and the other for behavioral willingness. Likewise, drinking is a latent variable with two indicators – one for heavy episodic drinking and the other for frequency of drunkenness. (For parsimony and ease of reporting, the errors have been omitted.)
Expectancies. The first part of Figure 4 represents the relationships between expectancies at times 1 and 2 (i.e., path $a_1$), decision-making at times 1 and 2 (i.e., path $b_1$), and drinking at times 1 and 2 (i.e., $c_1$). Results indicate significant and positive relationships between each variable assessed at the two different time points. Expectancies about AEC use at time 1 were positively associated with expectancies at time 2; decisions to use AECs at time 1 were associated with decisions at time 2; and finally, drinking at time 1 was associated with drinking at time 2.

In addition, Figure 4 represents the relationships between expectancies, decision-making variables, and drinking at time 1 (paths $d_1$ and $e_1$) and the relationships between expectancies, decision-making, and drinking at time 2 (paths $d_2$ and $e_2$). The latter relationships also control for the influence of the variables at time 1. Results indicate that the relationships between variables (paths $d_1$ and $e_1$) at time 1 were significant as were the same relationships between variables (paths $d_2$ and $e_2$) at time 2, demonstrating consistency of relationships over time.
Figure 4: Longitudinal relationships between expectancies and decision-making/drinking outcomes.

Injunctive norms. The first part of Figure 5 represents the relationships between injunctive norms at times 1 and 2 (i.e., path $a_1$), decision-making at times 1 and 2 (i.e., path $b_1$), and drinking at times 1 and 2 (i.e., $c_1$). Results indicate significant and positive relationships between each variable assessed at the two different time points. Injunctive norms about AEC use at time 1 were positively associated with injunctive norms at time 2; decisions to use AECs at time 1 were associated with decisions at time 2; and finally, drinking at time 1 was associated with drinking at time 2.

In addition, Figure 5 represents the relationships between injunctive norms, decision-making, and drinking at time 1 (paths $d_1$ and $e_1$) and the relationships between injunctive norms, decision-making variables, and drinking at time 2 (paths $d_2$ and $e_2$).
The latter relationships also control for the influence of the variables at time 1. Results indicate that the relationships between variables (paths $d_1$ and $e_1$) at time 1 were significant, as were the same relationships between variables (paths $d_2$ and $e_2$) at time 2, demonstrating consistency of relationships over time.

![Diagram](image)

**Figure 5**: Longitudinal relationships between injunctive norms and decision-making/drinking outcomes.

**Self-concept.** The first part of Figure 6 represents the relationships between self-concept at times 1 and 2 (i.e., path $a_1$), decision-making at times 1 and 2 (i.e., path $b_1$), and drinking at times 1 and 2 (i.e., $c_1$). Results indicate significant and positive relationships between each variable assessed at the two different time points. Self-concept about AEC use at time 1 was positively associated with self-concept at time 2;
decisions to use AECs at time 1 were associated with decisions at time 2; and finally, drinking at time 1 was associated with drinking at time 2.

In addition, Figure 6 represents the relationships between self-concept, decision-making, and drinking at time 1 (paths $d_1$ and $e_1$) and the relationships between self-concept, decision-making, and drinking at time 2 (paths $d_2$ and $e_2$). The latter relationships also control for the influence of the variables at time 1. Results indicate that the relationships between variables (paths $d_1$ and $e_1$) at time 1 were significant as were the same relationships between variables (paths $d_2$ and $e_2$) at time 2, demonstrating consistency of relationships over time.

![Figure 6: Longitudinal relationship between self-concept and decision-making/drinking outcomes.](image-url)
**Self-efficacy.** The first part of Figure 7 represents the relationships between self-efficacy at times 1 and 2 (i.e., path $a_1$), decision-making at times 1 and 2 (i.e., path $b_1$), and drinking at times 1 and 2 (i.e., $c_1$). Results indicate significant and positive relationships between each variable assessed at the two different time points. Self-efficacy about AEC use at time 1 was positively associated with self-efficacy at time 2; decisions to use AECs at time 1 were associated with decisions at time 2; and finally, drinking at time 1 was associated with drinking at time 2.

In addition, Figure 7 represents the relationships between self-efficacy, decision-making variables, and drinking at time 1 (paths $d_1$ and $e_1$) and the relationships between self-efficacy, decision-making, and drinking at time 2 (paths $d_2$ and $e_2$). The latter relationships also control for the influence of the variables at time 1. Results indicate that the relationships between variables (paths $d_1$ and $e_1$) at time 1 were significant, as were the same relationships between variables (paths $d_2$ and $e_2$) at time 2, demonstrating consistency of relationships across time.
Figure 7: Longitudinal relationships between self-efficacy and decision-making/drinking outcomes.

In sum, findings from the longitudinal path analyses reveal significant relationships between the examined psychosocial mediators and decision-making/drinking outcomes; these relationships remained stable over time.

**Exploratory Analysis of Change**

To determine if their individual differences between time 1 and time 2, I conducted an exploratory analysis of change. I examined demographic variables (i.e., GPA, gender and ethnicity) to distinguish those who changed compared to those that remained the same. Results revealed no statistically significant difference, however future research is warranted.
### Confirmation of Hypotheses

**Table 20: Hypotheses Confirmation**

<table>
<thead>
<tr>
<th>Psychosocial Mediator</th>
<th>Hypothesis</th>
<th>Confirmation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectancies</td>
<td>AEC users expect to feel an enhanced buzz that allows them to party longer and feel less drunk/more energized, which in turn will be associated with a greater willingness and intention to consume AECs as well as increase alcohol use.</td>
<td>Confirmed</td>
</tr>
<tr>
<td>Social Norms</td>
<td>AEC users believe their friends approve of their drinking behavior (injunctive norms) and their friends and other college students are engaging in the same or very similar drinking behaviors (descriptive norms), which in turn will be associated with a greater willingness and intention to consume AECs as well as increase alcohol use.</td>
<td>Confirmed for injunctive norms, but not for descriptive norms</td>
</tr>
<tr>
<td>Self-Concept</td>
<td>AEC users feel more favorable consuming AECs, which in turn will be associated with a greater willingness and intention to consume AECs as well as increase alcohol use.</td>
<td>Confirmed</td>
</tr>
<tr>
<td>Emotions</td>
<td>AEC users indicate perceived benefits of emotional arousal when consuming AECs, which in turn will be associated with a greater willingness and intention to consume AECs as well as increase alcohol use.</td>
<td>Not Confirmed</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>AEC users feel they will be successful at achieving desired effects (e.g., able to party longer, enhanced buzz) if they consume AECs, which in turn will be associated with a greater willingness and intention to consume AECs as well as increase alcohol use.</td>
<td>Confirmed</td>
</tr>
<tr>
<td>Longitudinal Focus</td>
<td>Because of the developmental changes experienced by college students (e.g. moving off-campus, increased curriculum load) AEC use will not remain stable over time, which in turn will be associated with a greater willingness and intention to consume AECs as well as increase alcohol use.</td>
<td>Not Confirmed</td>
</tr>
</tbody>
</table>

As hypothesized, the psychosocial mediators helped explain the relationship between alcohol-energy drink cocktail use and decision-making/drinking outcomes. Expectancies, injunctive norms, self-concept, and
self-efficacy were all statistically significant while descriptive norms and emotions were the only mediators not significant. Although it was hypothesized that individuals would change over time due to the developmental changes often experienced by college students, this was not confirmed by the present study.
Chapter 5: Discussion

There is an increasing body of literature demonstrating that college students who consume AECs are at increased risk for alcohol-related harm (O’Brien et al., 2008; Thombs et al., 2010; Woolsey et al., 2010). In fact, the health dangers associated with consumption of these beverages has recently caught national attention. Students at several colleges have experienced serious alcohol-related harm (e.g., alcohol poisoning) and some institutions have actually banned these substances from their campuses (Goodnough, 2010). On November 18, 2010 the state of Washington’s Liquor Control Board outlawed alcoholic energy drinks (Garber, 2010). Although it is possible that combined alcohol energy drinks will become more regulated or banned, problems could arise if students resort to mixing their own when the premixed combination drinks are no longer available. Some scientists have already begun examining this issue and found that only a minority of combined users of alcohol and energy drink consume premixed combination drinks (D.J. Rohsenhow, personal communication, November 19, 2010).

Several descriptive studies have shown associations between AECs and alcohol-related harm (O’Brien et al., 2008; Thombs et al., 2010; Woolsey et al., 2010), however less is known about the mechanisms that underlie the risks associated with consuming these beverages. The present study is the first to conduct a comprehensive examination of decision-making variables (e.g., expectancies, social norms, and self-efficacy) that were drawn from the five most empirically-based, peer-reviewed behavioral theories (i.e., general unified theory). A noteworthy strength of the present study is the two decision-making variables incorporated – behavioral intention and willingness. These variables contribute in an important way to understanding behavior, because intention addresses
the rational element of decision-making processes while willingness addresses the emotional or spontaneous element. Lastly, the present study explores a longitudinal design in an effort to understand the underlying psychosocial factors influencing college students to engage in this high-risk drinking behavior.

Organizational Framework

Following a brief summary of the findings, important implications and generalizability of the findings are discussed. The latter is particularly relevant to individuals working with college students (e.g., researchers, prevention scientists, college administrators, and health practitioners) who want to reduce alcohol-related harm. Finally, study limitations are noted along with ideas for future research directions.

Summary of Findings

Examination of psychosocial mediators. The present study sought to extend previous research in the area of college drinking by conducting an examination of a high-risk drinking behavior, i.e., AEC consumption. The goal was to answer the following questions: (1) What outcome expectancies are associated with AECs? (2) Are there social influences on AEC consumption? (3) What self-concepts or images associated with AEC consumption concern students? (4) How do emotions influence AEC use? (5) How important is self-efficacy to the behavioral decision to consume AECs? (6) Do these psychosocial mediators influence decision-making outcomes such as behavioral intent and willingness to use AECs? (7) Do the above psychosocial mediators change over time across the college experience?

Expectancies. Analyses revealed that expectancies (e.g., anticipating an enhanced buzz, more energy or less drowsiness when consuming AECs) were a
significant mediator in the relationship between group and decision-making/drinking outcomes. Individuals who consumed AECs had more positive expectancies related to AEC use which, in turn, were associated with stronger behavioral intentions to use AECs, increased willingness to use AECs, increased heavy episodic drinking and increased frequency of drunkenness. Past studies have shown that when individuals expect a strong impairment from alcohol they will seek a compensatory response to counteract the effects of alcohol on impairment (Fillmore & Blackburn, 2002; Fillmore, Mulvihill & Vogel-Sprott, 1994; Fillmore & Vogel-Sprott, 1996). Findings from the present study show that AEC users believe that AEC consumption will offer them the desired buzz effect from alcohol without the sedative effects which make them drowsy. In other words, they expect AECs to counteract the less desired effects of alcohol. However, these expectancies in turn promote drinking more, putting them at elevated risk of experiencing alcohol-related harm.

**Social norms.** The relationship between group and social norms was positive and significant for both injunctive (e.g., believe their friends approve of AEC use) and descriptive (e.g., friends typical AEC use) norms. AEC users believe their friends approve of their use and that their friends are consuming AECs as well. The results further revealed a significant mediating effect for injunctive norms, but not for descriptive norms. Individuals who reported more social approval about AEC use were more likely to have behavioral intention and willingness to consume AECs. They also reported more heavy episodic drinking and frequency of drunkenness. These findings might provide some empirical evidence that helps explain recent reports in the popular press such as the nine Central Washington University students who consumed alcoholic
energy drinks and were admitted together to the emergency room with BACs ranging from .12 percent to .35 percent – potentially lethal levels (Stein & Johnson, 2010). Given the growing popularity and perceived social approval of AEC use on college campuses, more accounts such as these might be forthcoming.

Last, descriptive norms are typically found to be a significant predictor of drinking behaviors in the college alcohol literature (e.g., Read, Wood, Davidoff, McLacken & Campbell, 2002). Although it was hypothesized that descriptive norms would be a significant mediator of the relationship between AEC use and decision-making/drinking outcomes, the findings revealed that they did not predict outcomes. Thus, these findings suggest that a social norms campaign may not be an ideal strategy for changing AEC behavior for college students.

**Self-concept.** Self-concept was also a significant mediator for decision-making/drinking outcomes. Results revealed that individuals who consumed AECs had a more positive self-concept related to AEC use (e.g., feeling more favorable toward consuming AECs) and as self-concept about AEC use became more positive, behavioral intentions to use AECs increased along with willingness, heavy episodic drinking and frequency of drunkenness. With regard to reaching different pathways for change, expectancies focused more on individual beliefs about AEC use (e.g., a knowledge pathway) and social norms focused more on peer approval (e.g., an interpersonal pathway), but self-concept focused on individual feelings resulting from AEC use (e.g., internal pathway). These general internal feelings help define an individual’s self concept or the core of an individual and may prove more challenging to change when trying to reduce high-risk behaviors.
**Emotions.** The three indices for emotions (i.e., self-assured, negative emotions, and stimulated) were examined as potential mediators. However, analyses revealed no distinction between groups (AEC users vs. alcohol only) on emotions.

**Self-efficacy.** Self-efficacy was a significant mediator in the relationship between AEC use and behavioral intention and behavioral willingness, as well as heavy drinking outcomes. The findings suggest that individuals who consume AECs have more self-efficacy related to AEC use (e.g., can party longer when consuming AECs). This is potentially analogous to athletes using performance enhancing substances (e.g., creatine) to improve performance, in that individuals may choose AECs to enhance/improve the party-going experience.

**Full model.** A full model was used to determine the importance of each psychosocial mediator relative to the other mediators by examining them simultaneously (see findings in Table 20). Injunctive norms was the only mediator that remained statistically significant for all outcomes. Descriptive norms, self-concept and stimulated emotions mediated the relationship between group and willingness, however self-concept was the only one of the three to mediate the relationship between group and intention. Lastly, self-efficacy mediated the relationship between group and intention and frequency of drunkenness. For the purposes of intervention or prevention efforts, it appears that the psychosocial mediators that remain important relative to each other involve interpersonal (e.g., social norms) and internal (e.g., self-concept and self-efficacy) pathways for change. If college alcohol education programs must be brief in their intervention efforts, then it may prove to be necessary to focus on these psychosocial mediators that
demonstrate more importance over the others (albeit the other mediators proved to be significant in the individual models).

**Table 21: Full Model Results**

<table>
<thead>
<tr>
<th>Mediator</th>
<th>Behavioral Intention</th>
<th>Behavioral Willingness</th>
<th>Heavy Episodic Drinking</th>
<th>Frequency of Drunkenness</th>
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<td>Self-Assured Emotions</td>
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The above findings are consistent with other college drinking literature that has identified outcome expectancies, injunctive norms, self-concept, and self-efficacy as significant predictors of drinking behavior (e.g., Sher et al., 1996; Borsari & Carey, 2003; Moeller & Crocker, 2009; Ray et al., 2009). Similar to previous college alcohol findings, the present results are encouraging for determining optimal predictors to target characteristics, which may be amenable to change in an effort to reduce alcohol-related harm associated with AEC consumption.

**Longitudinal analyses.** The first focus of the longitudinal analyses examined means differences between time (i.e., time 1 and time 2) and outcomes (i.e., psychosocial mediators, decision-making and drinking) for the different groups. The findings revealed significant interactions for behavioral intention and injunctive norms which showed that
AEC users were at greater risk at time 1 to be influenced by friends and to intend to use AECs than at time 2. The literature has shown that the first year in college is a particularly high-risk transitional phase for increased heavy drinking and alcohol-related consequences (e.g., Baer et al., 1995; Hingson et al., 2005; Schulenberg and Maggs, 2002; Wechsler et al., 1998; 2002). Thus, from a prevention standpoint, the identification of predictors of heavy alcohol use and related problems (e.g., AEC use) during this critical developmental period would enable intervention efforts to be targeted to the highest risk individuals. As it relates to injunctive norms and behavioral intention, intervention efforts should address social influences (e.g., developing healthy and positive social interactions) and behavioral intention – the rational element of decision-making (e.g., making safe-drinking plans before going out to party).

The second focus, longitudinal path analyses, revealed significant relationships between the examined psychosocial mediators at time 1 and time 2. These variables remained stable over time. Similar patterns emerged for the relationships between expectancies at time 1 and decision-making at time 1 and the relationship between expectancies at time 2 and decision-making at time 2, in that both remained consistent and stable over time. The same pattern was present when injunctive norms, self-concept and self-efficacy were examined relative to decision-making. However, whereas the relationship between decision-making at time 1 and drinking at time 1 remained significant at time 2, the pattern was different. The relationship at time 1 was greater by almost one unit suggesting that AEC users at time 1 were at more risk for heavy drinking than at time 2. Although studies have suggested that college students may naturally mature out of high risk behaviors over the course of their college experiences (e.g.,
Gotham, Sher & Wood, 1997; Turrisi, Padilla & Wiersma, 2000; Littlefield, Sher & Wood, 2009), early intervention efforts may prevent students from experiencing negative consequences their first year.

Implications

Implications for research/prevention science. The current study added to the existing literature by examining psychosocial mediators in the relationship between group (AEC use vs. alcohol only) and decision-making/drinking outcomes. Results appeared to indicate that specific mediators targeted individually or relative to each other are important when predicting an individual’s behavioral intent and willingness to consume AECs and subsequent heavy drinking outcomes. Moreover, these psychosocial mediators remain relatively stable over time, suggesting that understanding why students are engaging in this high-risk drinking behavior is important when trying to reduce and/or prevent alcohol-related harm associated with AEC consumption. Currently, in the field of alcohol research, identifying high-risk individuals is important from a prevention standpoint. The findings from the present study may offer the ability to identify high-risk individuals (e.g., AEC users) as a screening tool for programs designed to reduce the onset or extent of college alcohol use. Insights from the findings may also help tailor alcohol prevention materials. For example, a brief motivational feedback intervention such as BASICS (Larimer et al., 2007) may benefit from adding information about AEC use and the associated alcohol-related harm. This targeting or tailoring has the potential to improve efficacy of high-risk drinking reduction and has been shown to be less expensive than a universal/one-size-fits-all approach (Offord, 2000).
Implications for college administrators. The results of the current study could be useful to college administrators by demonstrating the health dangers associated with AEC use among their students and preventing or reducing negative alcohol-related behaviors on college campuses. Recommendations could include: 1) regulating or banning energy drinks or alcoholic energy drinks from being distributed or sold on college campuses; 2) adding information on the risks of combining alcohol and energy drinks to existing college alcohol literature and/or programs offered to college first-year students as they adjust to campus life (e.g., Alcohol Edu); and 3) partnering with other key stakeholders who also care about the health of college students and the safety of college campuses (e.g., parents, community partners, local police and community hospitals).

That being said, it is common for college administrators to address the issue of college student drinking by establishing laws and policies that limit the opportunities for drinking. Although this kind of "top down" approach can be effective in reducing student drinking, it often does so at the cost of alienating students, and can backfire. Therefore a suggestion for college administrators would be to involve their college students in decision-making processes that inevitably affect their personal health.

Generalizability of the Findings

The current study only looks at first year college students and therefore the findings may not generalize to other populations that may be at risk for alcohol-related harm associated with AEC use. The variables of interest for this study (e.g., expectancies, social norms, self-efficacy) might be stronger or weaker, but most likely will remain variables of interest for other populations. For example, although there is no
well developed literature on the non-college sample regarding alcohol consumption it has been shown that this population experiences similar negative consequences associated with high-risk drinking (Galiffa, 2010). Likewise, these variables make sense to target for potential examination of high-school students’ AEC use as well as all years of college students (e.g., sophomore, junior and seniors). Staying in the realm of college samples, it may also be interesting to explore smaller or more diverse college student samples than the present study such as small liberal arts colleges or historically black colleges and universities. Although it is likely that variables examined will still have an impact, future research is needed with regard to other high-risk populations.

**Study Limitations and Future Directions**

A limitation of the present study is a longitudinal design incorporating only two data collection points. It would be beneficial to add more time points to further examine the relationship between AEC use and subsequent drinking behaviors. The present study examined AEC use among college students during the spring of their freshman year and the fall of their sophomore year. Future studies should examine more time points such as before matriculation into college, possibly a time point during the summer when the demands of college life are not as intense, and time points during their upperclassman years (e.g., junior and senior years). An interesting empirical question is whether AEC use remains the same as students learn from negative experiences associated with AEC use. Additionally, because there is growing concern over the marketing of energy drinks to an even younger population (e.g., high school students), future work should examine AEC use by younger students. Adding an earlier wave while in high school could address this issue.
Whereas this study examined psychosocial mediators (e.g., expectancies) and decision-making/drinking outcomes, future studies should examine other factors related to AEC use and health. For example, personality traits such as sensation seeking and impulsivity could be explored, as these factors are associated with energy drink use (Miller, 2008) and alcohol abuse (Cyders et al., 2007). Caffeine, the main active ingredient in energy drinks, is also associated with sensation seeking and impulsivity in students (Jones & Lejuez, 2005). Additionally, student-athletes are a high-risk group for consuming AECs and experiencing the negative consequences associated with use (Miller, 2008; Woolsey et al., 2010). Thus, it might be interesting to explore the extent to which physical activity plays a role not just among an athletic population, but overall.

With respect to examining potential moderators, the present study does not explore gender or social affiliations (e.g., Greek, athletic status). For example, gender might influence the relationship between AEC use and drinking outcomes because of possible differences in caffeine and alcohol metabolism and/or tolerance (Julien, 2008). In addition, Greek membership and athlete status has been associated with AEC use and subsequent high-risk behaviors (Miller, 2008; Woolsey, 2010). Future studies should examine these factors, especially in relation to personality traits such as sensation-seeking and impulsivity also linked to these two populations (Schroth, 2009; Borsari, Murphy & Barnett, 2007).

Additionally, the sample is largely homogenous with regard to ethnicity (90% Caucasian) and consists of first-year students only. Although previous research has shown that students who are male, white, athletes, fraternity or sorority members, and younger are at most risk for alcohol-related harm from consuming energy drinks alone or
in combination with alcohol (Miller, 2008; O’Brien et al., 2008; Woolsey et al., 2010),
more work needs to be done in order to extrapolate conclusions to the general population.
In addition, the study was conducted at one university suggesting the need for future
work to examine different types of university settings and a more heterogeneous student
body for generalizability.

Moreover, the present study asks participants retrospectively about their drinking
behaviors, which may result in self-report bias. However, much of the previous literature
supports this method for behavioral assessment, and it has proven to be extremely reliable
(Burleson & Kaminer, 2006; Sobell & Sobell, 1997). That being said, there may be a
need for more refined methods of measurement, and future studies may want to explore
the inclusion of biological and psychophysiological markers (e.g., Functional Magnetic
Resonance Imaging (fMRI) for brain imaging, breathalyzers) direct observation (e.g.,
field studies, bar labs).

Furthermore, the issue of AEC use as being a fad is a noteworthy point. A review
of the Internet revealed that mixed drinks such as Red Bull and vodka are popular among
college students. However, it would be pure speculation to say the combination of
alcohol and energy drinks will remain a common drinking practice among college
students. It will be interesting to see if the recent national attention with regard to the
negative health consequences associated with AEC use will either increase or decrease
use among students.

Finally, there are no national guidelines or recommendations for a safe dosage of
AECs. However, for the purpose of the present study there is no healthy amount of
alcohol use recommended by the American Medical Association for individuals under the age of 21.

Conclusion

In sum, AEC consumption is an increasing health concern for college students. This study is the first to propose a single theoretical framework that may explain the reasons why college students choose to consume AECs. This knowledge may help frame educational policies and interventions aimed at reducing alcohol-related harm and directly inform changes in health policy to reduce the risk from AECs. Currently, the United States Food and Drug Administration does not regulate energy drinks, and often individuals are unaware of the potential negative health effects resulting from their consumption, especially in combination with alcohol. In addition, findings from this study may also highlight the need for future research examining psychophysiological factors involved in the use of AECs. It is possible that these findings may reduce deleterious effects on the developmental processes of young adults and decrease the potential of developing alcohol dependence or addiction later in life.
References


Appendix A

Predictor Groups

AEC Users.

Do you drink alcohol mixed with energy drinks (e.g. Red Bull and vodka or Jägerbomb)?

Yes, No

Alcohol only users.

Please describe your alcohol usage.

I have never tried alcohol.
I have tried alcohol, but currently don’t drink.
I am a light, social, non-problem drinker.
I am a moderate, social, non-problem drinker.
I am a heavy, non-problem drinker.
I am a heavy, problem drinker.
Appendix B

Mediators

Expectancies.

I expect to feel an enhanced “buzz” (energized and less drowsiness) when I consume alcohol mixed with energy drinks.

*Strongly Agree, Agree, Neither Agree nor Disagree, Disagree, Strongly Disagree*

Social Norms.

Consider a typical week during the LAST MONTH. How many energy drinks mixed with alcohol, on average, (measured in number of drinks*), do your closest friends drink on each day of a typical week?

(a) On a typical **MONDAY**, I have . . . □ drinks (*)
(b) On a typical **TUESDAY**, I have . . . □ drinks (*)
(c) On a typical **WEDNESDAY**, I have . . . □ drinks (*)
(d) On a typical **THURSDAY**, I have . . . □ drinks (*)
(e) On a typical **FRIDAY**, I have . . . □ drinks (*) How would your closest friends respond if they knew you consumed alcohol mixed with energy drinks?
(f) On a typical **SATURDAY**, I have . . . □ drinks (*)
(g) On a typical **SUNDAY**, I have . . . □ drinks (*)

*Strong disapproval, Moderate disapproval, Mild disapproval, Wouldn't care, Mild approval, Moderate approval, Strong approval*

Self-concept.

I like the way combining alcohol and energy drinks makes me feel.

*Strongly Agree, Agree, Neither Agree or Disagree, Disagree, Strongly Disagree*

How favorable do you feel about consuming alcohol mixed with energy drinks?
Unfavorable, Mildly Favorable, Favorable, Extremely Favorable

Affect and emotions.

The following scale consists of a number of words that describe different feelings and emotions. Read each item and then select the appropriate answer. Indicate to what extent you have felt this way while drinking energy drinks combined with alcohol.

Very slightly or not at all, A little, Moderately, Quite a bit, Extremely

(a) Excited  
(b) Upset  
(c) Strong  
(d) Guilty  
(e) Scared  
(f) Hostile  
(g) Enthusiastic  
(h) Irritable  
(i) Alert  
(j) Inspired  
(k) Nervous  
(l) Determined  
(m) Attentive  
(n) Jittery  
(o) Active  
(p) Afraid

Self-efficacy.

I drink alcohol mixed with energy drinks…

a. because it makes partying better.  
b. because it allows me to drink more and feel less drunk (i.e., less drowsy).  
c. because it allows me to party longer when I have had a tiring day (e.g., studying, working, tailgating).  
d. because I have less of a hangover the next day.

It would be easy for me to get alcohol mixed with energy drinks at a party.
Strongly Agree, Agree, Neither Agree or Disagree, Disagree, Strongly Disagree

I can consume more alcohol when I choose to combine alcohol and energy drinks.

Strongly Agree, Agree, Neither Agree or Disagree, Disagree, Strongly Disagree

I can party longer when I choose to mix alcohol with energy drinks.

Strongly Agree, Agree, Neither Agree or Disagree, Disagree, Strongly Disagree
Appendix C

Outcomes

Behavioral Willingness.

Please indicate your willingness to consume alcohol mixed with energy drinks in the next 30 days.

Not Willing, Slightly Willing, Mildly Willing, Extremely Willing

Behavioral Intention.

Please indicate your intent to consume alcohol mixed with energy drinks in the next 30 days.

Strongly Agree, Agree, Neither Agree or Disagree, Disagree, Strongly Disagree

Drinking.

Consider a typical week during the LAST MONTH. How much alcohol, on average, (measured in number of drinks*), do you drink on each day of a typical week?

(a) On a typical MONDAY, I have . . . drinks (*)
(b) On a typical TUESDAY, I have . . . drinks (*)
(c) On a typical WEDNESDAY, I have . . . drinks (*)
(d) On a typical THURSDAY, I have . . . drinks (*)
(e) On a typical FRIDAY, I have . . . drinks (*)
(f) On a typical SATURDAY, I have . . . drinks (*)
(g) On a typical SUNDAY, I have . . . drinks (*)
Appendix D

Analytic model used for longitudinal analyses. Note below is an example using expectancies. Analyses using the same model were conducted for the examination of injunctive norms, self-concept, and self-efficacy.
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Education

2011 Ph.D. Biobehavioral Health, The Pennsylvania State University
2002 Master of Social Work, University of Southern California
1997 Bachelor of Arts, Psychology, Georgetown University

Awards

2010-2011 NIAAA funded Supplement to Promote Diversity in Health-Related Research
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2009-2011 Project Coordinator, EPIC Study (PI: Dr. Tonya Dodge)
2010-2011 Research Assistant, Project ACT (PI: Dr. Rob Turrisi)
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Publications