Are All Alcohol and Energy Drink Users the Same? Examining Individual Variation in Relation to Alcohol Mixed with Energy Drink Use, Risky Drinking and Consequences

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Abstract

Individuals who consume alcohol mixed with energy drinks (AmEDs) have been identified as higher-risk drinkers, as they are more prone to drink increased amounts of alcohol and experience more consequences compared to non-AmED users. The present study examined differential AmED use and alcohol consumption simultaneously as multi-dimensional risk behaviors among AmED users. Students who identified as drinkers and current AmED users (n = 195) completed a web-based survey related to their AmED consumption and typical drinking patterns. Latent profile analysis was used to classify participants into distinct AmED user profiles. Profiles were then compared on AmEd-based cognitive factors (e.g., expectancies, norms) and alcohol-related consequences. Four AmED user profiles emerged: Moderate drinker, low proportion AmEd users (ML); Heavy drinker, low proportion AmED users (HL); Moderate drinker, high proportion AmED users (MH); and Heavy drinker, high proportion AmED users (HH). Membership in higher-proportion AmED groups was associated with more positive AmED expectancies and perceived norms. No significant differences were observed in the amount of consequences endorsed by HL and HHs, however MHs experienced significantly more alcohol-related physical consequences than MLs. This suggests increased use of AmEDs is associated with increased risk of experiencing alcohol related consequences for moderate drinkers. Screening students for AmED use could be used as a novel, inexpensive tool to identify high-risk drinkers for targeted interventions aimed at reducing alcohol consumption and related problems.

Keywords

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College student drinking is a prevalent high-risk behavior that continues to be a problem on campuses across the nation (National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2006). Student drinking is associated with a variety of harmful outcomes that range in severity from hangovers to severe injury or death (Perkins, 2002). One drinking activity that has received increasing attention due to its growing popularity among college students and its association with high-risk drinking behavior, is the use of alcohol mixed with energy drinks (AmEDs). AmEDs are a mixture of heavily caffeinated beverages such as Red Bull or Monster combined with alcohol. Approximately one quarter of students who report consuming alcohol also endorse consuming AmEDs in a typical month (O'Brien, McCoy, Rhodes, Wagoner, & Wolfson, 2008). Studies have shown individuals consume AmEDs for a variety of motives and expectations including the perception of increased energy, ability to consume more alcohol, availability, enjoy the taste, etc. (Marczinski, 2011; O'Brien et al., 2008; Peacock Bruno, & Martin., 2012). In addition, students who report using AmEDs have more positive expectancies associated with AmED use, higher perceptions of peer use (Varvil-Weld Marzell, Turrisi, Mallett, & Cleveland, in press) and endorse higher rates of general risk-taking tendencies (Brache & Stockwell, 2011; Miller, 2008a).

A variety of studies have found an association between AmED use, risky drinking behaviors, and related consequences. For instance, AmED users are more prone to drink increased amounts of alcohol and experience more consequences compared to non-AmED users (Berger Fendrich, Chen, Arria, & Cisler, 2011; Brache & Stockwell, 2011; O'Brien et al., 2008; Thombs et al., 2010; Woolsey, Waigandt, & Beck, 2010). Thombs and colleagues (2010) found AmED users surveyed while at a bar were more likely to leave intoxicated and had significantly higher intentions to drive home compared to patrons who consumed only alcohol, however the reason underlying this difference is unclear. In an attempt to better understand the relationship between AmED use and increased consumption and risk, preliminary laboratory based studies found an association between AmED consumption and impaired behavioral control (Marczinski Fillmore, Bardgett, & Howard, 2011) and increased desire to consume more alcohol (Marczinski Fillmore, Henges, Ramsey, & Young, 2012); however, more work is needed before definitive causal relationships can be drawn (Verster, Aufricht, & Alford, 2012).

In addition to incomplete information about causal relationships, certain methodological limitations found in the literature have restricted our understanding of AmED use and risky drinking. For instance, previous studies have treated AmED users the same regardless of whether they reported consuming one or 15 AmED drinks in the past month. Further, no previous studies in this area have examined what proportion of drinking is characterized by AmED use. This one-size fits all approach is overly simplistic and does not differentiate types of AmED users or provide adequate information about AmED users who are at significant risk for engaging in dangerous drinking and experiencing consequences. Further, a portion of studies that have shown an association between energy drink use and increased risk of alcohol use and problems have used energy drink consumption as a predictor rather than actual AmED use (e.g., Arria et al., 2011 Miller, 2008b), making it challenging to draw conclusions as to whether the combination of AmED is associated with increased alcohol-related problems or if it is alcohol use alone (Verster et al., 2012).

In order to address some of these limitations, and gain a better understanding of the specific risk associated with AmED use, the goals of the current study were to: 1) utilize a person-centered approach to identify distinct risk profiles using both AmED-specific use (e.g. quantity and frequency of AmED and use) and alcohol only use (e.g., quantity of alcohol-only drinks per week), 2) compare the AmED risk-profiles on AmED-based cognitive outcomes (expectancies, attitudes, norms), 3) compare AmED risk-profiles on the amount and type (i.e., physical, legal, academic, sexual) of alcohol-related consequences reported by the sample.

Expectancy-based theories (Janz & Becker, 1984; Rosenstock, Strecher, & Becker, 1988), the Theory of Reasoned Action (Fishbein & Ajzen, 2010), and the established college drinking literature have traditionally demonstrated positive relationships between alcohol expectancies, attitudes, and normative perceptions and drinking behavior and related problems (Borsari & Carey, 2003; Cooper, Frone, Russell, & Mudar, 1995; Jones, Corbin, & Fromme, 2001; Neighbors et al., 2008; Read, Wood, Davidoff, McLacken, & Campbell, 2002). Therefore, we anticipated similar relationships to emerge when focusing specifically on AmED use. Specifically, we anticipated the risk-profiles that emerged would consist of moderate to heavy drinkers with varying proportions of AmED use, based on previous work showing individuals who consume AmED tend to consume more alcohol (e.g. Brache & Stockwell, 2011; Price Hilchey, Darredeau, Fulton, & Barrett, 2010; Woolsey et al., 2010). The next step of the study compared the AmED risk-profiles on AmED-based cognitive outcomes. Studies focusing specifically on cognitive factors associated with AmED use found patterns between AmED specific expectancies, norms, and use to be similar to those found in alcohol only studies (Howland et al., 2011; Marczinski, 2011; O'Brien et al., 2008; Peacock et al., 2012; Varvil-Weld et al., in press). Therefore, we hypothesized individuals who reported higher proportions of AmED use would also report more positive AmED specific expectancies and attitudes, and higher perceived norms of peer AmED use and approval.

The final goal of the study compared AmED risk-profiles on the amount and type of reported alcohol-related consequences. First, we hypothesized individuals who were classified as heavy drinkers with the highest proportion of AmED use would report the highest rates of consequences based on studies that show heavy drinkers (Perkins, 2002) and AmED users (Brache & Stockwell, 2011; O'Brien et al., 2008) report experiencing increased consequences. Additionally, we hypothesized higher AmED use would be associated with higher rates of physical consequences (e.g. blackout, hangover) based on research showing individuals who consume AmEDs tend to have increases (e.g., sleep difficulties) and decreases (e.g., sedation) in specific physiological symptoms associated with intoxication (Peacock, et al., 2012) and drink larger amounts of alcohol, resulting in higher BACs (Thombs et al., 2011).

Methods

Participants & Recruitment Procedures

Participants were 195 undergraduate students selected from the student union building at a large Northeastern university. A data collection table (with a sign identifying the study and

inclusion criteria) was set up in a high traffic area of the student union building for five consecutive days from 11am to 3pm. Every third student that passed by was approached by a RA and invited to complete five screening questions: 1) age, 2) gender, 3) race, 4) do you drink alcohol, and 5) do you currently combine alcohol and energy drinks or use pre-mixed alcoholic energy drinks. A total of 675 students were screened, and individuals who indicated they were drinkers and had consumed alcoholic energy drinks (n = 382) were e-mailed a link to a web-based survey assessing more in depth information regarding their general drinking patterns, AmED behaviors, and related consequences. The final sample consisted of 195 AmED users, yielding a 51% response rate. Participants were: 57% male (43% female), 78.9% White, 8% Hispanic or Latino(a), 7.2% Asian, 6.7% Black or African American, 3.6% Multiracial, and 3.6% other. The average age of participants was 21 ($SD = .27$) years old. No significant differences were observed between respondents and non-respondents on age, gender, race, or drinking/AmED outcomes.

Measures

Measures consisted of students' self-reported assessments of alcohol use, AmED use, cognitive motives for AmED use, and alcohol-related consequences. All items, described in detail below, were based on measures used in previous AmED work (Marzell, 2011; Varvil-Weld et al., in press).

Latent profile indicators

Alcohol use indicators—Alcohol use was assessed using three measures. Typical number of drinks per week was measured using a modified version of the Daily Drinking Questionnaire (DDQ; Collins, Parks, & Marlatt, 1985), which asked participants to report the number of alcoholic drinks they consumed on each day of the typical week over the past month. Responses were summed to create an index ranging from 0 to 58 ($M = 14.23$, $SD = 10.37$) drinks per week. The Quantity/Frequency/Peak questionnaire (QFP; Dimeff et al., 1999; Marlatt et al., 1998) was used to measure frequency of heavy drinking and peak alcohol use over the past 30 days. Participants indicated "the number of times in the past 30 days that [they] got drunk, or very high from alcohol" and how much they drank on their peak drinking occasion in the past month. 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).

AmED use indicators—AmED use was assessed using modified versions of the DDQ and QFP. AmEDs were defined in the survey as alcoholic energy drinks (e.g., Four Loko, Joose) or alcohol combined with energy drinks (Red Bull and vodka, Jagerbombs). Items from the DDQ were modified to ask participants how many AmEDs they consumed on each day of the typical week. "Consider a typical week during the last 3 months. How many alcoholic energy drinks, on average (measured in number of drinks), do you drink on each day of a typical week?" These responses were summed to create an index of the number of AmEDs consumed in a typical week ($M = 3.93$, $SD = 6.73$). This questionnaire was also used to determine the number of days in a week that AmEDs were being used, such that each day received a dummy code indicating whether participants had reported any AmED use on that day (1 = yes; 0 = no). The seven dummy coded variables were summed to

determine the typical number of days in a week participants consumed AmEDs. Participants also reported their peak number of AmEDs consumed in the past 30 days. "Think of the occasion when you drank the most in the past month. How many alcoholic energy drinks or alcohol combined with energy drinks did you consume?"

AmED-cognitive outcomes

Expectancies—Expectancies regarding AmED use were measured using the following three items: " I can consume more alcohol when I choose to combine alcohol and energy drinks;" "I can party longer when I choose to combine alcohol and energy drinks;" and "I expect to feel an enhanced 'buzz' (energized and less drowsiness) when I consume alcohol and energy drinks." Items were scored on a five-point scale with response options ranging from –2 (Strongly Disagree) to 2 (Strongly Agree) and summed to create a composite score of AmED Expectancies (α= .71).

Attitudes—Participants responded to two items regarding attitudes towards AmED use, using a five-point scale with scores ranging from –2 (Strongly Disagree) to 2 (Strongly Agree). Items consisted of the following two statements: 1) "I like the way combining alcohol and energy drinks makes me feel" and 2) "I feel favorably about consuming alcohol mixed with energy drinks." Responses to these items were summed to create a composite score of AmED Attitudes (α= .79).

Descriptive and injunctive norms—To assess *descriptive peer norms*, a modified version of the Drinking Norms Rating Form (DNRF; Baer, Stacy, & Larimer, 1991) asked participants to report the number of AmEDs their closest friends consumed on each day of the typical week in the past 30 days. The responses were summed to create an index of perceived weekly AmED use by closest friends. An additional item measured perceived peer approval of AmED use, or *injunctive peer norms*. Participants were asked to indicate the extent to which their friends would approve or disapprove of their AmED use, using the following question: "How would your friends respond to you drinking alcohol mixed with energy drinks?" Response options ranged from –2 (Strongly Disapprove) to 2 (Strongly Approve).

Alcohol-related consequences

The Young Adult Alcohol Problems Screening Test (YAAPST; Hurlbut & Sher, 1992) was used to assess the number of alcohol-related consequences students experienced in the past year. Participants responded on a five-point scale ranging from 0 (0 times) to 4 (10 or more times). Using factor analysis, four consequence subscales were created to assess specific types of consequences. Three items assessed physical consequences such as headaches, hangovers, and vomiting that occurred as a result of alcohol consumption (α= .75). Two items were summed that measured legal consequences such as receiving a citation for or while drinking (2 items; α= .84). Sexual consequences, such as getting into a sexual situation you later regretted while drinking, were compiled from 5 questions (α= .80). Three items assessed academic consequences like getting a lower grade on a quiz or exam because of drinking (α= .78). Finally, a summed composite score of total consequences was calculated (α= .88).

Data Analysis Plan

The analytical process for the current study was two-fold, utilizing the "classify and analyze" approach presented by Clark & Muthén (2009). To achieve the study's first aim, latent profile analysis (LPA) was conducted following the procedures outlined by Lanza and colleagues (2007). LPA is a person-centered statistical approach that identifies subgroups of individuals who are most similar to each other with respect to selected indicators (i.e. peak AmED use, frequency of AmED use, and typical drinking behaviors), while maximizing between-group differences on those indicators. First, a restricted one-profile solution was fit to the data. Additional profiles were added iteratively until the best-fitting solution was determined.

Goodness of fit was based on the Akaike Information Criteria (AIC; Akaike, 1974), the Bayesian Information Criteria (BIC; Schwarz, 1978), and log likelihood (LL) values. In addition to these, the entropy value, which can range from 0 to 1, was also considered in order to determine classification quality, or how accurately individuals were classified into the "correct" profile. Lower AIC, BIC, and LL values (compared to those associated with the initial one-profile solution) and an entropy value closer to 1, were indicative of better model fit. Finally, model convergence and practical utility of the identified profiles were considered before determining the best solution for the data. Once the best-fitting solution was determined, descriptive characteristics were examined to complete the "classify" portion of the analyses. Posterior probabilities, which indicate the probability of a given individual belonging to each profile, were obtained and used to assign individuals to their "most likely" profile.

To address the study's second aim (i.e., "analyze"), a series of one-way analyses of variance (ANOVA) were used to assess whether there were significant differences between AmED user types with respect to each outcome variable of interest: AmED cognitive outcomes and alcohol-related consequences.

Results

Identification of Latent AmED User Profiles

When the six indicators of alcohol and AmED use were entered into the LPA, four distinct patterns of alcohol and AmED use emerged. Though the profile decision criteria (AIC, BIC, and LL) continued to decrease through analysis of the five-profile model, the fifth group characterized a very small portion of the sample (less than 5%), suggesting the profiles may be unstable within the LPA (Muthén & Muthén, 2000). Additionally, the profiles within the 5-group solution lacked clear qualitative differences, which were present in the more stable 4-group solution. Therefore, the four-profile solution was selected as the best-fitting model for the data. All models converged normally and the final four-profile solution had a good classification quality (Entropy= .92). Fit indices for all tested solutions are presented in Table 1.

The four AmED user types, or profiles, were defined based on the proportion of their drinks that were AmEDs relative to their typical drinking patterns, which were consistent with NIAAA standards for light/moderate and heavy drinking (NIAAA, 2003). The first profile,

Moderate drinker, Low proportion AmED users (ML), consisted of 55.9% (n = 109) of the sample. Participants who fit into this profile drank the least compared to the other profiles; however, they still reported consuming an average of 8.16 (*SD* = 5.50) drinks per week, with 11.7% of those drinks (*M* = 0.96, *SD* = 1.39) identified as AmEDs. Descriptive statistics for all indicators are presented by profile in Table 2.

The second type of AmED user consisted of 24.6 % of the sample (n= 48) and was labeled *Heavy drinker, Low proportion AmED users* (HL). Individuals in this profile drank more than those in the ML group, averaging 25.16 (*SD*= 9.77) drinks per week. They reported being drunk an average of 9.48 (*SD*= 2.49) times in the past month and had 13.42 (*SD*= 4.45) drinks at their peak drinking occasion. However, consistent with the ML profile, a low proportion of their alcoholic drinks were AmED's (8.0%). This type of AmED user averaged 1.94 (*SD*= 1.75) AmEDs per week, 2.03 (*SD*= 3.24) AmEDs at their peak drinking occasion, and typically consumed AmEDs on one or two (*M* = 1.45, *SD*= 1.01) days each week.

The third profile (n = 21; 10.8%) consisted of *Moderate drinker, High proportion AmED users* (MH). Participants averaged 12.75 (*SD*= 5.24) drinks per week, and they reported getting drunk 3.75 (*SD*=2.23) times in the past month and having 7.49 (*SD* = 2.97) drinks on their peak drinking occasion. MHs differed from students in the ML and HL profiles in the amount of AmEDs consumed and in the proportion of their drinks that consisted of AmEDs. These individuals averaged 8.99 (*SD*= 3.49) AmEDs per week, usually consuming AmEDs on an average of 2.90 (*SD*=1.12) days each week, and they reported drinking 1.79 (*SD*=2.29) AmEDs on their peak occasion. AmEDs made up 70.5% of this profile's weekly alcohol intake.

Seventeen participants (8.7%) were classified to profile four, which described *Heavy drinker, High proportion AmED users* (HH). These individuals drank a similar amount of overall alcoholic drinks as the HL profile, averaging 23.23 (*SD*=7.15) drinks per week, 8.65 (*SD*= 3.04) occurrences of being drunk in the past month, and 14.88 (*SD*= 8.92) drinks at their peak drinking occasion. However, nearly all (97.8%) of their alcoholic drinks consisted of AmEDs.

Differences Between AmED User Profiles

Descriptive statistics for all outcomes assessed are presented by profile in Table 3. Furthermore, chi-squared analyses revealed there were no significant profile differences due to age, gender, race, ethnicity, residency location, or Greek status (all *p*s > .05).

AmED cognitive outcomes—Individuals in the HH profile, had significantly higher scores on AmED-related expectancies than both low proportion AmED groups, $F(3, 191) = 7.04$, $p < 0.001$, $\eta^2 = 0.10$. The MH profile also had significantly higher AmED expectancies when compared to the ML profile. With respect to attitudes, students in the HH profile reported more positive attitudes towards AmED use when compared to students in the ML profile, $F(3, 191) = 7.57$, $p < 0.001$, $\eta^2 = 0.07$. In terms of descriptive and injunctive norms, students in both high proportion AmED user groups (MH and HH) perceived their friends to drink significantly more AmEDs, when compared to MLs, $F(3, 191) = 4.51$, $p < 0.001$, $\eta^2 =$

0.11, and MHs perceived their friends to be more approving of them (the high proportion AmED users) drinking AmEDs, when compared to the MLs, $F(3, 191) = 4.28$, $p = 0.006$, $\eta^2 = 06$.

Alcohol-related consequences—As shown in Table 3, heavy drinkers (both HL and HH) and moderate, high proportion AmED users (MHs) reported significantly more alcohol-related consequences (YAAPST total), relative to the moderate, low proportion AmED users (MLs), $F(3, 191) = 13.86$, $p < 0.001$, $\eta^2 = 0.18$. The same pattern was observed for physical consequences, $F(3, 191) = 22.45$, $p < 0.001$, $\eta^2 = 0.26$.

Discussion

The current study was the first to examine differences among AmED users rather than compare AmED users to non-users, and four distinct profiles of alcohol and AmED use (ML, MH, HL, & HH) were identified. Findings revealed that heavier AmED users (MH & HH profiles) had the most favorable cognitive factors related to AmED use. With regard to experiencing consequences, the study found heavy drinkers (HL & HH profiles) experienced the most consequences regardless of AmED consumption; however, of the moderate drinkers (ML & MH profiles), those who consumed high proportions of AmEDs reported significantly more consequences than moderate drinkers who consumed low proportions of AmEDs.

Summary of Key Findings

First, it is important to note that no light drinkers were identified as AmED users. This highlights that AmED use is associated with moderate and heavy drinking patterns, which is consistent with our hypothesis as well as previous work (e.g., Brache & Stockwell, 2011; Price et al, 2010; Woolsey et al., 2010). Another finding worthy of discussion is the identification of the MH and HH individuals who reported a high proportion (MH: 70% and HH: 97%) of their overall alcohol consumption consisted of AmEDs. This finding is particularly concerning considering individuals tend to drink more heavily during occasions in which they consume AmEDs (Peacock et al., 2012). Additionally, Peacock and colleagues found overall drinking occasions involving AmED occurred less frequently then occasions containing alcohol only. While our findings support this for the majority of individuals who consume AmEDs (MLs and HLs), our data suggest the existence of a subgroup of high-risk individuals who consume AmEDs the majority of the time they drink and report experiencing a substantial number of problems.

Second, findings suggest that moderate drinkers who consume more AmEDs are at elevated risk for experiencing more alcohol-related consequences than moderate drinkers who consume fewer AmEDs. Previous work has demonstrated that individuals who consume AmEDs experience more consequences than those who drink alcohol alone (e.g. O'Brien et al., 2008). However the present study was the first to examine differences in rates of reported consequences among AmED users. Further, MH individuals experienced more physical consequences (e.g. hangovers, blackouts and vomiting) compared to ML individuals, which cannot be explained by differences in drinking quantity. One possibility for this finding is the caffeine contained in the AmED may be altering individuals'

perceptions and cues related to intoxication, resulting in an underestimation of their own impairment and higher physical consequences. Survey research (Ferreira, Mello, Pompéia, & Souza-Formigoni, 2006; Peacock et al., 2012) and seminal laboratory studies (Marczinski et al., 2011; 2012) examining the physiological and cognitive effects of consuming AmEDs have indicated increases (e.g., sleep difficulties, stimulation) and decreases (e.g., nausea, sedation, subjective intoxication) in specific physiological symptoms associated with intoxication, which may contribute to increased reports of physical consequences. More work is needed to fully understand the physiological effects of AmED consumption and its association with elevated physical consequences and long-term outcomes.

Finally, results also indicated this MH group had higher expectancies about AmED use, supporting the alcohol expectancy literature that suggests higher expectancies are related to increased drinking and related problems (Jones, et al., 2001). In terms of heavy drinkers, no differences were observed between HL and HH individuals regarding alcohol-related consequences. This finding suggests a potential ceiling effect indicating that high risk-taking behavior (e.g., heavy episodic drinking, drinking to get drunk) may be the problem and not the type of drink individuals are consuming (Verster et al., 2012).

Implications

The present study demonstrated that AmED use is associated with higher levels of alcohol consumption and therefore screening students for this specific behavior could be used as a novel, inexpensive tool to identify high-risk drinkers for a targeted intervention aimed at reducing alcohol consumption and related problems. Specifically, moderate drinkers who consume high proportions of AmEDs while drinking are at an elevated risk for experiencing alcohol-related consequences, particularly those of a physical nature. This finding is particularly concerning considering experiencing an increased amount of physical alcohol-related consequences may lead to future dependence symptoms (e.g. increased tolerance). Future work that examines the drinking trajectories of these individuals is needed to determine their risk of transitioning to heavy, problematic drinkers. Further, the incongruence between the expectations of benefiting from AmED use and the increased number of reported consequences associated with AmED use is a potential area for intervention. Additional studies should focus on whether working to bridge this discrepancy can help decrease AmED use. Findings from the present study, if replicable, could be useful to college alcohol prevention efforts by creating an increased focus on AmED use and by helping to tailor alcohol prevention materials. For example, a brief motivational feedback intervention such as BASICS (Dimeff et al., 1999) may benefit from adding information about AmED use and the associated alcohol-related harm. This targeting of high-risk students and tailoring of interventions to address AmED consumption has the potential to reduce high-risk drinking and has been shown to be less expensive than a universal/one-size-fits-all approach (Offord, 2000).

Limitations and Future Directions

Although the present study extends our knowledge of AmED use, there are limitations that should be considered. First, the current study assessed negative consequences associated with alcohol consumption. Individuals who consume AmEDs may experience additional

negative outcomes associated with caffeine use (e.g. sleep problems, agitation, etc.) that may not be captured in our study. Second, students were drawn from a single campus suggesting the need for future work to examine different types of university settings and a more heterogeneous student body for generalizability. Additionally, the sample is largely homogenous with regard to ethnicity. However, previous research has shown that students who are male, white, athletes, and/or fraternity or sorority members, are at most risk for alcohol-related harm from consuming energy drinks alone or in combination with alcohol (Miller, 2008a; O'Brien et al., 2008; Woolsey et al., 2010). In addition, the data collected were self-report and retrospective in nature. We took several steps to increase the probability of honest and accurate responding by informing participants their responses were confidential. With regard to the retrospective nature of the data, most items were given a fairly short reference time to recall (i.e. past month) and have been shown to be reliable and valid. It is important to note the current study utilized a between subjects retrospective design. While this provides important information about group differences, studies utilizing event-level and within-subjects designs are needed to compare alcohol only and AmED consumption in relation to specific high-risk drinking events and experiencing negative consequences (Verster et al., 2012). Further, the ordering of AmED vs. non-AmED use in a drinking session may influence the likelihood of adverse consequences. Specifically, the level of risk associated with mixing alcohol and caffeine may vary depending on time of consumption as it pertains to the ascending or descending level of the blood alcohol curve. For example, it is unclear if consuming AmEDs early in the evening is more or less risky than doing so later in the evening. Future research that examines both the proportion of AmEDs to alcohol only drinks consumed and the pattern of use are necessary to better understand individuals' risk. Finally, while the current study examined AmED use, it is possible that non-alcoholic energy drink use may precede alcohol use, and could serve as a potential precursor to alcohol use and/or high risk drinking. Future studies are needed to examine this relationship in order to evaluate potential added benefits of screening energy drink consumption as an early indicator of problem behavior.

Conclusion

Although college alcohol use has been an area of study for decades, the different types of behaviors students engage in with respect to their drinking continues to change. This study extends the growing body of literature that indicates the combined use of alcohol and energy drinks is a risky behavior associated with increased alcohol use and related problems, particularly for moderate drinkers who consume high proportions of AmEDs. College alcohol prevention efforts may be enhanced by accounting for different patterns of AmED use in order to identify high-risk individuals who could potentially be in a greater need of attention.

Acknowledgments

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Table 1

LPA model fit indices

Number of Profiles	AIC	BIC	Adjusted BIC	Log Likelihood	Entropy Value
1	6685.596	6724.872	6686.857	−3330.798	-
2	6405.018	6467.205	6407.016	−3183.509	0.978
3	6219.882	6304.980	6222.616	−3083.941	0.910
4	6122.460	6230.469	6125.930	−3028.230	0.919
5	6049.201	6180.121	6053.407	−2984.601	0.929

Note: AIC = Akaike's Information Criterion; BIC = Bayesian Information Criterion.

Table 2

Means (SD) for alcohol and AmED use indicators for the four AmED profiles

Indicators	Latent AmED User Type			
	ML (n = 109)	MH (n = 21)	HL (n = 48)	HH (n = 17)
Alcohol Use				
Peak Use	6.60 (3.91)	7.49 (2.97)	13.42 (4.45)	14.88 (8.92)
Times Drunk	2.55 (2.25)	3.75 (2.23)	9.48 (2.49)	8.65 (3.04)
Total Weekly Use	8.16 (5.50)	12.75 (5.24)	25.16 (9.77)	23.23 (7.15)
AmED Use				
Peak Use	0.79 (1.29)	1.79 (2.92)	2.03 (3.24)	3.59 (2.92)
Total Weekly Use	0.96 (1.39)	8.99 (3.49)	1.94 (1.75)	22.71 (5.73)
Days Per Week Used	0.68 (0.77)	2.90 (1.12)	1.45 (1.01)	3.88 (1.62)
Proportion of alcoholic Drinks that are AmEDs	11.8%	70.5%	8.0%	97.8%

Note. SD = Standard deviation. ML = Moderate drinker, low proportion AmEds; HL = Heavy drinker, low proportion AmEDs; MH = Moderate drinker, high proportion AmEDs; HH = Heavy drinker, high proportion AmEDs.

Table 3

Means (SD) for cognitive- and consequence-based outcomes by AmED user profile

	AmED User Profile				
	ML (n=109) 55.9%	**MH** (n=21) 10.8%	**HL** (n=48) 24.6%	**HH** (n=17) 8.7%	*F*
AmED Cognitive Outcomes					
Expectancies	−0.53 (2.37)	1.19^{a} (2.29)	0.08 (2.49)	$1.82^{a,b}$ (1.94)	7.04^{**}
Attitudes	−0.50 (1.78)	0.57 (1.72)	0.17 (1.72)	0.71^{a} (1.76)	4.51^{**}
Descriptive Norms	5.36 (6.67)	11.90^{a} (8.01)	6.94 (7.99)	12.06^{a} (9.01)	7.57^{**}
Injunctive Norms	0.23 (0.82)	0.8^{a} (0.68)	0.29 (0.71)	0.65 (0.70)	4.28^{**}
Alcohol-Related Consequences					
YAAPST Total	$8.44^{b,c,d}$ (6.22)	12.95^{a} (7.10)	16.68^{a} (8.37)	15.89^{a} (9.01)	17.43^{**}
Physical	$4.33^{b,c,d}$ (2.65)	6.48^{a} (2.56)	7.92^{a} (2.80)	7.24^{a} (2.97)	22.45^{**}
Legal	0.37^{b} (0.96)	0.54 (1.25)	1.03^{a} (1.26)	0.58 (2.40)	3.96^{*}
Academic	$0.94^{b,d}$ (1.33)	1.62 (1.53)	2.32^{a} (2.08)	2.39^{a} (2.04)	10.01^{**}
Sexual	$1.09^{b,d}$ (1.83)	1.64 (2.41)	2.10^{a} (2.51)	2.87^{a} (3.08)	4.65^{*}

Note F = test of mean differences;

Note 2.

[*] $p < .05$.

[**] $p < .001$

[a] = Mean difference as compared to the ML profile;

[b] = Mean difference as compared to the MH profile;

[c] = Mean difference as compared to the HL profile;

[d] = Mean difference as compared to the HH profile $p < 0.05$.