



# Alcohol mixed with energy drinks: Expectancies of use and alcohol-related negative consequences among a young adult sample

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## ABSTRACT

**Objective:** Energy drinks are a popular mixer with alcohol among college-aged young adults. Few studies to date have examined the relationships between expectancies of alcohol mixed with energy drink (AmED) use, AmED use and AmED-related negative consequences.

**Methods:** Eighty college-aged young adults were surveyed regarding their alcohol and AmED use, related negative consequences and AmED expectancies. Associations were assessed using chi-square tests and Cramér's V. A simple mediational model also was used to explore the potential relationships between AmED expectancies, AmED use and AmED-related negative consequences.

**Results:** AmED use was associated with more types of related negative consequences than heavy alcohol use alone, and where AmED use and heavy alcohol use were mutually associated with a related negative consequence, the strength of association was stronger for AmED use. While several AmED-related negative consequences were associated with AmED expectancies, unwanted sexual contact and getting into a verbal argument were associated with the greatest number of expectancies. The mediational model identified a statistically significant indirect effect of AmED expectancies on AmED-related negative consequences mediated by AmED use.

**Conclusions:** The study results contribute to the evidence that AmED use may confer additional risk for related negative consequences beyond heavy alcohol use and suggest that AmED expectancies may have a role in AmED use, which, in turn, is associated with AmED-related negative consequences. AmED expectancies may be targets for intervention to reduce AmED use considering the possible subsequent related negative consequences, especially those involving negative interpersonal experiences.

## 1. Introduction

Emerging in the United States in the late 1990s, energy drinks are a rapidly expanding segment of the beverage market, growing by 240% from 2004 to 2009 and having an estimated global value of \$43 billion in 2016 (Grand View Research, 2017; Heckman, Sherry, & Gonzalez de Mejia, 2010). Energy drinks purport a boost in wakefulness, delivered by a moderate to large dose of caffeine (50–500 mg per energy beverage vis-à-vis 77–150 mg per 6 oz coffee or 34–54 mg per 12 oz soda) and secondary ingredients including amino acids, herbs, micronutrients and sugars (Arria & O'Brien, 2011; O'Brien, McCoy, Rhodes, Wagoner, & Wolfson, 2008). Considerable marketing efforts by drink manufactures have been directed towards children and young adults (Emond, Sargent, & Gilbert-Diamond, 2015), driving their popularity in this demographic. Energy drink consumption has been associated with risky

behaviors and unhealthy diets (Arria, Caldeira, Kasperski, O'Grady, Vincent, Griffiths, & Wish, 2010; Miller, 2008; Poulos & Pasch, 2015), and concern has been raised regarding their caffeine content and potential adverse health outcomes (Seifert, Schaechter, Hershorin, & Lipshultz, 2011).

Energy drink popularity extends to use as an alcohol mixer. Determined to be unsafe when mixed with alcohol, products containing caffeine premixed with alcohol were effectively prohibited by the U.S. Food and Drug Administration in 2010. The use of energy drinks as a mixer with alcohol is nonetheless common among college students (Marczinski & Fillmore, 2014). In a study of undergraduate psychology students, 44% reported lifetime use of alcohol mixed with energy drinks (AmED; Marczinski, 2011), and in a more recent probability sample, 75.2% of undergraduate students aged 18 to 25 reported such use (Berger, Fendrich, & Fuhrmann, 2013).

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A diverse yet growing methodological body of research now exists on AmED use and associated risks. A potential mechanism of AmED risk is suggested by findings that caffeine interferes with perception of intoxication but not its objective effects (Ferreira, de Mello, Pompéia, & de Souza-Formigoni, 2006; Marcziński & Fillmore, 2006) and further by its correlation with heavy episodic drinking (Marcziński & Fillmore, 2014; Marcziński, Fillmore, Henges, Ramsey, & Young, 2013; Price, Hilchey, Darredeau, Fulton, & Barrett, 2010). AmED use and more frequent AmED use has been associated with negative consequences such as riding in a car driven by someone who has been drinking, being physically hurt or injured, being taken advantage of sexually or perpetrating such an act (Brache & Stockwell, 2011; O'Brien et al., 2008), having unprotected sex (Berger, Fendrich, & Fuhrmann, 2013) and illicit substance use (Housman & Williams, 2018; Martz, Patrick, & Schulenberg, 2015).

Less understood is the relationship between AmED use expectancies, AmED use and AmED consequences. AmED use often takes place in the context of partying among college students. In one study of college students, the four most highly rated motivations for AmED use among regular users were to feel less tired, get drunk faster, drink more, and AmED is a common drink (Marcziński, 2011). In the alcohol field, positive and negative expectancies—the expected outcome of drinking—play a notable role in motivation for alcohol use as well as risk for alcohol-related problems (Howland, Rohsenow, Vehige Calise, MacKillop, & Metrik, 2011; Lee, Atkins, Cronce, Walter, & Leigh, 2015; Oei & Baldwin, 1994) and have been associated with drinking patterns among college students (Jones, Corbin, & Fromme, 2001; Young, Connor, Ricciardelli, & Saunders, 2007).

As few studies to date (e.g. Heinz, de Wit, Lilje, & Kassel, 2013) have examined relationships between AmED expectancies, AmED use and related negative consequences, the purpose of this study was threefold: (1) to examine the relationships between AmED use vis-à-vis heavy alcohol use and related negative consequences; (2) to explore the relationships between AmED expectancies and AmED-related negative consequences; and (3) to explore relationships among AmED expectancies, AmED use and AmED-related negative consequences.

## 2. Material and methods

### 2.1. Sample and procedure

This study employed a cross-sectional, non-probability survey design. The study location was a large, public, urban university in the Midwestern United States, and participants were recruited from a dining area in the student union. During the 2015 spring semester, study procedures were first piloted with five participants. Specifically, every third person entering the area was approached by a study team member who used a recruitment script and handed out a study flyer. Individuals interested in participation then either completed the survey at that time, or if during peak dining hours, they proceeded to a second study team member for survey completion. Participants answered survey questions on a tablet computer with a privacy screen, and instructions at the beginning of the survey indicated that participants must be at least 18 years old and consent voluntarily to participate.

During the spring and fall 2015 semesters, data collection proper began once additional study funding was secured. Participants took 10 minutes on average to complete the survey and were compensated \$5.00 for their time and effort. Data were collected anonymously, and all study procedures were approved by the university Institutional Review Board. Because no procedures changed based on the study procedures pilot, the pilot data also were included in study analyses. In total, 80 participants were recruited into the study.

Participants were 55.1% male, 70.5% non-Hispanic white, and most were between the ages of 18–25 (89.7%); the rest were between the ages of 26–35). Finally, the majority of participants were in a relationship (57.7%), including a few participants who were engaged or married.

**Table 1**  
Associations Between Heavy Drinking, Alcohol Mixed With Energy Drinks (AmED) Use and Related Negative Consequences.

Consequence	Heavy Drinking		AmED Use	
	$\chi^2$	$\phi_c$	$\chi^2$	$\phi_c$
Driving under influence	4.46*	0.26	14.27***	0.46
Hurt or injured	1.34	0.15	3.42	0.22
Unprotected sex	3.95*	0.25	14.88***	0.46
Unwanted sexual contact	3.58	0.24	8.50**	0.35
Missing school/work	7.70**	0.35	12.76***	0.43
Verbal argument	3.07	0.22	21.21***	0.54
Physical fight	1.10	0.13	2.24	0.18

\*p < .05.

\*\*p < .01.

\*\*\*p < .001.

### 2.2. Measures

#### 2.2.1. Alcohol, energy drink, and AmED use

The Alcohol Use Disorders Identification Test—Consumption (AUDIT-C; Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993) was used to assess participant alcohol use in the past 12 months. The three-item AUDIT-C asks how often one has a drink, how many drinks in standard drink units are consumed on a typical day when drinking, and how often per week one engages in heavy drinking, defined as 5 standard drinks or more for men and 4 drinks or more for women (National Institute on Alcohol Abuse and Alcoholism, 2005). Participants also were asked whether or not they had an energy drink (Red Bull, Monster, etc.) or an AmED (e.g., vodka mixed with Red Bull) in the past 12 months.

#### 2.2.2. Alcohol-related and AmED-related negative consequences

Participants were asked how often (0 times or never, 1 time, or 2 or more times) they experienced seven different negative consequences (e.g., driven a car while under the influence of alcohol; see Table 1. for a complete list) as a result of drinking in the past 12 months. Participants also were asked how often they experienced these same negative consequences as a result of AmED use in the past 12 months. Negative consequences items were derived from the Core Alcohol and Drug Survey for College Students (Presley, Meilman, & Lyerla, 1994).

#### 2.2.3. AmED expectancies

Participants reported whether they agreed or disagreed with 11 AmED expectancies generated from an empirical review of the literature (e.g., it helps alcohol to taste better; see Table 2. for a complete list).

### 2.3. Data reduction and statistical analysis

Data were analyzed via descriptive statistics and chi-square tests (or, where the assumptions of chi-square were violated, Fisher's exact tests) were used to examine/explore associations, the strength of which was measured using Cramér's V ( $\phi_c$ ). Cramér's V is a measure of the strength of association between two nominal variables; it is bounded between 0, or no association, and 1, or perfect association (Sheskin, 2000). The item responses of the alcohol-related and AmED-related negative consequences were first collapsed prior to analyses due to low endorsement of 2 or more times such that 0 = 0 times or never and 1 = 1 or 2 or more times. In addition, only AmED-related negative consequences significantly associated with AmED use were tested for associations with AmED expectancies. To explore the potential relationships between AmED expectancies, AmED use and AmED-related negative consequences, a simple mediation model was fit within the counterfactual framework to accommodate the binary mediator of AmED use (Yung, Lamm, & Zhang, 2018). In order to run the model, the

**Table 2**  
Associations Between AmED Expectancies and Alcohol Mixed With Energy Drinks (AmED)-Related Negative Consequences.

Expectancy	Driving Under Influence		Unprotected Sex		Unwanted Sexual Contact		Missing School/Work		Verbal Argument	
	$\chi^2$	$\varphi_c$	$\chi^2$	$\varphi_c$	$\chi^2$	$\varphi_c$	$\chi^2$	$\varphi_c$	$\chi^2$	$\varphi_c$
Helps me drink more	1.03	0.12	4.27	0.25	1.62	0.15	1.77	0.16	2.60	0.20
Have more energy	1.00	0.12	0.73	0.10	6.10*	0.30	11.05**	0.40	10.78**	0.40
Be more alert	1.13	0.13	6.04*	0.30	6.82*	0.31	9.56**	0.37	10.65**	0.39
Improve taste	0.06	0.03	2.29	0.18	2.59	0.19	0.79	0.11	2.91	0.20
Feel less drunk	0.01	0.01	4.11	0.24	0.00	0.01	2.77	0.20	1.32	0.14
Get drunk faster	3.01	0.21	2.51	0.19	2.75	0.20	3.12	0.21	5.16**	0.28
Better buzz	0.12	0.04	4.11	0.25	1.33	0.14	0.16	0.05	0.02	0.02
More social	1.54	0.15	2.81	0.20	2.89	0.21	0.63	0.10	0.06	0.03
Not use illegal drugs	2.28	0.18	7.13*	0.33	18.22**	0.52	4.80	0.27	0.81	0.11
Perform sexually	0.35	0.07	2.13	0.18	10.23*	0.40	0.78	0.11	0.05	0.03
Better time	1.03	0.12	2.31	0.18	3.64	0.23	2.35	0.19	2.31	0.18

\*p < .05.

\*\*p < .01.

AmED-related negative consequences items were summed to create a total consequences variable ( $M = 1.01, SD = 1.37$ ). Similarly, the AmED expectancies items were summed to create a total expectancies variable ( $M = 2.85, SD = 2.67$ ). Finally, 80% of study participants had complete survey data; only complete cases were utilized in the analysis. All analyses were conducted using SAS 9.4 (SAS Institute Inc, 2017).

### 3. Results

#### 3.1. Scope of alcohol, energy drink, and AmED use

In the past 12 months, most participants reported drinking alcohol (91.2%). The most commonly endorsed frequency of drinking was 2–3 times a week (35%), and on a typical day when drinking, the most commonly endorsed quantity was 1 or 2 drinks (49.3%). In the past 12 months, most participants had engaged in heavy drinking (74.3%). Also, in the past 12 months, most participants had consumed an energy drink (72.7%), but not quite half had consumed AmED (47.4%).

#### 3.2. Alcohol-related and AmED-related negative consequences

Table 1. details the associations between heavy drinking, AmED use and related negative consequences. AmED use was uniquely associated with unwanted sexual contact and getting into verbal arguments. Where heavy drinking and AmED use share a negative consequence (driving under the influence, unprotected sex and missing school or work), AmED use has, in all cases, the greater strength of association:  $\varphi_c = 0.46$  vs.  $\varphi_c = 0.26$  for driving under the influence,  $\varphi_c = 0.46$  vs.  $\varphi_c = 0.25$  for unprotected sex, and  $\varphi_c = 0.43$  vs.  $\varphi_c = 0.35$  for missing school or work.

#### 3.3. AmED expectancies

Participant agreement with the AmED expectancies were as follows: to improve the taste of alcohol (59.5%); to have more energy while drinking (43.1%); to have a better time while drinking (38.2%); to be more social (31.9%); to improve alertness (29.2%); to have a better “buzz” (25.0%); to be able to drink more alcohol (22.5%); to get drunk faster (21.4%); to feel less drunk (12.9%); to not use illegal drugs (10.0%); and to help perform sexually while drinking (5.9%).

#### 3.4. AmED expectancies and AmED-related negative consequences

Table 2 details the associations between AmED expectancies and AmED-related negative consequences statistically associated with AmED use (see Table 1). No AmED expectancy was associated with driving under the influence of alcohol. Being more alert and not using

illegal drugs while drinking were associated with engaging in unprotected sex. Having more energy, being more alert, not using illegal drugs, and helping to perform sexually while drinking were associated with unwanted sexual contact. Having more energy and being more alert while drinking were associated with missing school or work. Having more energy, being more alert, and getting drunk faster while drinking were associated with getting into a verbal argument.

#### 3.5. Simple mediation model

To further explore the relationships between AmED expectancies and AmED-related negative consequences, a simple mediation model was specified whereby AmED use was the mediator (see Fig. 1.). The overall model was statistically significant ( $b = 0.27, p < .001$ ; 95% CI 0.13, 0.40). The direct effect between AmED expectancies and AmED-related negative consequences was not statistically significant ( $b = 0.11, p = 0.11$ ; 95% CI  $-0.03, 0.25$ ), but the indirect effect was significant ( $b = 0.18, p = .003$ ; 95% CI 0.06, 0.30). Decomposing the mediational pathway, total AmED expectancies was significantly related to AmED use ( $OR = 1.57, p < .001$ ; 95% CI 1.03, 2.17), and AmED use was significantly related with total AmED-related negative consequences ( $b = 1.60, p < .001$ ; 95% CI 1.22, 2.04). These results suggest a possible pathway from total AmED expectancies to total AmED-related negative consequences through AmED use.

### 4. Discussion

Several study results were consistent with prior research. Almost half of respondents (47.4%) reported AmED use in the past 12 months, supporting previous findings that AmED use is common among college-aged samples (e.g., Berger, Fendrich, & Fuhrmann, 2013). Results also replicate previous findings that link AmED use with related negative consequences (e.g., Berger, Fendrich, & Fuhrmann, 2013; Brache & Stockwell, 2011; O’Brien et al., 2008). AmED use was associated with more related negative consequences than heavy drinking, and where

Simple Mediation Model of Alcohol Mixed With Energy Drink (AmED) Use

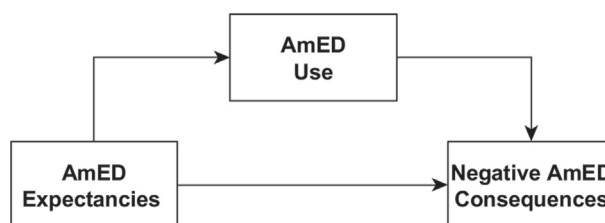


Fig. 1. Simple Mediation Model of Alcohol Mixed With Energy Drink (AmED) Use.

heavy drinking and AmED use shared a negative consequence, AmED use had the greater strength of association. Given the scope and strength of the related negative consequences and ties to previous research, AmED use may be an important screening criterion to identify at-risk college-aged individuals.

Agreement with several AmED expectancies such as to be able to drink more alcohol, to get drunk faster and to be more social while drinking also was consistent with previous research (Marczinski, 2011). In addition, several AmED expectancies were significantly associated with AmED-related negative consequences, and in most cases, these AmED expectancies were associated with more than one negative consequence. The associations of several AmED expectancies with a mixture of AmED-related negative consequences may suggest a range of experienced negative consequences related to AmED use.

Interestingly, and perhaps not surprisingly, the selling points of energy drinks, like being more alert and having more energy (Reissig, Strain, & Griffiths, 2009), were the AmED expectancies most frequently associated with AmED-related negative consequences. The AmED expectancies of not using illegal drugs, helping to perform sexually while drinking, and, to a lesser extent, getting drunk faster were also associated with negative consequences. These expectancies too seem consistent with a potential desire for being more alert and having more energy. Further, experiencing unwanted sexual contact was associated with the most AmED expectancies—four, in total—including helping to perform sexually while drinking, an expectancy also identified in the alcohol literature (Palmer, McMahon, Rounsaville, & Ball, 2010). The relationship between alcohol use and sexual assault among college students is well documented (Abbey, 2002); however, whether or not AmED use increases the risk of sexual assault beyond alcohol use only is unknown. In previous research, our group found that AmED use may increase risk beyond hazardous drinking for unprotected sex, but not unwanted sexual contact (Berger, Fendrich, & Fuhrmann, 2013). Getting into a verbal argument, another example of interpersonal conflict/aggression, was associated with the next most AmED expectancies—three, in total. Finally, the simple mediation model may suggest that AmED expectancies are associated with increased odds of AmED use, and AmED use with more negative consequences. Modifying AmED expectancies may be a target for intervention given the association with AmED use, and indirectly, AmED-related negative consequences, especially those of an interpersonal nature.

This study has limitations. The sample was not random and was drawn from one location: findings therefore may not generalize. Yet, the study findings were largely consistent with prior literature. Also, a validated measure of AmED expectancies was not used (e.g. Miller, Dermen, & Lucke, 2017): none were available at the time of data collection. This limitation was offset by drawing upon existing literature to inform the AmED expectancies items (e.g., Marczinski, 2011). An additional limitation is that causal relationships cannot be inferred as study data were drawn from a cross-sectional survey. Future research may include replication of study findings—potentially including longitudinal designs to more strongly test relationships—and the modeling of AmED use feeding back on AmED expectancies.

## 5. Conclusion

AmED use is prevalent among college-aged individuals, and screening for AmED use may identify individuals at-risk for related negative consequences. In addition, AmED expectancies may be a target for intervention in terms of reducing AmED use and subsequent related negative consequences, especially those of an interpersonal nature.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to

influence the work reported in this paper.

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