Published in final edited form as:

Alcohol Clin Exp Res. 2017 June ; 41(6): 1228–1238. doi:10.1111/acer.13402.

Intoxication-Related AmED (Alcohol Mixed with Energy Drink) Expectancies Scale: Initial Development and Validation

Kathleen E. Miller, PhD, Kurt H. Dermen, PhD, and Joseph F. Lucke, PhD

Research Institute on Addictions, University at Buffalo, The State University of New York

Abstract

BACKGROUND—Young adult use of alcohol mixed with energy drinks (AmEDs) has been linked with elevated risks for a constellation of problem behaviors. These risks may be conditioned by expectancies regarding the effects of caffeine in conjunction with alcohol consumption. The aim of this study was to describe the construction and psychometric evaluation of the Intoxication-Related AmED Expectancies Scale (AmED_EXPI), 15 self-report items measuring beliefs about how the experience of AmED intoxication differs from the experience of noncaffeinated alcohol (NCA) intoxication.

METHODS—Scale development and testing were conducted using data from a U.S. national sample of 3,105 adolescents and emerging adults aged 13–25. Exploratory and confirmatory factor analyses were conducted to evaluate the factor structure and establish factor invariance across gender, age, and prior experience with AmED use. Cross-sectional and longitudinal analyses examining correlates of AmED use were used to assess construct and predictive validity.

RESULTS—In confirmatory factor analyses, fit indices for the hypothesized four-factor structure (i.e., Intoxication Management [IM], Alertness [AL], Sociability [SO], and Jitters [JT]) revealed a moderately good fit to the data. Together, these factors accounted for 75.3% of total variance. The factor structure was stable across male/female, teen/young adult, and AmED experience/no experience subgroups. The resultant unit-weighted subscales showed strong internal consistency and satisfactory convergent validity. Baseline scores on the IM, SO, and JT subscales predicted changes in AmED use over a subsequent three-month period.

CONCLUSIONS—The AmED_EXPI appears to be a reliable and valid tool for measuring expectancies about the effects of caffeine during alcohol intoxication.

Keywords

alcohol; caffeinated energy drink; expectancies; scale development; psychometric validation

Please direct communication to Dr. Kathleen Miller, Research Institute on Addictions, University at Buffalo, 1021 Main Street, Buffalo, NY 14203. Phone: (716) 887-2588. Fax: (716) 887-2215. kmiller@ria.buffalo.edu.

Conflict of Interest

The authors declare no competing financial interests.

Introduction

Alcohol misuse by young adults is a pervasive and long-standing public health issue (Johnston et al., 2015). Over the past decade, this problem has been compounded by the now popular practice of mixing alcohol with caffeinated energy drinks (AmEDs). AmED use has consistently been linked with heavy or hazardous drinking (Patrick & Maggs, 2014; Snipes et al., 2015). Compared to peers who consume noncaffeinated alcohol (NCA) only, young adults who consume AmEDs are more likely to engage in a range of risky or health-compromising behaviors including sexual risk-taking (Miller, 2012; Snipes & Benotsch, 2013), interpersonal aggression (Miller et al., 2016), and vehicular risk-taking (Arria et al., 2016; Martz et al., 2015; Woolsey et al., 2015), which may lead to subsequent adverse outcomes such as pregnancy, injury, or accidents. The drinking patterns that drive these risks may be conditioned by expectancies regarding the effects of caffeine in conjunction with alcohol consumption. Below, we introduce and provide psychometric validation for a new scale designed to measure beliefs about how the experience of AmED intoxication differs from the experience of noncaffeinated alcohol (NCA) intoxication.

Possible explanations for the links between AmED use and risk-taking

It is likely that several factors bear on the relationship between AmED use and health-risk behaviors. Research has established clear links between AmED use and individual-level characteristics that contribute to risk, including disposition (e.g., sensation-seeking personality; O'Brien et al. 2013) and attitudes (e.g., endorsement of conventionally masculine norms, including risk tolerance; Miller, 2008). In addition to these individual selection effects, environmental contexts may play an additional role, with AmED use occurring primarily in gregarious social settings (e.g., bars or private parties) that promote both heavy drinking and risk-taking (Droste et al., 2016; Miller et al., 2015).

The pharmacological properties of AmEDs may also play an indirect causal role in promoting risky behavior at the event level. Because caffeine is a stimulant, it counteracts the somnogenic properties of alcohol while simultaneously priming or reinforcing alcohol cravings (Marczinski et al., 2016; McKetin & Coen, 2014). Together, these interactive pharmacological effects facilitate overdrinking. Increased alcohol consumption may in turn contribute to a state of "alcohol myopia" in which the drinker focuses only on the most salient cues in the environment at the expense of less salient abstract cues (Steele & Josephs, 1990). Since instigatory cues (e.g., provocation) are often more immediate than inhibitory cues (e.g., possibility of injury or arrest), alcohol myopia tends to promote risk-taking (Giancola et al., 2010). Thus, the quantity of alcohol consumed may mediate the relationship between drink type (AmED vs. NCA) and risk behavior.

When drinkers anticipate that some potential consequences of drinking will be undesirable, they may engage in conscious vigilance and deliberate compensatory strategies to avert those outcomes. Placebo studies have shown that drinkers who are led to expect significant impairment employ adaptive responses to improve their psychomotor performance (Fillmore & Vogel-Sprott, 1996) and, to a lesser extent, inhibitory control (Marczinski & Fillmore, 2005). Premeditated use of protective behavioral strategies in advance of a drinking session, such as arranging a designated driver or planning ahead to avoid drinking games or leave the

bar at a designated time, can also reduce alcohol intake and/or reduce associated harms (Borden et al., 2011).

However, the addition of caffeine potentially undermines the relationship between alcohol use and deliberate strategies to avoid adverse drinking outcomes. Although caffeine does not in fact counteract alcohol-driven pharmacological impairments to judgment or coordination, its capacity to mask some of the common symptoms of intoxication has given rise to a pervasive misconception that it antagonizes alcohol and can be strategically used to reduce or manage intoxication levels (Jones et al., 2012; O'Brien et al., 2008). To the extent that the drinker endorses this belief, AmED use may be perceived as an alternative to other risk-reduction strategies. Because compensatory responses are likely to be engaged only when there are clear expectations of alcohol-related impairment (Fillmore et al., 2002; Fillmore & Vogel-Sprott, 1996), drinkers who expect caffeine to have an antagonist effect actually display greater impairment than those who do not – a pattern that Fillmore and colleagues (2002) have described as the “ironic effects of expectancy.”

Assessing AmED expectancies

Given caffeine's undeserved reputation as a sober-up-quick folk remedy, expectancies regarding its effects on the experience of intoxication invite investigation on two counts: first, as a possible driver of AmED use; and second, as a possible moderator of the relationship between AmED use and compensatory vigilance, with subsequent implications for alcohol-related risk-taking. Drawing on existing measures of alcohol expectancies (Fromme et al., 1993; George et al., 1995) and caffeine expectancies (Huntley & Juliano's 2012 CaffEQ; Heinz et al.'s 2009 CEQ), a few studies have attempted to assess their unique and separate contributions to explaining variance in AmED use outcomes. Lau-Barraco and colleagues found that endorsements of both substance-specific types of beliefs had predictive utility, with alcohol expectancies generally accounting for more of the variance in caffeinated alcoholic beverage use than caffeine expectancies (Lau-Barraco & Linden, 2014; Lau-Barraco et al., 2014).

However, little is yet known about AmED expectancies, i.e., beliefs regarding the effects of caffeine specifically in conjunction with alcohol use. Measuring such expectancies adds a level of complexity that offers a unique challenge both in survey design and in interpretation, since subjects are effectively asked to recall (and then directly compare) two sets of expectancies – those for alcohol alone, and those for alcohol combined with caffeine. A few researchers have identified commonly held and sometimes conflicting AmED expectancies, such as the perception that AmED allows drinkers to party longer, get drunk more quickly, drink more without feeling as drunk, or feel more energized when drinking (Mallett et al., 2014; Marczinski, 2011; Varvil-Weld et al., 2013). Although there is to date no comprehensive instrument assessing AmED expectancies across all of these domains, MacKillop and colleagues (2012) have introduced the nine-item Caffeine + Alcohol Combined Effects Questionnaire (CACEQ), the first validated measure to examine caffeinated alcoholic beverage expectancies systematically. The CACEQ consists of two expectancy factors: Intoxication Enhancement (IE; 3 items; e.g., “get high or ‘buzzed’ quicker”) and Avoidance of Negative Consequences (ANC; 6 items; e.g., “drive safer”).

MacKillop et al. (2012) found that the frequency of AmED use was significantly correlated with IE expectancies. In further tests of the CACEQ on a college drinking sample, Linden-Carmichael and colleagues (2015) found that ANC expectancies were associated with less use of protective behavioral strategies for safe drinking.

Despite evidence for its utility in assessing overall enhancement and harm-avoidance AmED expectancies, the CACEQ's conceptual heterogeneity and the limited number of items in the two subscales necessarily restrict in-depth examination of more nuanced expectancy domains, such as the common perception of caffeine as an alcohol antagonist. We therefore sought to develop and validate a scale that would more precisely deconstruct the nature of individuals' expectancies regarding the impact of caffeinated energy drink mixers on the intoxication experience.

The present study extends previous work in three ways. First, we have focused more narrowly on beliefs regarding the direct effect of AmED use on the drinking experience itself, in order to develop an explicit measure of intoxication-related AmED expectancies. Second, within this domain, we examined four dimensions of the AmED drinking experience, including Intoxication Management, Alertness, Sociability, and Jitters. Third, whereas samples in prior studies have largely been limited to college student drinkers alone, our sample included adolescents and noncollege young adults in addition to college students.

Materials and Methods

Participants and Procedure

This study is a subset of the larger six-wave Caffeinated Energy Drinks and Alcohol (CEDA) Study (NIAAA grant #AA021395 to Kathleen E. Miller). In addition to providing the first detailed, nationally representative descriptive portrait of energy drink and AmED use in adolescents and emerging adults, the CEDA Study seeks to examine event-level and prospective relationships among AmED use, AmED expectancies, and (among young adult participants) sexual risk-taking. The original sample consisted of 3,145 cases, including 2,113 young adults aged 18 to 25 and 1,032 adolescents aged 13 to 17. The study protocol was approved by the University at Buffalo's Institutional Review Board for the protection of human subjects.

Sampling and recruitment—Participants were members of KnowledgePanel, a probability-based online non-volunteer access panel maintained by the commercial sampling firm GfK (formerly Knowledge Networks). While data collection for the CEDA Study was conducted online, recruitment to the panel was not. Members of this nationally representative panel are recruited through address-based probability sampling of all U.S. households with a postal address (approximately 97%). Randomly sampled addresses are invited to join the panel through a series of mailings (in English and Spanish) and by telephone follow-ups to nonresponders. Upon recruitment, sampled households without web access are provided with a netbook computer and free Internet service and technical support to enable them to participate in online survey data collection. Demographic profile information is collected for all new panel members, after which the member becomes eligible for selection for specific surveys. Continuous recruitment of new members to

compensate for attrition results in a demographically diverse ongoing panel of approximately 50,000–60,000 members, including both landline and cell-phone-only households. The CEDA sample was drawn from among active KnowledgePanel members who met our age criteria, using a probability proportional to size (PPS) weighted sampling approach (Dennis, 2012). An implicitly stratified sample of young adults aged 18–25 received an e-mail invitation via KnowledgePanel administrators to participate in the CEDA Study. For participants in the minor adolescent (aged 13–17) sample, a parent or guardian in the household was contacted first to secure permission to recruit the teen, and participants provided assent rather than consent.

Procedure—Young adult panelists who accepted the invitation to participate were directed to a secure survey website, where they read a description of the study, electronically provided informed consent, and then completed a 25-minute on-line questionnaire detailing their drinking habits (alcohol, non-alcohol energy drinks, AmEDs, and other caffeine), expectancies regarding how the effects of alcohol differ in the presence or absence of caffeine, sexual history, and detailed event reports of recent sexual experiences accompanied by the use of AmEDs and/or NCA drinks. A shorter survey (approximately 10–15 minutes) was administered to participants in the minor adolescent (aged 13–17) sample, omitting sensitive questions about sexual history and experiences. Upon survey completion, all participants were redirected to the KnowledgePanel site to receive a monetary credit worth ten dollars (\$10.00 USD). Participants in the young adult sample were resurveyed at three month intervals for a total of six waves of data collection. Only the first two waves were included in the present analyses.

Response rates—Data collection for Wave 1 of the CEDA Study occurred during May and June of 2014. Separate samples were drawn for young adults and for minor adolescents. Out of 3,783 young adults invited to participate, 2,113 consented and completed the survey, for an overall adult response rate of 55.9%. For the teen portion of the study, 2,786 households were contacted; 1,331 responded and screened as eligible (i.e., parent confirmed the presence of a child aged 13–17 in the household). Of these, 1,130 parents gave permission for their children to be recruited and 1,032 adolescents subsequently assented. Collectively, 77.5% of responding households with eligible teens completed the survey. In the present analysis, our sample was restricted to the 3,105 participants who provided responses to questions about their AmED expectancies.

Teen participants were surveyed only once, at Wave 1. Of those young adult participants who participated in the first wave of the study, 2,037 were recontacted three months later for a second wave of data collection. The remaining 76 were excluded because they were either permanently withdrawn or temporarily inactive on the panel during the fielding period and had requested not to be contacted. Of those invited, 1,660 young adults consented and completed the Wave 2 survey, for a response rate of 81.5%.

Intoxication-Related AmED Expectancies Scale (AmED_EXPI)

Three categories of review informed our early development of scale items: (1) the existing separate literatures on caffeine expectancies (e.g., Heinz et al., 2009) and alcohol

expectancies (e.g., Fromme et al., 1992), (2) past and then-current advertising claims for commercially available ready-to-drink AmEDs (Simon & Mosher, 2007), and (3) emergent reports of AmED-related risks and effects reported in previous studies (Miller, 2008; O'Brien et al., 2008). Informed by these general concepts (e.g., common perceptions of caffeine as a sober-up-quick folk remedy), a member of our research team then conducted preliminary focus groups with young adult AmED users aged 18–25 to generate a list of intoxication-related AmED expectancy items. Focus group members were asked about the perceived effects of AmEDs compared to those of NCA drinks. Our AmED_EXPI items were culled from the focus group discussions, with additional review of the then-existing literature to ensure that no key concepts had been omitted. In particular, our final item roster was informed by Marczynski's 2011 four-item scale of motivations for using AmEDs ("AmEDs help me hold my liquor better," "I can drink more if I drink AmEDs," "I don't feel as tired when I drink AmEDs," and – conversely – "AmEDs allow me to get drunk faster"), all of which coincided closely with beliefs expressed by members of our focus groups. The items derived from this iterative process were viewed a priori as representing four themes: *Intoxication management* (IM), *alertness/counteracting sedation* (AL), *sociability/social enhancement* (SO), and *jitters/arousal* (JT).

In the present study, participants were presented with a series of 16 statements, using the following instructional set: "The following questions are about your beliefs and experiences with AmEDs. (Even if you don't drink AmEDs, we would like to know how you think it would affect you if you did.) Some people believe that caffeine can influence how they react to alcohol. How much do you agree or disagree with the following statements?" Participants were then prompted to assess each item, using the stem question, "Compared to drinking an equal amount of noncaffeinated alcohol, drinking AmEDs (caffeinated energy drinks mixed with alcohol) is likely to have the following effect on me..." Items were rated on a scale from 1–6 (*strongly disagree* to *strongly agree*).

Alcohol and AmED Consumption

We assessed participants' use of alcohol (any kind, including but not limited to AmEDs) in the past three months and, separately, their use of AmEDs in the past three months. Participants were provided with standard definitions and examples, including visual guidelines as reminders, of what counts as alcohol (beer/malt beverages, wine, and hard liquor), and standard drink sizes for each (i.e., 1 drink = 12 ounces of beer, 5 ounces of wine, 1 ½ ounce shot of hard liquor), as well as general rules of thumb for common drink portions (e.g., a 40-ounce container of malt liquor = 5 drinks). AmEDs were defined as "mixed drinks that combine a caffeinated energy drink or energy shot with alcohol," such as Red Bull vodka or Jagerbombs. Because some people remain unaware that pre-mixed energy drink malt beverages such as Four Loko have been decaffeinated since 2011 at the behest of the U.S. Food and Drug Administration, participants were explicitly asked not to include "canned drinks like Four Loko, Joose, Max, Sparks, Tilt, and Liquid Core" in their estimates of AmED use. As a reminder of these distinctions, participants were also provided with visual guidelines ("What Counts/What Doesn't Count") at the beginning of the questionnaire section on AmED use. A standard drink size for AmEDs was defined as 8 ounces of mixed drink.

To measure frequency of recent alcohol use and AmED use, participants were asked how often in the past three months they had consumed each type of drink. Categorical response options (e.g., 1–2 days/week) were then converted to numerical ranges, using 13 weeks as a standard for the three-month period (e.g., 1–2 days/week = 13–26 days in the past three months), and recoded to categorical midpoint in order to approximate the total number of use days (0=never; 1=once a month or less; 7.5=2–3 times a month; 19.5=1–2 days/week; 45.5=3–4 days/week; 71.5=5–6 days/week; 90=every day). To measure typical quantities of alcohol and AmED use, participants also reported how many drinks of each type (alcohol of any kind, and AmEDs specifically) they usually consumed on a typical drinking day (range 0 to 12+).

Baseline frequency and quantity measures of both alcohol and AmED use were re-administered three months later to young adults only in a Wave 2 follow up. From these additional data we calculated measures of AmED initiation (i.e., Wave 1 nonusers who began using by Wave 2) and AmED continuation (i.e., Wave 1 users who continued to use at Wave 2).

Demographic Characteristics

Demographic data reported by each participant included age, gender, race (white, black, other race, or 2+ races), ethnicity (Hispanic or nonHispanic), and school or college enrollment status.

Data Analyses

Sample—The entire sample comprised 3,145 participants. Of these, 3,064 participants provided complete AmED_EXPI data, i.e., responses for all AmED expectancy items. Forty-one (41) participants provided incomplete AmED_EXPI data, i.e., responses for at least one item but not all. The remaining 40 participants completed no AmED_EXPI items and their data were not included. Most analyses were conducted for the 3,105 participants who provided a valid response for at least one item. For these incomplete data, missing responses were assumed to be missing at random (Allison, 2002).

Preliminary analyses—Basic sample descriptive statistics were computed. Boxplots and density plots were used to examine the sample densities for each item for distributional anomalies. Correlograms (Wei & Simko, 2016) were employed to examine the sample correlations among the 16 AmED_EXPI items.

Exploratory factor analyses (EFA)—In order to develop an initial factor structure for subsequent confirmation, we conducted a full information maximum likelihood (FIML) factor analysis with geomin rotation for oblique factors on the 3,105 cases with full or incomplete data (Muthén & Muthén). Model choice was determined by both empirical and theoretical criteria. Factor analysis models ranging from one to six factors were estimated and compared to one another by the Akaike information criterion (AIC), a goodness-of-fit measure with a penalty for overfitting. The best fitting model was then tested by the root mean square error of approximation (RMSEA) against the hypothesis of close fit ($0 < \text{RMSEA} \leq .05$) (MacCallum et al., 1996).

Confirmatory factor analyses (CFA)—Upon choosing the number of factors, a FIML confirmatory factor analysis estimated the parameters of a linear item response (congeneric) model postulating a perfect cluster configuration among the factors identified through exploratory analyses (Browne, 2001).

Measurement invariance—In order to be useful, the properties of psychometric scales should remain unchanged or invariant across major demographic categories. There are three levels of invariance over subgroups: *metric*, in which only the factor loadings remain the same; *scalar*, in which the factor loadings and intercepts remain the same; and *strict*, in which the factor loading, factor intercepts, and residual variances remain the same (Millsap, 2011). Metric invariance is a minimum requirement for a scale to be useful; scalar and strict invariance provide additional assurance the scale properties are not affected by the subgroup being measured. In order to establish whether the postulated four-factor measurement structure remains the same across various subgroups, measurement invariance was separately tested across genders (male vs. female), age groups (teens aged 13–17 vs. young adults aged 18–25), and levels of prior experience with AmED (never used vs. ever used).

Internal consistency and reliability analyses—Both sample and model-based estimates of Cronbach's α were calculated to assess the internal consistency of the instrument as a whole and for each factor separately. Similarly, the model-based reliability ω (McDonald, 1999) was also estimated.

Tests of validity—Subscale scores were created by unweighted summation of the item responses for each subscale. Concurrent validity was assessed by Pearson product-moment correlations between each of the four subscales and frequency and quantity measures of AmED use, controlling for total alcohol use. Predictive validity was assessed using logistic regression to evaluate the individual and combined ability of the AmED_EXPI subscale scores to predict initiation of AmED use and continuation of AmED use at Wave 2.

Software—The statistical and programming environment R using Rstudio (R Core Team, 2016) was used for preliminary analyses. The statistical package SPSS v. 24.0 (IBM Corp., 2016) was used for descriptive statistics and logistic regression. The statistical program Mplus (Muthén & Muthén, 2012) was used for the FIML exploratory and confirmatory factor analyses. The R package **lavaan** (Rosseel, 2012) was used to compute model-based internal consistency and reliability estimates as well as measurement invariance.

Results

Preliminary Analyses

Descriptive statistics regarding the 3,105 adolescents and young adults whose data were used in the present study are shown in Table 1. The mean age was 20.02 years. A majority of participants were female, and the sample was racially/ethnically diverse. Approximately half of the young adult participants were not enrolled in college. Drinking prevalence in our sample was comparable to national benchmarks established by the most recent National Survey on Drug Use and Health (NSDUH; Center for Behavioral Health Statistics and Quality, 2016). Two in three participants reported any lifetime alcohol use, including 30% of

minor adolescents aged 13–17 (comparable to 28% of teens aged 12–17 in the 2015 NSDUH) and 87% of young adults aged 18–25 (comparable to 82% in the 2015 NSDUH). Slightly more than half of our overall sample reported alcohol use in the past three months, including 16% of minor adolescents and 74% of young adults; while the NSDUH did not collect data on past-three-month drinking, 10% of teens and 58% of young adults in that dataset reported alcohol use in the past thirty days. Approximately one third reported having used AmEDs, and about one in seven had done so in the past three months. Unsurprisingly, AmED use was significantly more prevalent among older participants; nearly half of young adults age 18–25 (47.2%) reported any use, compared to only 5.8% of minor adolescents age 13–17 ($\chi^2 = 525.9$, $p < .001$).

Missing data for the 16 AmED expectancy items ranged from 13 to 24 cases, or 0.42% to 0.77%, over the 16 items. Boxplots and density plots revealed no anomalous data. All points on all items had positive response frequencies. The correlogram revealed that one item (“I would get drunk more quickly”) showed low correlations with all remaining items. This item was therefore targeted for possible removal from the instrument.

Exploratory Factor Analysis

The FIML EFA used all 3,105 participants with at least one AmED_EXPI item response. Non-missing covariance coverage exceeded 99% for all items. Model fitting from one to six factors showed continued improvement in the AIC goodness-of-fit measure until reaching four or five factors, with the six-factor model not converging. The change in AIC from the one-factor to the four-factor model was $AIC = 4609$. The five-factor model showed relatively small improvement in fit over the four-factor model with $AIC = 685$. The four-factor model was then chosen because of its greater interpretability. These factors conformed to the four a priori themes identified during the item generation phase of scale development: Intoxication Management (IM: 6 items, e.g., “I would have more control over how drunk I get”), Alertness (AL: 4 items, e.g., “I would stay alert longer”), Sociability (SO: 3 items, e.g., “I would be more fun to be around”), and Jitters (JT: 2 items, e.g., “I would be irritable”). A third item that loaded on the Jitters factor (“I would get drunk more quickly”) was subsequently eliminated from the instrument because it bore little conceptual relationship to the other two items, had a factor loading well below the other two, and had a small correlation with respect to any other item. This model showed close fit with $RMSEA = .042$, $Pr(RMSEA \leq .05) = .999$. Supplementary fit indices, such as the comparative fit index ($CFI = .99$), the Tucker-Lewis index ($TLI = .98$), and the standardized root mean square residual ($SRMR = .01$), all indicated adequate fit (Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004).

Confirmatory Factor Analysis

The final model comprised a four-factor model based on the factors identified in the EFA, but additionally, postulating a perfect cluster configuration among the factors (Browne, 2001) such that each item loaded on a single factor. Table 2 presents the factor loadings and factor correlations from the confirmatory analyses. This model showed close fit ($RMSEA = .051$, $Pr(RMSEA \leq .05) = .39$). Supplementary fit indices, such as the comparative fit index

(CFI = .98), the Tucker-Lewis index (TI = .97), and the standardized root mean square residual (SRMR = .02) all indicated adequate fit (Hu & Bentler, 1999; Marsh et al., 2004).

Model Invariance across Gender, Age, and AmED Experience

To determine if the four-factor model was invariant across major demographic categories, we conducted three between-groups analyses of the following subgroups: female vs. male participants; minor adolescents (age 13–17) vs. young adults (age 18–25); and participants with any lifetime experience with AmED use vs. those with no lifetime experience. The last test of invariance assessed whether expectancies based purely on vicarious social learning versus those with an experiential component induced differences in the factor structure. Scalar invariance (equal loadings, equal intercepts) was found between minor adolescents and young adults ($RMSEA=.052$, $Pr(RMSEA \leq .05) = .125$). Strict invariance (equal loadings, equal intercepts, equal residual variances) was found between female and male participants ($RMSEA=.047$, $Pr(RMSEA \leq .05) = .932$) and between AmED-experienced participants and those with no experience ($RMSEA=.050$, $Pr(RMSEA \leq .05) = .449$). In conclusion, the AmED instrument appears sufficiently invariant with respect to age, gender, and experience.

Internal Consistency

The overall AmED_EXPI demonstrated high internal consistency ($\alpha = .93$) and reliability ($\omega = .95$). Internal consistency was excellent for the IM ($\alpha = 0.91$) and AL subscales ($\alpha = 0.90$), good for the SO subscale ($\alpha = 0.88$), and adequate for the JT subscale ($\alpha = 0.76$). As shown in Table 3, scores on the three subscales reflecting expectancies of desirable effects (IM, AL, and SO) were highly intercorrelated (.69 – .73), but were weakly correlated with the single subscale (JT) that reflected expectancies of undesirable effects (.15 – .22).

Concurrent Validity

Concurrent validity was assessed via partial correlations between each subscale and two AmED use measures (see Table 4) using only the subsample of participants who reported any AmED use in the past three months ($n=433$). Correlations with AmED use frequency controlled for the frequency of any alcohol use (AmED + NCA) in the past three months. Correlations with typical number of AmEDs in a drinking session controlled for typical number of drinks of any alcohol (AmED + NCA) in a drinking session. The IM and SO subscales were significantly correlated with both measures of AmED use.

Predictive Validity

The predictive validity of the subscales for AmED use in young adults was assessed by regressing changes or continuity of AmED use between the Wave 1 baseline (when AmED expectancies were measured) and Wave 2 follow-up (three months later) against the AmED_EXPI subscales. A separate logistic regression analysis was conducted for each subscale in isolation; then a final analysis (shown in Table 5) was conducted with all four subscales together, in order to assess their relative predictive capacity. Participants who provided responses about AmED use in both waves ($n=1,638$) fell into one of four conditions: Nonuse (no use at either Wave 1 or Wave 2; $n=1,196$, or 73.0%), Initiation (use

at Wave 2 only; $n=120$, or 7.3%), Continuation (use at both Wave 1 and Wave 2; $n=187$, or 11.4%), or Discontinuation (use at Wave 1 only; $n=135$, or 8.2%). Because the subscale scores were continuous variables, the resulting odds ratio (OR) is interpreted as the change in OR per unit increase in the subscale score, denoted OR (Hosmer & Lemeshow, 2000, pp. 63–64).

Initiation—Among all nonusers of AmED in Wave 1, initiation of AmED use in Wave 2 was positively predicted by IM expectancies (OR=1.31, CI=1.09–1.57, $p<.01$) and SO expectancies (OR=1.21, CI=1.03–1.41, $p<.05$) and negatively predicted by JT expectancies (OR=.81, CI=.70–.94, $p<.01$). When scores for all four subscales were assessed simultaneously, only IM and JT remained significant as predictors.

Continuation—Among all AmED users in Wave 1, continuation of AmED use in Wave 2 was positively predicted by AL expectancies (OR=1.25, CI=1.03–1.52, $p<.05$) and SO expectancies only (OR=1.48, CI=1.22–1.80, $p<.001$). When all four subscales were assessed simultaneously, only SO remained a significant predictor.

Discussion

The present study provides initial evidence for the validity of a newly developed measure of intoxication-related AmED expectancies among adolescents and young adults in a diverse national sample. This measure is comprised of three positive/desirable expectancy subscales (Intoxication Management, Alertness, and Sociability) and one negative/undesirable expectancy subscale (Jitters). Confirmatory factor analyses showed an acceptable model fit, with internal consistency ranging from adequate to excellent on the four subscales.

As expected, scores for the three positive subscales were highly intercorrelated, suggesting a possible halo effect whereby expectations of one desirable consequence of AmED use (e.g., feeling more sociable and outgoing) tend to reinforce expectations of other desirable consequences (e.g., feeling more energetic or more in control of the intoxication experience). Correlations between positive and negative expectancies, while considerably weaker, were also significant, suggesting that this scale may also have broader utility with respect to identifying youth who endorse the belief that AmED has a functional impact on the quality of the intoxication experience, notwithstanding the valence of that impact.

The AmED_EXPI measure showed measurement invariance over three sets of subgroups: females vs. males, minors vs. young adults, and experienced vs. inexperienced users. Thus any observed differences in these groups in new applications of the AmED_EXPI can be attributed to differences in the groups themselves and not in differences in the AmED_EXPI itself.

Concurrent validity was demonstrated via significant correlations between the Intoxication Management and Sociability subscale scores and baseline AmED use, including both frequency of use in the past three months and typical number of drinks in a session, in a subsample of recent AmED users only. Neither Alertness nor Jitters subscale scores were significantly correlated with the extent of recent AmED use. We offer two potentially viable

explanations in need of further exploration and empirical testing. The first possibility is that when added to alcohol, caffeine has an objective impact on sociability and on the capacity for intoxication management that is simply more powerful, and therefore more salient to users, than any corresponding effects on alertness or jitteriness. If this is the case, then users are merely reporting expectancies learned from past AmED consumption experiences. The second possibility is that users holding stronger expectancies for intoxication management and sociability engage in more frequent and/or heavy AmED use because the posited effects are more greatly valued or desired than other possible effects. That is, users may strategically use AmEDs in the expectation of achieving the effects they prefer.

With respect to the predictive validity of the scale, follow-up logistic regressions demonstrated nuanced relationships between AmED expectancies and changes in AmED use over time. The finding that predictors of initiation differ from predictors of continued use suggests that the perceptions of nonusers whose AmED expectancies are based solely on vicarious observation or conventional “wisdom” differ from those of peers whose AmED expectancies are based on personal experience. Among inexperienced youth, increased odds of initiation were associated with the belief that AmED would function as a means of intoxication management and decreased odds of initiation were associated with anticipated side effects of nervousness or irritability. Neither of these expectancies was a significant predictor of continued AmED consumption by experienced users, among whom only the expectation of enhanced sociability proved significant.

Collectively, these findings must be understood in the context of a prevailing cultural mythos about the effects of caffeine in conjunction with alcohol. Long before the advent of AmEDs, the popular mischaracterization of caffeine as an alcohol antagonist contributed to the phenomenon of the “wide awake drunk” (Arria & O’Brien, 2011). Furthermore, advertising slogans for ready-to-drink AmEDs like Four Loko, Joose, Sparks, or Bud Extra aggressively promoted narratives of enhanced energy and sociability, such as “You Can Sleep When You’re 30” or “Fun Doesn’t Punch the Clock” (Simon & Mosher, 2007). Although sales of these prepackaged AmEDs are now in abeyance due to safety concerns (U.S. Food and Drug Administration, 2010), caffeinated cocktails (e.g., Red Bull vodka or Jagerbombs) mixed on location at bars and party venues remain highly popular. It is likely that lingering marketing themes associated with premixed AmEDs continue to resonate for prospective consumers of AmED mixed drinks.

To date, no research has examined how effective these collective messages are in establishing a body of presumptive expectancies upon which prospective users base their decisions to initiate AmED consumption, or whether they survive in the aftermath. In the present analyses, we assessed AmED expectancies at a single point in time only. Thus, we did not test whether anticipatory beliefs about AmED effects get reformulated in the face of cumulative personal experience. If administered prospectively to the same subjects prior to and after first use of AmEDs, however, the AmED_EXPI scale would offer an opportunity to test how well those expectancies survive actual exposure to the experience of AmED-fueled intoxication.

Moreover, our findings suggest that while intoxication management expectancies motivate initiation, it is instead the expectation of enhanced sociability that predicts continued use. Thus, it would also be illuminating to expand the present configuration of the scale to assess not merely how likely, but also how important or rewarding, the prospective user considers the effects represented by each AmED_EXPI subscale.

Several limitations of the data mandate caution when interpreting these findings. Measures were not available to perform tests of convergent validity with any other AmED expectancy instrument. The AmED_EXPI items were administered to the full sample only at baseline, so it was not possible to assess test-retest reliability. As noted above, prospective studies are needed to assess how or if AmED expectancies change over time, particularly for youth making the transition from nonuser to user status. Because follow-up data were collected for young adults only, our findings with respect to the predictive validity of the scale cannot be generalized to minor adolescents. Furthermore, our participants were asked to compare the expected effects of AmEDs vs. NCA globally, with no specification of dosage; future research is needed to assess whether expectancies diverge for high vs. low levels of intoxication. Some users might expect variation between AmED effects and NCA effects after a certain threshold number of drinks, or only in given circumstances (e.g., on the ascending but not descending limb of the alcohol absorption curve). For optimal comparisons, future tests of the AmED_EXPI should include separate assessments of NCA and AmED and should specify the level and timing of alcohol use. Further research will be needed to test for invariance across racial/ethnic groups and across national boundaries, since AmED use is becoming increasingly common globally (e.g., Cheng et al., 2012; Kristjansson et al., 2015; Peacock et al., 2015).

The AmED_EXPI scale has the potential to advance research that informs the development of intervention programs aimed at either reducing AmED use or ameliorating health-compromising behaviors associated with its use. AmED use has consistently been linked with problem drinking (Patrick & Maggs, 2014; Snipes et al., 2015) and its associated adverse outcomes such as alcohol poisoning (SAMHSA, 2013), sexual risk-taking (Miller, 2012; Snipes & Benotsch, 2013), physical and verbal aggression (Miller et al., 2016), and driving while intoxicated (Arria et al., 2016; Martz et al., 2015; Woolsey et al., 2015). However, no research to date has examined if these relationships are robust across levels of AmED expectancy endorsement. Nor has it previously been established if heavy-drinking AmED users are motivated by the expectation of desired functional effects such as greater control over their intoxication levels, enhanced mood, or increased energy.

The AmED_EXPI scale extends previous work on AmED expectancies, most notably the CACEQ introduced by MacKillop et al. (2012). Where the CACEQ's strength is in distinguishing between overall enhancement and harm-avoidance expectancies, the AmED_EXPI offers a more in-depth and nuanced assessment of intoxication-related expectancies, such as gregariousness or capacity to manage one's own level of impairment. Our multidimensional approach permits a more precise deconstruction of individuals' beliefs regarding the effects of caffeinated energy drink mixers on the drinking experience itself, which in turn allows for hypothesis testing to determine the extent to which any or all of these expectancy domains are predictive of the initiation or continuation of AmED use.

Because the AmED_EXPI scale will also facilitate research into which intoxication-related expectancies are key drivers of AmED consumption, it has the potential to be useful in identifying high-value targets for expectancy challenge interventions. These protocols build on three core premises of expectancy theory, namely, that expectancies predate drinking initiation; that they are causally linked to drinking outcomes; and that they are manipulable via deliberate intervention. After interacting with others in an experimental group setting, participants in an expectancy challenge intervention are tasked with using behavioral cues to identify which members of the group (themselves included) received alcohol and which received a placebo. Since participant assessments typically have low accuracy rates, their errors are then highlighted in order to challenge the expectancies upon which those assessments were based (Darkes & Goldman, 1993). While evidence supportive of the success of expectancy challenges has been somewhat equivocal for women, most studies have found that they both modify alcohol expectancies and reduce subsequent alcohol consumption in young men (Labbe & Maisto, 2011).

The AmED_EXPI scale will facilitate assessment of the utility of an expectancy challenge approach for reducing AmED use in adolescent and young adult populations. Toward that end, it will highlight two additional issues unique to AmED expectancies. First, although AmEDs combine caffeine and alcohol, their interactive effects cannot be reduced to the sum of their individual components. Yet it remains unclear how AmED expectancies map onto alcohol expectancies overall. By testing the specific effects of each subscale, it will be possible to distinguish if users expect caffeine to reinforce existing desired effects of alcohol (e.g., sociability), neutralize undesired alcohol effects (e.g., sedation, hangover, or loss of control), or both. Second, since recreational AmED use is a recent addition to the recreational drinking landscape, AmED-related expectancies are less culturally entrenched than alcohol expectancies in general. As such, they may be more amenable to deliberate manipulation intended to reduce AmED use and/or buffer against adverse consequences of excessive consumption.

The AmED_EXPI scale is the first instrument to provide an explicit, psychometrically valid, multidimensional measure of intoxication-related AmED expectancies, using a diverse national sample that spans generational cohorts (aged 13–25) and college student/nonstudent populations. It is also the first to use prospective data to show a predictive relationship between AmED expectancies and subsequent initiation or continuation of AmED use. As such, it has potential utility for understanding how and if adolescents and young adults who hold positive AmED expectancies attempt to use caffeine as a means of shaping or moderating the alcohol drinking experience. Comprehending how these expectancies incentivize AmED use is a first step in developing strategies to manage youth AmED consumption and related risks for adverse behavioral consequences.

Acknowledgments

The authors extend their sincere thanks to Pamela Novello Smith, Carolyn Chu, and Rebecca Eliseo-Arras for assistance with survey programming, data collection, and project management.

This research was supported by grant R01 AA021395 from the National Institute on Alcohol Abuse and Alcoholism (to Kathleen E. Miller).

References

- Allison, PD. Missing data. Sage Publications; London, UK: 2002.
- Arria AM, Caldeira KM, Bugbee BA, Vincent KB, O'Grade KE. Energy drink use patterns among young adults: Associations with drunk driving. *Alcohol Clin Exp Res*. 2016; 40:2456–2466. [PubMed: 27676240]
- Arria AM, O'Brien MC. The 'high' risk of energy drinks. *JAMA*. 2011; 305(6):600–601. [PubMed: 21266673]
- Borden LA, Martens MP, McBride MA, Sheline KT, Block KK, Dude K. The role of college students' use of protective behavioral strategies in the relation between binge drinking and alcohol-related problems. *Psychol Addict Behav*. 2011; 25:346–351. [PubMed: 21443303]
- Browne MW. An overview of analytic rotation in exploratory factor analysis. *Multivariate Behav Res*. 2001; 36:111–150.
- Center for Behavioral Health Statistics and Quality. 2015 National Survey on Drug Use and Health: Detailed Tables. Substance Abuse and Mental Health Services Administration; Rockville, MD: 2016.
- Cheng W-J, Cheng Y, Huang M-C, Chen C-J. Alcohol dependence, consumption of alcoholic energy drinks and associated work characteristics in the Taiwan working population. *Alcohol Alcohol*. 2012; 47:372–379. [PubMed: 22493045]
- Darkes J, Goldman MS. Expectancy challenge and drinking reduction: Experimental evidence for a mediational process. *J Consult Clin Psychol*. 1993; 61:344–353. [PubMed: 8473588]
- Dennis, MJ. KnowledgePanel design summary. 2012. GfK proprietary document Available at: [http://www.knowledgenetworks.com/ganp/docs/KnowledgePanel\(R\)-Design-Summary.pdf](http://www.knowledgenetworks.com/ganp/docs/KnowledgePanel(R)-Design-Summary.pdf). Accessed January 23, 2017
- Droste N, Miller P, Pennay A, Zinkiewicz L, Lubman DI. Environmental contexts of combined alcohol and energy drink use: Associations with intoxication in licensed venues. *Int J Drug Policy*. 2016; 36:58–66. [PubMed: 27497238]
- Fillmore MT, Roach EL, Rice JT. Does caffeine counteract alcohol-induced impairment? The ironic effects of expectancy. *J Stud Alcohol*. 2002; 63:745–54. [PubMed: 12529075]
- Fillmore MT, Vogel-Sprott M. Evidence that expectancies mediate behavioral impairment under alcohol. *J Stud Alcohol*. 1996; 57:598–603. [PubMed: 8913990]
- Fromme K, Stroot E, Kaplan D. Comprehensive effects of alcohol: Development and psychometric assessment of a new expectancy questionnaire. *Psychol Assess*. 1993; 5:19–26.
- George WH, Frone MR, Cooper ML, Russell M, Skinner JB, Windle M. A revised alcohol expectancy questionnaire: Factor structure confirmation and invariance in a general population sample. *J Stud Alcohol*. 1995; 56:177–185. [PubMed: 7760564]
- Giancola PR, Josephs RA, Parrott DJ, Duke AA. Alcohol myopia revisited: Clarifying aggression and other acts of disinhibition through a distorted lens. *Perspect Psychol Sci*. 2010; 5:265–278. [PubMed: 26162159]
- Heinz AJ, Kassel JD, Smith EV. Caffeine expectancy: Instrument development in the Rasch measurement framework. *Psychol Addict Behav*. 2009; 23:500–511. [PubMed: 19769434]
- Hosmer, DW., Jr, Lemeshow, S. Applied logistic regression. New York: John Wiley & Sons; 2000.
- Hoyle RH, Stephenson MT, Palmgreen P, Lorch EP, Donohew RL. Reliability and validity of a brief measure of sensation seeking. *Pers Individ Dif*. 2002; 32:401–414.
- Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct Equ Modeling*. 1999; 6:1–55.
- Huntley ED, Juliano LM. Caffeine expectancy questionnaire (CaffEQ): Construction, psychometric properties, and associations with caffeine use, caffeine dependence, and other related variables. *Psychol Assess*. 2012; 24:592–607. [PubMed: 22149323]
- IBM Corp. IBM SPSS statistics for windows, version 24.0. Armonk, NY: IBM Corp; 2016.
- Johnston, LD., O'Malley, PM., Bachman, JG., Schulenberg, JE., Miech, RA. Monitoring the Future national survey results on drug use, 1975–2014: Volume 2, College students and adults ages 19–55. Institute for Social Research, University of Michigan; Ann Arbor, MI: 2015.

- Jones SC, Barrie L, Berry N. Why (not) alcohol energy drinks? A qualitative study with Australian university students. *Drug Alcohol Rev.* 2012; 31:281–87. [PubMed: 21605204]
- Kristjansson AL, Mann MJ, Sigfusdottir ID, James JE. Mode of daily caffeine consumption among adolescents and the practice of mixing alcohol with energy drinks: Relationships to drunkenness. *J Stud Alcohol Drugs.* 2015; 76:397–405. [PubMed: 25978825]
- Labbe AK, Maisto SA. Alcohol expectancy challenges for college students: A narrative review. *Clin Psychol Rev.* 2011; 31:673–683. [PubMed: 21482325]
- Lau-Barraco C, Linden AN. Caffeinated alcohol use and expectancies for caffeine versus alcohol. *Subst Use Misuse.* 2014; 49:1241–1249. [PubMed: 24708428]
- Lau-Barraco C, Milletich RJ, Linden AN. Caffeinated alcohol consumption profiles and associations with use severity and outcome expectancies. *Addict Behav.* 2014; 39:308–315. [PubMed: 24210683]
- Linden-Carmichael AN, Lau-Barraco C, Stamates AL. Testing a model of caffeinated alcohol-specific expectancies. *Addict Behav.* 2015; 47:38–41. [PubMed: 25864133]
- MacCallum RC, Browne MW, Sugawara HM. Power analysis and determination of sample size for covariance structure modeling. *Psychol Methods.* 1996; 1:130–149.
- MacKillop J, Howland J, Rohsenow DJ, Few LR, Amlung MT, Metrik J, Calise TV. Initial development of a measure of expectancies for combinations of alcohol and caffeine: The Caffeine + Alcohol Combined Effects Questionnaire (CACEQ). *Exp Clin Psychopharmacol.* 2012; 20:466–472. [PubMed: 23230858]
- Mallett K, Marzell M, Scaglione N, Hultgren B, Turrissi R. 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. *Psychol Addict Behav.* 2014; 28:97–104. [PubMed: 23528198]
- Marczinski CA. Alcohol mixed with energy drinks: Consumption patterns and motivations for use in U.S. college students. *Int J Env Res Public Health.* 2011; 8:3232–3245. [PubMed: 21909303]
- Marczinski CA, Fillmore MT. Compensating for alcohol-induced impairment of control: Effects on inhibition and activation of behavior. *Psychopharmacol.* 2005; 181:337–346.
- Marczinski CA, Fillmore MT, Stamates AL, Maloney SF. The desire to drink alcohol is enhanced with high caffeine energy drink mixers. *Alcohol Clin Exp Res.* 2016; 40:1982–1990. [PubMed: 27419377]
- Marsh HW, Hau K-T, Wen Z. In search of golden rules: Comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Struct Equ Modeling.* 2004; 11:320–341.
- Martz ME, Patrick ME, Schulenberg JE. Alcohol mixed with energy drink use among U.S. 12-grade students: Prevalence, correlates, and associations with unsafe driving. *J Adolesc Health.* 2015; 56:557–563. [PubMed: 25907654]
- McDonald, RP. Test theory: A unified approach. Lawrence Erlbaum; Mahwah, NJ: 1999.
- McKetin R, Coen A. The effect of energy drinks on the urge to drink alcohol in young adults. *Alcohol Clin Exp Res.* 2014; 38:2279–85. [PubMed: 25041069]
- Miller KE. Alcohol mixed with energy drink use and sexual risk-taking: Casual, intoxicated, and unprotected sex. *J Caffeine Res.* 2012; 2:62–69. [PubMed: 24761266]
- Miller KE. Wired: Energy drinks, jock identity, masculine norms, and risk taking. *J Am Coll Health.* 2008; 56:481–89. [PubMed: 18400659]
- Miller, KE., Dermen, KH., Lucke, JF. Comparison of young adult risk-taking during sexual events accompanied by use of alcohol mixed with energy drinks vs. alcohol alone. Research Society on Alcoholism annual meeting; San Antonio, TX: 2015.
- Miller KE, Quigley BM, Eliseo-Arras RK, Ball NJ. Alcohol mixed with energy drink use as an event-level predictor of physical and verbal aggression in bar conflicts. *Alcohol Clin Exp Res.* 2016; 40:161–169. [PubMed: 26727532]
- Millsap, RE. Statistical approaches to measurement invariance. Routledge; New York: 2011.
- Muthén, LK., Muthén, BO. Mplus user's guide: Statistical analysis with latent variables. 7th. Muthén & Muthén; Los Angeles: 2012.

- O'Brien MC, McCoy TP, Egan KL, Goldin S, Rhodes SD, Wolfson M. Caffeinated alcohol, sensation seeking, and injury risk. *J Caffeine Res.* 2013; 3:59–66. [PubMed: 24761275]
- O'Brien MC, McCoy TP, Rhodes SD, Wagoner A, Wolfson M. Caffeinated cocktails: Energy drink consumption, high-risk drinking, and alcohol-related consequences among college students. *Acad Emerg Med.* 2008; 15:453–60. [PubMed: 18439201]
- Patrick ME, Maggs JL. Energy drinks and alcohol: Links to alcohol behaviors and consequences across 56 days. *J Adolesc Health.* 2014; 54:454–59. [PubMed: 24309196]
- Peacock A, Droste N, Pennay A, Miller P, Lubman DI, Bruno R. Typology of alcohol mixed with energy drink consumers: Motivations for use. *Alcohol Clin Exp Res.* 2015; 39:1083–1092. [PubMed: 25988585]
- R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing; Vienna, Austria: 2016.
- Rosseel Y. lavaan: An R package for structural equation modeling. *Journal of Statistical Software.* 2012; 48(2):1–36.
- Simon, M., Mosher, J. Alcohol, energy drinks, and youth: A dangerous mix. Marin Institute; San Rafael, CA: 2007.
- Snipes DJ, Benotsch EG. High-risk cocktails and high-risk sex: Examining the relation between alcohol mixed with energy drink consumption, sexual behavior, and drug use in college students. *Addict Behav.* 2013; 38:1418–23. [PubMed: 23006245]
- Snipes DJ, Jeffers AJ, Green BA, Benotsch EG. Alcohol mixed with energy drinks are robustly associated with patterns of problematic alcohol consumption among young adult college students. *Addict Behav.* 2015; 41:136–41. [PubMed: 25452057]
- Steele CM, Josephs RA. Alcohol myopia: Its prized and dangerous effects. *Am Psychol.* 1990; 45:921–933. [PubMed: 2221564]
- Substance Abuse and Mental Health Administration [SAMHSA], Center for Behavioral Health Statistics and Quality, U.S. Department of Health and Human Services. The DAWN report: Update on emergency department visits involving energy drinks: A continuing public health concern. SAMHSA; Rockville, MD: 2013.
- U.S. Food and Drug Administration, U.S. Department of Health and Human Services. Update on caffeinated alcoholic beverages: FDA announces progress on removal of certain caffeinated alcoholic beverages from the market. 2010. Available at: <http://www.fda.gov/NewsEvents/PublicHealthFocus/ucm234900.htm>. Accessed November 7, 2016
- Varvil-Weld L, Marzell M, Turrise R, Mallett KA, Cleveland MJ. Examining the relationship between alcohol-energy drink risk profiles and high-risk drinking behaviors. *Alcohol Clin Exp Res.* 2013; 37:1420–1416.
- Walters GD. The alcohol expectancy process: Origins, structure, and change. *Alcoholism Treatment Quarterly.* 1998; 16(3):25–38.
- Woolsey CL, Williams RD, Housman JM, Barry AE, Jacobson BH, Evans MW. Combined use of alcohol and energy drinks increases participation in high-risk drinking and driving behaviors among college students. *J Stud Alcohol Drugs.* 2015; 76:615–619. [PubMed: 26098038]
- Wei, T., Simko, V. Corrplot: Visualization of a correlation matrix. 2016. Available at: <https://cran.r-project.org/web/packages/corrplot/index.html>. Accessed October 30, 2016

NOTE:
 Circles depict the four, pure-cluster, latent factors: Intoxication Management, Alertness, Sociability, and Jitters.
 Squares depict each expectancy item, numbered to correspond with numbered items in Table 2.
 Arrows between latent factors and each item depict factor loadings.
 Arrows below each item depict residual standard errors.
 Arrows between factors depict factor correlations.
 Placement of the JT factor apart from the other factors depicts the pattern of correlations.

Figure 1.
 Psychometric Structure of the AmED_EXPI Scale.

Table 1**Participant Characteristics at Baseline (N=3,105)**

	Mean (SD)	N (Percentage)
Demographic characteristics		
Age in years	20.02 (4.04)	
Minor adolescent (13–17)		1018 (32.8%)
Young adult (18–25)		2087 (67.2%)
Gender		
Male		1165 (37.5%)
Female		1940 (62.5%)
Race/ethnicity		
White, non-Hispanic		2002 (64.5%)
Black, non-Hispanic		282 (9.1%)
Other race, non-Hispanic		119 (3.8%)
2+ races, non-Hispanic		166 (5.3%)
Hispanic		536 (17.3%)
Student enrollment status		
Not enrolled in school (minor adolescents)		28 (2.8%)
Not enrolled in college (young adults)		1033 (49.8%)
Alcohol use (any kind)		
Used alcohol, lifetime		2120 (68.3%)
Used alcohol, past 3 months		1700 (54.8%)
Among past three month alcohol users:		
Days used alcohol in past three months	13.50 (16.76)	
Typical # alcohol drinks in a session	2.86 (2.12)	
AmED use		
Used AmED, lifetime		1044 (33.6%)
Used AmED, past 3 months		435 (14.0%)
Among past three month AmED users:		
Days used AmED in past three months	4.52 (8.81)	
Typical # AmED drinks in a session	2.30 (1.89)	

Table 2

Factor Loadings for Intoxication-Related AmED Expectancies (AmED_EXPI): FIML Confirmatory Model of Four Factors

	Factor			
	IM	AL	SO	JT
INTOXICATION MANAGEMENT (IM)				
09. I would have more control over how drunk I get.	1.07			
07. I would hold my liquor better.	1.03			
17. I would be less likely to wake up with a hangover.	1.02			
10. I could drink more without feeling drunk.	1.00			
08. I could stay buzzed without getting completely drunk.	1.04			
04. I could drink more without passing out.	0.93			
ALERTNESS (AL)				
05. I would feel more awake at the end of the night.		1.27		
01. I would stay alert longer.		1.25		
02. I could drink more without feeling tired or sleepy.		1.31		
03. I would have more energy to party.		1.25		
SOCIABILITY (SO)				
11. I would be more fun to be around.			1.22	
13. I would be friendly and sociable.			1.06	
12. I would become the life of the party.			1.21	
JITTERS (JT)				
16. I would be irritable.				1.24
14. I would be nervous.				1.14
Factor Correlations				
Intoxication management	1.00			
Alertness	0.76	1.00		
Sociability	0.82	0.81	1.00	
Jitters	0.23	0.27	0.18	1.00

$\chi^2(84) = 750.0, p < .001$

RMSEA = .051, $p < .389$

CFI = .978

TLI = .973

SRMR = .023

Table 3

Means, Standard Deviations, Reliabilities, and Intercorrelations among AmED_EXPI Subscales

Subscale	<i>M</i>	<i>SD</i>	<i>A</i>	Subscale correlations			
				<i>IM</i>	<i>AL</i>	<i>SO</i>	<i>JT</i>
1. Intoxication Management	2.41	1.07	.91	—			
2. Alertness	3.08	1.34	.90	.69	—		
3. Sociability	2.67	1.24	.88	.73	.72	—	
4. Jitters	3.09	1.37	.76	.19	.22	.15	—

Note: All subscale correlations significant at the $p < .001$ level.

Table 4

Bivariate Correlations Testing AmED_EXPI Subscales for Concurrent Validity

	IM	AL	SO	JT
AmED use				
Days used AmED in past three months ^a	.14**	.03	.13**	.02
Typical # AmED drinks in a session ^b	.24***	.07	.20***	-.01

***
p < .001**
p < .01*
p < .05

Note: Sample restricted to past-three-month AmED users (n=435).

^aPartial correlations controlling for frequency of any alcohol use in the past three months.^bPartial correlations controlling for typical number of drinks of any alcohol in a drinking session.

Table 5

Logistic Regressions of Young Adult AmED Initiation and Continuation at Wave 2 on AmED_EXPI Subscale Scores

	Initiation of AmED at Wave 2 ^a (N=1,313)		Continuation of AmED at Wave 2 ^b (N=322)	
	OR	95% CI	OR	95% CI
Intoxication Management	1.43 [*]	(1.09–1.88)	.84	(.63–1.13)
Alertness	.88	(.71–1.11)	1.06	(.83–1.36)
Sociability	1.14	(.89–1.46)	1.59 ^{**}	(1.21–2.10)
Jitters	.74 ^{***}	(.63 – .88)	1.02	(.83–1.25)
Nagelkerke R ²	.04		.07	

***
p < .001

**
p < .01

*
p < .05

^a Includes only Wave 2 participants who reported no lifetime AmED use in Wave 1. Reference group is Nonusers (no AmED use at Wave 1 or Wave 2).

^b Includes only Wave 2 participants who reported lifetime AmED use in Wave 1. Reference group is Discontinuers (AmED use at Wave 1 but not at Wave 2).