

College Students' Use of Energy Drinks, Social Problem-Solving, and Academic Performance

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Abstract—Energy drink (ED) use among college students to improve academic performance (AP) has skyrocketed. A growing body of literature indicates that the risks associated with ED use may outweigh the perceived benefits. In this study, 486 undergraduates were surveyed on their general substance and ED usage, Social Problem-Solving (SPS) ability, and AP. It was hypothesized that: (1) ED use would be a negative predictor of AP; (2) SPS would be a positive predictor of AP; (3) SPS would be a negative predictor of ED use; and (4) SPS and ED use would account for a significant amount of the variance in AP. A linear multiple regression for AP was conducted, with predictor variables entered in the following order: total drug use, non-ED caffeine use, SPS, and ED use. The overall model was significant and accounted for approximately 7% of the variance in AP. The hypotheses of the study were supported, indicating that ED use may be related to decreased AP, SPS ability may be related to increased AP, or that students with poor AP and less effective SPS skills are more likely to use EDs. Implications of these findings are important for college students and other users of ED products.

Keywords—academic performance, caffeine use, college students, energy drinks, problem-solving

Caffeine is the most widely used psychoactive drug in the world (Gilbert 1976; James 1997). Energy drinks (ED) have become a common and popular way for college students to obtain the desired stimulant effects of caffeine, but the full effects of ED use are not well understood (IsHak et al. 2012). Research indicates that the majority of college students consume EDs to increase their energy, to study, or to complete academic work, and that college students may

drink as many as two or more EDs while studying or engaging in other academic activities (Malinauskas et al. 2007). These findings suggest that college students may not only be consuming potentially high levels of caffeine, but may also have false expectations about the perceived benefits of caffeinated products.

Various psychosocial factors are associated with ED use, such as marijuana use, sexual risk taking, fighting, seat

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belt omission (Miller 2005), and anxiety and sleep quality (Stasio et al. 2011). Social Problem-Solving (SPS) ability has been linked to various health behaviors and is worthy of investigation in regards to ED use. This paper explores relationships among SPS ability, ED use, and AP in order to better inform students' decision-making processes and develop potential interventions to improve overall health, well-being, and functioning in this population.

Many ED consumers are unaware of their potential health hazards. Food manufacturers market these drinks as an easy way to improve physical and psychological performance (Finnegan 2003), but EDs vary greatly in the amount of caffeine they contain and can have unpredictable outcomes. Estimates of caffeine content for a typical cup of coffee range from 80 mg to 150 mg of caffeine, while estimates for EDs vary from 75 mg to 300 mg of caffeine (Gupta & Gajilan 2007). However, accurate estimates of the caffeine content of any drink can be difficult. EDs often contain herbal sources of caffeine that may or may not be counted towards the caffeine content of the product. Food manufacturers try to persuade the public that herbal sources of caffeine are different because they are "all natural." However, herbal sources of caffeine have the same stimulant effects and health risks as "regular" caffeine. For example, Guarana is an ingredient found in many energy drinks and contains about twice the caffeine of coffee beans (Bempong, Houghton & Steadman 1993). While manufacturers of "all natural" EDs are moving towards listing herbal sources of caffeine, products' various "energy blends" are often deemed proprietary and not accounted for in product labeling. As such, it is difficult for students to determine the actual amount of caffeine they are ingesting.

Even if caffeine is listed accurately, it is usually listed per serving, but consumers often do not account for the fact that one container of an ED may actually contain two or more servings, effectively doubling their perceived caffeine intake. Even moderate levels of caffeine consumption can result in elevated levels of anxiety in college students (Vinder-Caerols et al. 2012). Consuming high levels of caffeine can cause a variety of unpleasant symptoms, including caffeine dependence (Cherniske 1998).

Chronically consuming high levels of caffeine, which essentially triggers the body's stress response (Cherniske 1998), can result in caffeinism, "a state of chronic toxicity resulting from excess caffeine consumption" (Cherniske 1998, 36). Some side-effects of caffeinism include fatigue, anxiety, irritability, mood swings, and difficulty sleeping (Cherniske 1998). If caffeine consumption is lessened or stopped, withdrawal symptoms will set in within 12 to 24 hours. Thus, regular caffeine consumers may become dependent on the stimulant and experience withdrawal symptoms, making it difficult to perform everyday tasks (Oberstar, Bernstein & Thuras 2002). Common withdrawal symptoms include headaches, fatigue, diminished energy, irritable mood, and decreased alertness. Ingesting more

caffeine may relieve withdrawal symptoms, but may also cause a person to experience the jitters or increased tension (Miller 2005). These elevated levels of stimulation can cause diminished sleep quality, negatively affect the immune system, and lead to changes in mood. Caffeine consumption can also lower a person's threshold for coping and handling stress (Cherniske 1998), which has been reported to be the number-one health impediment to students' academic performance (American College Health Association 2006; Pettit & DeBarr 2011).

Earlier research has shown college students also commonly use illicit stimulant drugs for academic purposes (Low & Gendaszek 2002), but Arria et al. (2008) found that the high school and college GPAs of stimulant users were significantly lower compared to non-users. Stimulant users also earned lower GPAs on average by the end of their first year of college. ED use also has been associated with poor sleep and increased anxiety in a college population (Stasio et al. 2011), which would likely be counterproductive to improved AP.

Multiple factors impact college students' AP and their decision-making processes regarding the use of caffeine and other stimulant drugs. Given the risks of using stimulants to improve AP, it is critical to find predictive factors for these behaviors. One such factor may be social problem-solving skills, or meta-cognitive skills. For instance, Heppner and Krauskopf (1987) indicated that individuals who self-appraised as effective problem solvers exhibited efficient study habits, presumably because they were more skillful at adopting attitudes and behaviors that facilitated adaptation to the environment. The ability of self-appraised problem solvers to succeed in an academic environment involves the use of metacognitive thinking. Metacognition allows problem solvers to evaluate and assess a problem and generate alternative strategies to a solution. Findings have shown the use of metacognitive thinking allows people to perform better than average on problem-solving tasks (Brand 2003).

Elliot et al. (1990) expanded on earlier research by hypothesizing that problem-solving appraisal was a significant predictor of study habits in academically at-risk college students. The researchers used college course grades and semester GPAs to measure participants' effective study habits. Participants were all undergraduates enrolled in a course designed for students struggling academically. Findings supported Elliot et al.'s hypotheses that problem-solving appraisal was a significant predictor of effective study habits and AP.

Self-appraised problem-solving also has been found to be positively correlated to college undergraduates' health experiences. Self-appraised effective problem solvers view their health as something in their control and tend to cope more actively with their health, whereas self-appraised ineffective problem solvers report more health problems. In addition, because of positive perceptions of their health,

self-appraised problem solvers are able to regulate their emotions and possess the skills necessary to handle stress (Elliot & Marmarosh 1994), allowing them to perform better academically.

One of the most robust and widely applied problem-solving models, particularly in regards to health behaviors, is the Social Problem-Solving (SPS) model, which focuses on five stages of the problem-solving process: problem orientation, problem definition, generation of alternatives, solution implementation, and verification (D’Zurilla 1986). The SPS model has been shown to be relevant across a range of behavioral health issues, including depression (Nezu & Nezu 2010), weight management (Perri et al. 2001), and coping with cancer (Nezu et al. 1998). It has also been investigated as a factor in tobacco and alcohol use in survivors of smoking-related cancers and their caregivers (Trunzo, Pinto & Chougule 2014).

The current study is designed to explore whether the dynamics between SPS ability and ED use have any predictive value on AP. Based on previous research, we hypothesized that: (1) ED use would be a negative predictor of AP; (2) SPS would be a positive predictor of AP; (3) SPS would be a negative predictor of ED use; and (4) SPS and ED use would account for a significant amount of the variance in AP.

METHODS

Participants

A total of 574 students were surveyed, predominantly from Bryant University (84.8%), but participants were also recruited from LaSalle University (12.8%) in Philadelphia, PA, and University of the Pacific (2.5%) in Stockton, CA. Incomplete data forced deletion of 88 participants, leaving a total of 486 participants who completed the study. Mean age of the sample was 20.38 years ($SD = 4.1$) with 187 male and 293 female participants. The sample was predominantly Caucasian (68.6%), with 7.1% Asian American, 2.8% African American, 2.6% Hispanic, and 1.4% for both Native American and “other.” A significant number of participants (15.3%) did not complete the item inquiring about race, but reported numbers are consistent across demographic information for each site.

Measures

Participants completed demographic information regarding gender, age, race, self-reported GPA, and other descriptive characteristics. Measures of social problem-solving ability and drug use were also completed.

Social Problem-Solving Inventory-Revised, Short Form (SPSI-R). The SPSI-R short form is a 25-item self-report questionnaire assessing problem-solving skills along the five dimensions of the SPS model (D’Zurilla & Nezu 2007). Each question provides a statement

describing one approach to solving a problem (e.g., “I wait to see if a problem will resolve itself first, before trying to solve it myself.”) The respondent rates each item on a five-point Likert-type scale ranging from 0 (*not at all true of me*) to 4 (*extremely true of me*). The measure produces a total score and subscale scores for each of the five problem-solving dimensions (Positive Problem Orientation, Negative Problem Orientation, Rational Problem-Solving, Impulsivity/Carelessness Style, Avoidance Style). Higher scores indicate more adaptive problem-solving. Internal consistency of the five scales range from 0.69–0.95 and test-retest reliability ranges from 0.72–0.91. Structural, concurrent, predictive, convergent, and discriminant validity estimates support the validity of this measure (D’Zurilla, Nezu & Maydeu-Olivares 2002).

Drug use. This measure was developed for the present study, based on similar measures (e.g., CORE Drug and Alcohol Survey) used in university settings and showing adequate reliability and validity (Presley et al. 1996). We set out to measure college students’ use of both traditional drugs as well as drugs not typically captured by current measures. College students were asked to report their use of 23 different drugs, including prescription medications (taken as prescribed, not taken as prescribed, taken but not prescribed to them), stimulant medications prescribed for ADHD, energy drinks, traditional caffeinated drinks (e.g., colas, coffee), as well as substances typically assessed on other substance use questionnaires (e.g., alcohol, cigarettes, marijuana, amphetamines). College students were asked “Within the last 30 days, on how many days did you use the following substances” and were given the following options for responses: 0 = *never used*; 1 = *Used, but not within the last 30 days*; 2 = *1–2 days*; 3 = *3–5 days*; 4 = *6–9 days*; 6 = *10–19 days*; 7 = *20–29 days*; and 8 = *all 30 days*, which were modeled after the timeframes provided in the CORE Drug and Alcohol Survey (Presley et al. 1996).

Procedures

All data were collected using the online data collection service Psychdata.com. Participants were approached via introductory and advanced undergraduate classes in psychology, communication, and other undergraduate courses. Some students received extra credit for participation and all students choosing not to participate were afforded equivalent alternative options for extra credit. The study was approved by the Bryant University Institutional Review Board, as well as the IRBs of the other institutions where data were collected. Participants were provided with a link to the Psychdata.com website, where they read and electronically signed the informed consent page. Participants then completed demographic and other measures. Data were collected as part of a larger study on college student health behaviors.

TABLE 1
Summary of Intercorrelations between GPA, Drug Use, and Social Problem-Solving

	1	2	3	4	5	6	7	8	9	10
1. GPA	—	-.09*	.07	-.23***	.06	.03	.17***	-.19***	-.12**	.15**
2. Drug		—	.36**	.39***	-.02	.00	-.09	.19***	.08	-.11*
3. Non-ED Caff			—	.07	.09*	-.01	.11*	-.08	-.08	.11*
4. ED Use				—	.02	.05	-.08	.19***	.07	-.11*
5. PPO					—	-.38***	.56***	-.10*	-.41***	.74***
6. NPO						—	-.05	.28***	.48***	-.66***
7. RPS							—	-.20***	-.18***	.59***
8. ICS								—	.45***	-.59***
9. AS									—	-.76***
10. SPS										—

Note. GPA = Grade Point Average; Drug = Total Drug Use; Non-ED Caff = Non-Energy Drink Caffeine Use; ED Use = Energy Drink Use; PPO = Positive Problem Orientation; NPO = Negative Problem Orientation; RPS = Rational Problem-Solving; ICS = Impulsiveness/Carelessness Style; AS = Avoidance Style; SPS = Total Social Problem-Solving score.

* $p < .05$; ** $p < .01$; *** $p < .001$.

RESULTS

Mean self-reported GPA for the subject pool was 2.93 ($SD = .81$), mean caffeinated non-energy drinks use was 5.14 ($SD = 1.94$), and mean total drug use (multiple substances) was 39.72 ($SD = 10.4$). Mean energy drink use was 2.52 ($SD = 1.53$), as defined by the CORE survey response scale. As such, mean ED use among the sample was two to five days in the past 30 days. Mean total SPS score was 11.91 ($SD = 2.3$).

Correlational results support the first three hypotheses of the study. ED use was negatively correlated with AP ($r = -.23$, $p < .0001$) and SPS was positively correlated with GPA ($r = .15$, $p < .001$). Additionally, total SPS ability was negatively correlated with ED use ($r = -.11$, $p = .02$). In regards to SPSI-R subscale correlates with ED use and AP, GPA had significant correlational relationships with Rational Problem-Solving ($r = .17$, $p < .0001$), Impulsivity/Compulsivity ($r = -.19$, $p < .0001$), and Avoidance ($r = -.12$, $p = .007$). ED use was correlated with Impulsivity/Compulsivity ($r = .19$, $p = .0001$). See Table 1 for a full correlational matrix of the variables of interest.

However, it is possible that students who are more likely to use EDs are also more likely to use all substances compared to those who do not use EDs, or use them rarely. Thus, to test the predictive value of ED use and SPS ability on GPA, we conducted a linear multiple regression in which we controlled for other drug use and non-ED caffeine use. Variables were entered in the following order: total drug use (minus ED use), non-ED caffeine use, SPS ability, and ED use. The overall model was significant, $F(4, 481) = 9.33$, $p < .0001$, and accounted

for approximately 7% of the variance in AP as measured by grade point average ($R^2 = .072$). Total drug use and non-ED caffeine use did not contribute significantly to the model, but SPS had a significantly positive impact $t(4, 481) = 2.57$, $p = .01$ and ED use had a significantly negative impact $t(4, 481) = -4.39$, $p < .0001$ on AP, even when controlling for total drug use and other caffeine use. Multicollinearity diagnostics were insignificant (all VIFs below 2.0), indicating no effect of correlations among the predictor variables on the regression analysis results.

DISCUSSION

Study results indicate that ED use was negatively associated with AP, while SPS was positively associated with AP. Moreover, SPS was significantly correlated with ED use, indicating either that better problem-solvers consume fewer EDs, or those who consume more EDs are poorer problem-solvers. This suggests that students who have better problem-solving skills may use EDs at a lower rate, possibly because they are better equipped to make decisions about their health and well-being and have stronger study habits. This is consistent with Elliot & Marmarash's (1994) findings regarding self-appraised effective problem solvers viewing their health as being under their control, thus making better decisions regarding their health. Conversely, students with poorer problem-solving skills may seek other recourse to deal with their difficulties, including use of EDs in an attempt to improve their study skills.

For example, students having academic difficulty who also have strong problem-solving skills may be less likely

to reach for an ED to provide a “boost” to enhance AP and more likely to engage better resources, such as meeting with a professor, getting a tutor, or changing study habits. Students with poorer SPS ability may instead seek “the quick fix” by using EDs or other substances in an attempt to give them an academic edge or to attempt to stay awake for long stretches of time to study. This may trigger negative outcomes, where students who are poorer problem-solvers use EDs to improve their situation, but instead these behaviors may increase anxiety, various physiological symptoms, and distress. Additionally, if excess caffeine intake is disrupting sleep, this may exacerbate cognitive and emotional difficulties and reduce one’s ability to cope with stress and everyday responsibilities. Increased distress and decreased functioning may then lead to additional maladaptive coping (i.e., more ED use), and so the cycle continues.

There was a significant positive relationship between Rational Problem-Solving and GPA, and significantly negative relationships among GPA and Impulsivity/Compulsivity and Avoidance. This would suggest that students who are more impulsive (i.e., less thoughtful and deliberate) and more avoidant may be poorer academic performers and more vulnerable to ED use. Indeed, ED use had a significantly positive correlation with Impulsivity/Compulsivity, further supporting the notion that this factor may play a role in students’ decision making about ED use and its subsequent impact on AP.

Our results actually suggest that ED use is the single most significant negative predictor of AP in the model, even beyond that of overall drug use (e.g., alcohol, marijuana, other stimulant drugs). This is consistent with previous research on stimulant use and GPA (Arria et al. 2008). Companies that produce EDs typically claim that they contain no more caffeine than a cup of coffee and they are not harmful but, in our model, non-ED caffeine use (i.e., coffee, tea, colas) did not have a significant relationship to GPA. Moreover, since non-ED caffeine use was entered into the regression analysis before EDs, it was controlled for, thus negating any claim that use of EDs in combination with coffee or other caffeinated beverages blurs the negative relationship with AP. These results indicate that the potential negative impact of EDs on AP is in addition to that of other caffeinated beverages and overall drug use.

The finding that overall drug use was not a significant predictor of AP was somewhat surprising. One would expect that, as drug use increases, AP would decrease. While this relationship was present in straight correlational results, it was not a significant predictor in the overall model. This could be due to a measurement artifact. The drug use measure we used was very broad, and included everything from alcohol and marijuana to cocaine and meth-amphetamine use. The broad nature of the measure may be contributing to this particular outcome.

We must also consider the way in which these substances are typically used by college students. While other drugs may, at times, be used when engaging in academic pursuits, most college students probably use them in a recreational manner (e.g., on weekends, at parties). While the occasional student may use recreational drugs before a class, an exam, or when studying, most students likely recognize this kind of behavior as counterproductive to their academic functioning and would therefore moderate or refrain from using these drugs while engaging in academic activities. EDs, however, are more often used for the expressed purpose of improving or assisting their AP (Malinauskas et al. 2007). Students may be more likely to intentionally use EDs while doing academic work as a way to stay awake and increase perceived energy, concentration, and focus. When coupled with students’ general lack of awareness of the potential detrimental effects of these products, it makes sense that their ED use may have a more significant negative impact on AP than recreational drug use.

There are several limitations to this study and the findings should be interpreted accordingly. First, we have a relatively homogeneous sample. Most of the participants came from a private, New England university, limiting the generalizability of the results. It is not known if these results would be replicated at other colleges and universities with different populations and in different parts of the country. Also, while we used predominantly strong, scientifically valid measures, we did not verify accuracy of self-reported drug use with blood or urine testing. Lastly, the self-report nature of the drug use measure utilized ordinal versus interval or ratio scales. This could adversely affect the regression analysis by increasing error variance and should be considered when interpreting results.

Overall, the results of the investigation are telling, informative, and important for students, parents, and college and university officials. While much has been done to publicize the health risks of using EDs, little has been done to highlight the fact that these products do not seem to serve the purpose for which they are frequently used: to enhance AP. In fact, it appears their use leads to the opposite of their intended effect. Moreover, given the relationship between SPS ability, AP, and ED use, we suggest further investigation into the use of problem-solving training in this population. Incorporating simple problem-solving materials into freshmen orientations with reinforcing seminars or workshops throughout the college experience may help to mitigate the deleterious effects of ED use, and also improve AP. We hope that if students become more aware that their use of these products potentially inhibits rather than enhances AP, their use will decrease.

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