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Examining the Effects of Energy Drinks on Academic Performance

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EXAMINING THE EFFECTS OF ENERGY DRINKS ON ACADEMIC PERFORMANCE

by

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(Under the Direction of Jessica Brooks)

ABSTRACT

Reports of energy drink (ED) consumption have grown among the United States population. Research suggests reasons for consumption vary across populations, including increased attention and enhanced endurance performance. However, ED consumers could suffer from negative effects of ED, including health problems, caffeine overdose, and death. Energy drink consumption is also linked to substance use. Despite risks of consuming ED, heavy use of EDs remains among college students, often to help with academic performance; however, research has not examined effects of ED consumption on perceived and actual academic performance. This study evaluated relationships among ED consumption, self-efficacy, and academic performance in 122 (Day I) and 98 (Day II) undergraduate students whereby they completed a number of academic tasks and questionnaires. Each participant was randomly assigned to one of four conditions prior to participating: (1) Water-Academic Task delayed condition; (2) Water-Academic Task immediate condition; (3) Energy drink-Academic Task delayed condition; (4) Energy drink-Academic Task immediate condition. Preliminary analysis of bivariate correlations revealed higher levels of self-efficacy in academics were negatively correlated with beliefs of positive self-efficacy, whereas actual performance on an academic task during Day I was positively correlated with actual performance during Day II. Multiple regression analysis yielded nonsignificant results; that is, beliefs of typical and atypical features of EDs and attitudes toward EDs failed to significantly predict perceived performance or actual performance on an academic task. Two separate 2 x 2 repeated measures ANOVAs revealed no significant effect of consumption of an ED on perception of performance or actual performance. A moderation analysis using hierarchical multiple regression found participants who consumed ED and have higher perception of performance scored higher on the academic task than those who consumed ED and had lower perceptions of performance. Two independent t-tests revealed significant differences existing in ED consumption levels between genders (women vs. men)—with men consuming more ED than women—and among childhood geographic status (rural vs. nonrural)—with those living in rural areas consuming more ED than those living in urban/suburban areas during childhood. Overall, ED consumption positively impacts academic performance, but only when combined with higher levels of perceived performance.

INDEX WORDS: Caffeine, Energy drinks, Academic performance, Self-efficacy, Optimism

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DEDICATION

This dissertation is dedicated to my husband, my parents, and my sister. With your unconditional support, I am able to continuously work toward my goals to reach success. Thank you for your endless words of encouragement and believing in me throughout the years.

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CHAPTER 1

INTRODUCTION

Energy drink consumption has escalated internationally, resulting in more money spent on these beverages. According to BCC Research (2012), as cited by Faris (2014), international sales of energy drinks have increased to more than 123 billion dollars in 2011 from 115 billion dollars in 2010. Energy drink consumption among the college population is increasingly popular, without a firm understanding of how consumption impacts perceived and actual academic performance. Many researchers studied the popularity of energy drinks among college-aged students and nonstudent peers, including Seifert, Schaechter, Hershorin, and Lipshultz (2011) who reported an estimated 30% to 50% of adolescents and young adults consume energy drinks. Malinauskas, Aeby, Overton, Carpenter-Aeby, and Barber-Heidal's (2007) study found 51% of 496 participants reported consuming more than one energy drink each month.

In light of the increasing consumption rate of energy drinks, researchers have investigated the risks and benefits of consuming energy drinks. According to Attila and Cakir (2010), energy drinks provide positive effects, including cognitive benefits such as increased attention and more rapid reaction to stimuli; whereas Miller (2015) reported consumption of energy drinks are related to increased heart and neurological problems. Energy drinks contain anywhere between 50 and 505 milligrams of caffeine, in addition to the same amount of sugar found in a can of soda (e.g., 33 grams; Higgins, Tuttle, & Higgins, 2010; Miller, 2015). Similarly, according to Higgins et al. (2010), energy drink consumption can increase one's heart rate and blood pressure. These physiological side effects make energy drinks dangerous for those prone to hypertension. Alarmingly, no known studies to date have examined the long-term effects of the ingredients of energy drinks, such as caffeine, taurine, and glucuronolactone, on a person’s body. However, research has examined the negative behaviors associated with energy drink consumption.

Energy drink consumption is positively correlated with substance use across various studies. For instance, in 2008, Miller found positive correlations between energy drink consumption and marijuana use, sexual risk-taking, aggression, alcohol use, tobacco use, and illicit prescription drug use. Energy drink consumption among sophomore college students is linked to nonmedical prescription drug use during junior year of college (Arria et al., 2010). Additionally, Arria et al. (2011) linked energy drink consumption to alcohol dependence in college students. Other research highlights the increase of alcohol use with energy drink consumption. Price, Hilchey, Darredeau, Fulton, and Barrett (2010) found individuals drink more alcohol when in conjunction with consumption of energy drinks (i.e., energy drinks mixed with alcoholic beverages, henceforth referred to as AmED). AmED consumption is linked to alcohol-related driving accidents, binge drinking, and illicit drug use (Martz, Patrick, & Schulenberg, 2015).

Consumers of energy drinks may be more at risk for alcohol-related driving accidents, binge drinking, and illicit drug use depending on the intersection of their identities (e.g., race, gender, undergraduate status). Arria et al. (2010) and Berger, Fendrich, Chen, Arria, and Cisler (2011) found college students who identified as white, male, and who were involved in fraternities, sororities or intramural sports life on campus, were more likely to consume AmED. Miller (2008) found the problematic behaviors (e.g., impulsivity, increased risky sexual behaviors, risk-taking behaviors) and energy drink consumption relation is particularly strong among white participants, especially white men. In contrast, Wells et al. (2014) found younger Latino males who identified as a sexual minority reported higher AmED consumption in comparison to their counterparts. These identities seem to be risk factors for higher consumption of energy drinks.

Many energy drink companies suggest energy drinks will provide enhanced performance, mental alertness, and improved overall performance. Although the risks of engaging in negative behaviors are correlated with consuming energy drinks, the potential benefits have also been examined. In a review, Rath (2010) examined various studies to identify the negative health effects, as well as perceived benefits, associated with energy drink consumption. Braganza and Larkin (2007) reported consumption of energy drinks, in moderation, could improve memory, mood, and performance, as well as provide alertness. A survey conducted by Gregory and Fitch (2007) found consumers perceive short-term benefits of energy drinks, including energy boost and improved performance. Miller (2008) found a correlation between energy drink consumption and alertness, physical endurance, visual processing, verbal reasoning, and attention. These studies provide correlational evidence that energy drinks can enhance attention and alertness. Moreover, these studies suggest that, in moderation, energy drink consumption could be beneficial in other areas besides athletic activities, such as academia.

Limited research has investigated the relationship between energy drink consumption and academic performance among college students. To date, Pettit and DeBarr (2011) are the only researchers to investigate the impact of energy drink consumption on academic performance and found a negative correlation between the two; that is, as energy drink consumption increased, academic performance suffered. Pettit and DeBarr (2011) also found differences in consumption patterns based on academic status and gender: juniors in college consumed more energy drinks than freshmen and sophomores, and men consumed more than women. In a separate study, Berger et al. (2011) also discovered more prevalent energy drink consumption among men than women. Different patterns of energy drink consumption are posited to be a result of graduation and senior projects approaching. Gender differences in consumption may be the result of gender role stereotypes. Olson (2015) stated that men may feel pressured to complete more courses and assignments to make more money after college. Further study is warranted to determine links between gender, year in college, and energy drink consumption.

To date, no study has investigated the effects of energy drink consumption on both perceived academic performance and actual academic performance in college students; however, a study conducted by Stringer and Heath in 2008 looked at perceived performance and academic performance among children ages 9 to 12. The researchers found perceived competence in mathematics and reading was predictive of future performance. However, self-perception of competence was not related to academic performance; that is, participants who perceived themselves as competent did not differ on academic performance when compared to those who did not perceive themselves as competent. Interestingly, perceived performance in combination with emotional support and effective instructional activities provided by teachers were more indicative of academic performance. In separate research, Chemers, Hu, and Garcia (2001) conducted a study in which first-year college students completed questionnaires about high school grade point average, academic self-efficacy, optimism, ability to cope with pressure and demand, academic self-rating, academic evaluations (grades in classes), academic expectations, stress levels, health, and adjustment to college academics. Chemers et al. (2001) found optimism and self-efficacy contributed to success and achievement. From this research, they postulated participants' levels of optimism and self-efficacy as it relates to academics need to be taken into account rather than perceived performance. Although this information is helpful, little is known about the impact of caffeine use at high rates among college-aged students, as well as the role energy drink consumption affecting the relationship between perceived academic performance and actual academic performance, specifically among college students.

Purpose of the Study

The current study sought to address gaps in research concerned with energy drink consumption and academic performance in the college population. Mixed findings in the literature show negative aspects of energy drink consumption as it relates to physiological symptoms and risky behaviors and positive aspects as it relates to improved attention, while neglecting to consider its impact on perceived and actual academic performance. The objectives of the current study were to understand the influence of energy drink consumption on actual academic performance, as well as perception of their performance on an academic task in comparison to their actual performance, by answering the following questions:

(1) To what extent does energy drink-related attitudes influence one's perception of how they perform on an academic task and one's actual performance on an academic task?

(2) To what extent does consumption of an energy drink influence one's actual performance and one's perception of performance on an academic task?

(3) Can consumption of an energy drink moderate the relationship between actual performance and one's perception of performance on an academic task?

(4) Are men more likely to consume energy drinks than women?

An exploratory aim of the current study sought to determine the extent to which demographic variables impact prevalence rates of energy drink consumption. A specific inquiry addressed by this aim includes the extent to which energy drink consumption differs among individuals who grew up in rural areas during childhood in comparison to those who grew up in an urban area.

Definition of Terms

Actual Academic Performance: Referred to as academic achievement; measured by standardized tests that focus on change (Huitt, Huitt, Monetti, & Hummel, 2009).

Caffeine: “A bitter white alkaloid, C8H10N4O2, found in certain plants such as cacao, coffee, kola, and tea, that stimulates the central nervous system and body metabolism” (para. 1; The Free Dictionary, 2016a).

Caffeine Toxicity: Occurs when symptoms such as nervousness, anxiety, restlessness, gastrointestinal upset, tachycardia, insomnia, psychomotor agitation, and tremors arise as a result of excessive caffeine consumption (Reissig, Strain, & Griffiths, 2009).

Energy Drink: Any beverage containing “caffeine, taurine, guarana, sugar, vitamins, herbal supplements, and other ingredients” (Faris, 2014; para. 1; Seifert et al., 2011).

Glucuronolactone: “A popular ingredient in energy drinks with claims that it detoxifies the body” (The Free Dictionary, 2016b).

Perceived Academic Performance: A person’s perceptions of her competence in a certain academic area (Anderman & Midgley, 1997).

Taurine: A crystallized acid from the bile; found also in small quantities in lung and muscle tissues (The Free Dictionary, 2016c).

CHAPTER 2

LITERATURE REVIEW

Energy drinks are beverages containing large amounts of caffeine and other stimulants, such as β-complex vitamins, carbohydrates, glucoronolactone, inositol, niacin, panthenol, and taurine (Reissig et al., 2009). Caffeine, the most widely used drug in the world, is the most common ingredient in energy drinks (Rath, 2010). Hundreds of different brands of energy drinks exist, with a wide range of caffeine per can (e.g., 50 milligrams (mg) to 505 mg; Higgins et al., 2010). Most energy drinks contain between 70 and 200 mg per 16 ounces, whereas other caffeinated beverages contain about 50 to 100 mg (Higgins et al., 2010). According to Higgins and colleagues (2010), in 2007 the United States was the world's largest consumer of energy drinks, with 290 million gallons consumed. No energy drinks are banned in the United States and there are no restrictions in regard to what energy drink companies are able to include on their nutrition labels (Higgins et al., 2010). For example, *Monster* energy drinks do not list the amount of caffeine in one beverage, and instead advertise "part of a 5000-mg "energy blend." Because of the lack of restrictions on energy drinks, the interactions of the ingredients are not widely discussed in regard to amount or purpose. This is important to note, because consumers are not fully aware of the ingredients they are consuming or their effects, which can result in negative outcomes if consumed in excess amounts. College students as a group are particularly at risk for experiencing the negative effects of energy drink use as a result of their high rate of consumption.

Conceptualizations of Substance Use

Even with an understanding of the consequences related to energy drink and alcohol consumption or other illicit drug use, individuals continue to consume excessive amounts of each, separate and combined. The sociocultural model of addiction conceptualizes reasons for beginning substance use and continuing use despite negative consequences from an environmental and cultural perspective (Becker, 1953). This theory was developed from the idea that first time substance users learn about the effects of substances from their more experienced peers. For example, individuals who live in a culture glorifying substance use and not showing the harmful components of it will be more likely to begin using substances.

Another theory of substance use is the self-medication model. The self-medication model is defined as individuals using substances to alleviate negative symptoms (Buckley, 1998; Dalack, Healy, & Meador-Woodruff, 1998; Krystal, D'Souza, Madonick, & Petrakis, 1999). The self-medication model posits individuals begin to use substances as a way to cope with adversity or self-medicate (Fields, 2012). If the culture condones substance use, individuals within that culture may be more likely to continue use as a way to self-medicate or socialize with others. Although sociocultural and self-medication theories are applicable to addiction and substance use generally, a more specific model is necessary to understand underlying mechanisms of energy drink consumption and academic performance.

A model encapsulating reasons for energy drink consumption in relation to academic performance is the social stress model (Rhodes & Jason, 1990), which views substance use as developing as a result of stressors arising from external sources, including pressures from family, expectations of academic performance, and peer pressure. In this model, individuals who have difficulty coping with adversity or stress are more likely to resort to using substances as a way to cope. Additionally, the conditioning model can be used to examine the rewards individuals receive from consuming energy drinks. For example, someone may experience a positive outcome (e.g., better focus on an exam resulting in a good grade) the first time they consume an energy drink, which then may lead to further use to gain that feeling again. These models account for motivations for consuming energy drinks, such as coping with stress from school (e.g., doing well on an exam) or succumbing to peer pressure (e.g., drinking AmED as a result of friends drinking AmEDs). These models provide theoretical guidance for this study, which sought to examine those perceived positive outcomes and how they relate to continued consumption of energy drinks.

Comprehensive Review of the Effects of Energy Drinks

The United States is one of top consumers of energy drinks in the world. As a result, researchers, including O'Dea (2003), Ivy et al. (2009) and Mets et al. (2011), examined the motivations for and effects of energy drink consumption. Specifically, research has been conducted on the effects of energy drink ingredients and the drink as a whole. When caffeine is combined with glucose positive effects can occur. Researchers assessed mood and cognitive and physiological effects of energy drink ingredients. Scholey and Kennedy (2004) conducted a study assessing the effects of an energy drink containing glucose and caffeine on mood, cognition, and physiology. Participants who consumed the energy drink significantly improved performance on secondary memory factors, such as delayed word recognition, delayed picture recognition, delayed word recall, and immediate word recall. Additionally, these participants improved on speed of attention factors, such as simple reaction time, choice reaction time, and digit vigilance (Scholey & Kennedy, 2004). Peacock, Martin, and Carr (2013) also examined effects of caffeine with an added examination of taurine on performance. Peacock et al. (2013) found taurine only reduced the effects of caffeine in a degradation task, whereas caffeine facilitated faster reaction time in a degradation task. Although these studies provide evidence energy drink ingredients improve reaction time and other attention factors, other researchers found more complex, if not conflicting, results.

A subset of research highlights the complex effects of energy drink ingredients on cognitive abilities and performance. Giles, Mahoney, Brunyé, Gardony, and Kanarek (2012) examined the effects of caffeine, glucose, and taurine on cognitive abilities in 48 undergraduate college students. The participants completed four caffeine and taurine treatments, including: (1) 0 mg caffeine, 0 mg taurine; (2) 0 mg caffeine, 2000 mg taurine; (3) 200 mg caffeine, 0 mg taurine; and (4) 200 mg caffeine and 2000 mg taurine. Half of the participants also received 50 grams (g) of glucose, whereas the other half were administered a placebo of 50 g of Stevia. The caffeine and taurine were administered in capsule form with water and the glucose was administered in a 500-milliliter drink. Similar to Scholey and Kennedy's (2004) findings, Giles et al. (2012) found caffeine improved performance with regard to executive control and working memory. In contrast to previous findings, Giles et al. (2012) found caffeine reduced simple and choice reaction time, and also reduced feelings of fatigue and increased tension and vigor, whereas taurine decreased feelings of vigor. Similarly, glucose slowed choice reaction time, and taurine increased choice reaction time and reduced reaction time in working memory tasks. Moreover, taurine intensified caffeine withdrawal symptoms, whereas caffeine reduced caffeine withdrawal symptoms. When combined with caffeine, glucose enhanced object-working memory. Glucose combined with taurine enhanced orienting attention.

This literature indicates positive and negative effects can occur when ingredients of an energy drink are combined, such as enhanced attention, working memory, and slowed reaction time. Scholey and Kennedy (2004) and Giles et al.'s (2012) studies provide evidence that the ingredients within energy drinks can enhance attention and memory. Based on these results, this study sought to further explore the possibility of increased attention and memory as a result of energy drink consumption. Although this information is useful, little research has examined individuals' perceptions of energy drinks, consumption of energy drinks, or how energy drinks affect academic performance. The following section will review research investigating the benefits and negative consequences associated with the consumption of energy drinks as a whole.

Positive Effects of Energy Drink Consumption. The perceived benefits of energy drinks have been examined to better understand the increased consumption throughout the United States. A study conducted by O'Dea in 2003 included 78 adolescents in grades 7 to 11. Participants were assigned to focus groups and responded to a series of questions, including reasons for consumption of various supplements (i.e., vitamins and minerals, high protein milk formulas, herbal supplements, guarana coenzyme Q_{10}, creatine, sports drinks, and energy drinks). The reasons for consumption of energy drinks endorsed by these adolescents included energy, taste, pressure from a peer group, attractive advertising and packaging, sports performance, and soft drink substitute. A majority of participants stated energy drinks made them feel more energetic and more alert (O'Dea, 2003). In a separate study, Hidiroglu, Tanriover, Unaldi, Sulun, and Karavus (2013) surveyed motivations for energy drink consumption in medical students finding increased cognitive performance, increased physical performance, and taste as primary motivators. The motivations for consumption of energy drinks among adolescents, as shown by O'Dea (2003), and medical students, as shown by Hidiroglu et al. (2013), provide correlational evidence that energy drinks are consumed for their enhancement purposes and taste.

In addition to understanding the perceived benefits of energy drink consumption, experimental research examined positive effects of energy drinks in specific groups, such as athletes. For example, Ivy et al. (2009) conducted an experiment in which they assigned six male and six female cyclists to either a flavored-placebo condition or Red Bull condition after a 12-hour fast. Participants were instructed to consume the assigned beverage 40 minutes before a cycling trial. Performance of those assigned to the energy drink condition improved compared to those in the placebo condition; however, no significant differences in participants' ratings of perceived exertion were found between groups. This evidence supports the idea that energy drink consumption can enhance endurance performance.

The benefits of energy drink consumption have also been evidenced on performance of mundane activities, such as long-distance driving. Mets et al. (2011) examined the extent to which Red Bull energy drink consumption could overcome sleepiness and driving difficulties during prolonged driving. Twenty-four participants were randomly assigned to one of three conditions: (1) driving with break and Red Bull; (2) driving with break and placebo; and (3) driving uninterrupted. Those in conditions 1 and 2 drove for two hours on a simulator and then took a 15-minute break. During the break, participants either consumed 250 ml of Red Bull or placebo. Once the 15-minute break was completed, each participant drove two more hours on the simulator. The third condition consisted of uninterrupted driving on the simulator for four hours. Those in the Red Bull condition had significantly improved driving (e.g., able to overcome driving difficulties such as traffic) after consumption compared to participants in the placebo condition and uninterrupted driving condition. In addition to improved driving, individuals in the Red Bull condition also reported significant decreases in sleepiness compared to the placebo condition and uninterrupted driving condition. This study provides evidence for energy drink consumption aiding in sleepiness-relief and difficulty driving during prolonged driving experiences.

Overall, key reasons among adolescents and adults for consumption include enhanced performance and taste of energy drinks (Hidiroglu et al., 2013; O'Dea, 2003). Positive effects of energy drinks appear to match the perceptions consumers have of energy drinks. These effects include enhanced and improved endurance performance and prolonged alertness and attention (Ivy et al., 2009; Mets et al., 2011). This body of research provides information regarding endurance and performance as it relates to energy drink consumption. However, little is known about positive effects on academic performance as it relates to energy drink consumption.

Negative Effects of Energy Drink Consumption. Researchers and health professionals are concerned about the adverse effects of consuming energy drinks because of the amount of caffeine they contain. One of the more notable adverse effects of excessive consumption of energy drinks includes caffeine toxicity. Caffeine toxicity occurs when symptoms such as nervousness, anxiety, restlessness, gastrointestinal upset, tachycardia, insomnia, psychomotor agitation, and tremors arise as a result of excessive caffeine consumption (Reissig et al., 2009).

The risk for caffeine toxicity appears to be greater for those who consume energy drinks than those who consume other caffeinated beverages. Energy drink companies are not required to display warning labels about proper use and often do not label their energy drink products with the amount of caffeine in the product. Additionally, advertisement of energy drinks often involves claims regarding enhanced performance after consumption; this claim is subject to debate (see, for example, Reissig et al., 2009), as caffeine dependence and withdrawal are possible adverse consequences to consuming energy drinks on a regular basis. Reduction of or withdrawal from caffeine can result in emotional and physical symptoms, including headaches, fatigue, drowsiness, dysphoria, depression, difficulty concentrating, irritability, nausea, and muscle aches (Reissig et al., 2009). As a result, many individuals may resort to maintaining or increasing their caffeine consumption to avoid these negative symptoms.

In addition to withdrawal and dependence, energy drinks often yield health problems. The sugar content of energy drinks can impair dental health (e.g., erosion; Rath, 2010). Obesity is another concern for those who consume energy drinks, which often have high caloric content. For women who are pregnant or lactating, some of the health risks of high caffeine consumption include hypertension, dysrhythmias, and congestive heart failure (Clauson, Sheilds, McQueen, & Persad, 2008). Energy drink consumption can also cause dizziness, agitation, confusion, insomnia, hallucinations, heat intolerance, stroke, anxiety, and paranoia (Rath, 2010). These health-related trends are seen internationally. For instance, a study in Germany tracked incidents related to energy drink consumption since 2002 including liver damage, respiratory disorders, agitation, kidney failure, psychotic conditions, seizures, hypertension, and heart failure (Seifert et al., 2011).

Excessive energy drink consumption is linked to overdoses and death. According to Breda et al. (2014), a caffeine overdose can result in heart palpitations, central nervous system stimulation, vomiting, convulsions, hypertension, metabolic acidosis, and dieresis. In the United States, overdoses attributed to energy drink consumption have not been documented under energy drink overdoses, but instead were coded as “caffeine” or “multisubstance exposures” (Seifert et al., 2011). In 2013, an updated report emerged regarding emergency department visits involving energy drinks in the United States. The Substance Abuse and Mental Health Services Administration (SAMHSA; 2013) stated emergency department visits involving energy drinks have doubled from 10,068 in 2007 to 20,783 in 2011. In addition to visits doubling, SAMHSA (2013) found more males were seen in the emergency department for visits involving energy drinks than females, and most of the patients were 18 to 39 years of age. Fifty-eight percent of the emergency department visits involving energy drinks were strictly energy drink visits, and 42% involved energy drinks with other drugs. Although rare, energy drink consumption is linked to deaths in Germany, Ireland, and the United States (Rath, 2010; Seifert et al., 2011). Without regulations regarding consumption, fatal outcomes, including overdose and death, as well as emergency department visits could continue to increase because of consumption of energy drinks.

Existing research provides information about the negative effects as well as the positive effects of energy drink consumption. Fortunately, this allows consumers to better understand the possible risks they are taking when consuming energy drinks. These risks include caffeine toxicity, withdrawal symptoms (e.g., headaches, fatigue, difficulty concentrating), caffeine dependence, obesity, dizziness, insomnia, paranoia, caffeine overdose, and death (Rath, 2010; Reissig et al., 2009; Seifert et al., 2011).

Association of Energy Drink Consumption and Substance Use. In addition to negative effects of energy drink consumption, licit and illicit substance use is linked to energy drink consumption. Higgins et al. (2010) reported energy drink consumption is positively associated with illicit drug use. Similarly, frequency of energy drink consumption is positively correlated with binge drinking and prescription drug misuse (Miller & Quigley, 2011). Istvan and Matarazzo (1984), along with Kozlowski et al. (1993), found individuals who consume large amounts of caffeine to be more likely to consume large amounts of alcohol. More recently, O’Brien, McCoy, Rhodes, Wagoner, and Wolfson (2008) found that, of 496 college students surveyed, 27% reported mixing energy drinks and alcohol in the past month. A similar study conducted by Velazquez, Poulus, Latimer, and Pasch (2012) surveyed 585 college students and found alcohol use and heavy drinking increased by 80% and AmED use increased by 90% for those students who consumed energy drinks for more than one month. These two studies confirm previous research linking energy drink consumption to substance use (Istvan & Matarazzo, 1984; Kozlowski et al., 1993). With the popularity of AmED increasing, researchers are interested in the effects these drinks have on consumers.

Among the many effects AmED consumers experience, AmED leads to more physiological and psychological effects than the consumption of alcohol alome (Peacock, Bruno, & Martin, 2012). The physiological effects include heart palpitations, tremors, sleep difficulties, increased speech speed, and agitation, while the psychological effects include irritability, depression, and tension. Azagba, Langille, and Asbridge (2014) found consumers also experience higher levels of depression than non-consumers. Lohsoonthorn et al. (2013) further confirmed energy drink and alcohol consumption negatively impacted quality of sleep and daytime functioning. Although these effects can occur during consumption of alcohol, these effects tended to be significantly higher during consumption of AmED. Moreover, these physiological and psychological effects appear to lead to primarily negative consequences with no reduction in consumption rates among consumers.

As a result of the increasing consumption rates of energy drinks, researchers are examining alcohol consumption rates among individuals who also report consuming energy drinks. Terry-McElrath, O'Malley, and Johnston (2014) found that 30% of eighth, tenth, and twelfth graders consumed energy drinks and 40% consumed soft drinks daily. Energy drink consumption was positively correlated with previous 30-day alcohol consumption, illicit drug use, and cigarette use (Mann, Smith, & Kristjansson, 2016; Terry-McElrath et al., 2014). Among 298 undergraduate students, 124 consumed energy drinks at least once a week, and 191 reported previous 30-day alcohol use (Skewes, Decou, & Gonzalez, 2013). Motives for consuming energy drinks were also examined among college students, including social, enhancement, coping, and conformity motives (Skewes et al., 2013). Among individuals reporting consumption of energy drinks, Skewes et al. (2013) and Faris (2014) found consumption is linked to appealing advertising by energy drink companies, viewing energy drinks as safe because of advertisement, and social factors, such as friends and parents drinking energy drinks. For the non-consumers of energy drinks, most reported they were not interested in drinking energy drinks or felt energy drinks were not healthy.

In addition to reports of and motives for consuming energy drinks, substance use behaviors have been examined in conjunction with energy drink consumption. Mann et al. (2016) found among sixth to eighth graders, 20% of participants reported they had consumed energy drinks, 10% had smoked cigarettes, and 14% had consumed alcohol at least once. Gallimberti et al. (2013) found similar results among sixth to eighth graders. Gallimberti et al. (2013) also found specific reports of energy drink consumption differing among gender, indicating that 33% of male participants consumed energy drinks at least once a week in comparison to 10.9% of female participants. Among those participants, smoking and alcohol consumption were positively correlated with energy drink consumption. Similarly, Mann et al. (2016) also found energy drink consumption was more common among boys than girls, and those who consumed energy drinks were more likely to smoke and drink alcohol. Although these studies provide reports of one-time consumption of energy drinks and other substances, it seems reports of energy drink and other substance consumption increases as individuals continue their education.

Unfortunately, as individuals continue into college, AmED consumption begins to increase. Faris (2014) found 93 out of 119 participants indicated they consumed AmED because energy drinks made alcohol taste better. Out of 465 college students, 105 students reported previous 30-day AmED consumption (Brache & Stockwell, 2011). AmED consumers also drank heavier, experienced more negative consequences, such as receiving an AmED-related injury, engaged in substance use, such as marijuana and ecstasy, and engaged in risky sexual behaviors, such as engaging in unprotected sex while under the influence, compared to non-consumers (Higgins et al., 2010; Miller, 2012; Snipes & Benotsh, 2012). However, Peacock, Bruno, Martin, and Carr (2013) found risk-taking behavior only increased for energy drink consumption, with or without alcohol.

In addition to risk-taking behaviors and illicit drug use, other internal effects can occur. Cognitive effects, such as perception of impairment, seem to be lessened during AmED consumption. Ferreira, de Mello, Pompéia, and de Souza-Formigoni (2006) assessed participants' perceptions of their impairment while drinking either a Red Bull with vodka or vodka alone. Those who consumed Red Bull with vodka perceived their level of impairment as lower than those who consumed vodka alone, suggesting AmED consumers feel less intoxicated than alcohol consumers alone, which could increase the likelihood of receiving an alcohol-related injury. A real-world example of this phenomenon is Donté Stallworth, a wide receiver for the Cleveland Browns who killed a pedestrian with his car after consuming four shots of tequila and a can of Red Bull (Jones, 2009). Mr. Stallworth reportedly did not feel intoxicated after consuming the liquor and energy drink. Although impairment is perceived as lower while consuming AmED, those who consume AmED report remembering activities they partook in while consuming AmED (e.g., remembering drinking but not realizing level of intoxication).

Awareness of inaccuracies in perception is critical for consumers to understand to help prevent future accidents or injuries.

Energy Drink Consumption Across Populations. Researchers investigated correlates of energy drink consumption, including rates across sex, race and ethnicity, and athlete status. The majority of research revealed energy drink consumption, as well as alcohol consumption, is more prevalent among males than females (Hamilton, Boak, Ilie, & Mann, 2013; Miller, 2008; Velazquez et al., 2012). Ballard, Wellborn-Kim, and Clauson (2010) also found a higher consumption rate of AmED among white men and intramural athletes. As previous research shows, energy drinks are often advertised as performance enhancing (Rath, 2010). Because energy drinks are targeted more for athletes, Ballard et al.'s (2010) findings are not surprising. Miller (2008) termed the identity of athletes as "jock identity," and found individuals who identify strongly as a jock, conform to masculine norms, and partake in risky behaviors also consumed more energy drinks than their counterparts. Another study assessing energy drink consumption among 401 athletes revealed 315 consumed alcohol, 150 consumed AmED, and 194 consumed energy drinks (Woosley, Waigandt, & Beck, 2010). Those who consumed AmED were also more likely to consume larger amounts of alcohol and engage in binge drinking.

Research findings revealed racial and ethnic differences in energy drink consumption rates. A telephone survey conducted by Berger et al. (2011) found consumers of energy drinks in the past year were more likely to identify as non-Black minorities. Past-year AmED consumption was more frequently endorsed by individuals who identified as white. Similarly, Hamilton et al. (2013) found lower percentages of consumption among East, Southeast, and South Asian ethnic backgrounds. Unfortunately, a limited range of research exists concerning racial and ethnic demographics of consumers.

A large body of research focuses on the trends of energy drink consumption based on age. Energy drink consumption among adolescents and young adults has reached 30 to 50%. Caffeine dependence becomes a greater risk when caffeinated energy drinks are consumed at an earlier age (Reissig et al., 2009). Because of the increasing rate of consumption among younger adults and children, researchers have made efforts to determine adverse consequences for these age groups. These consequences include increased rates of insomnia, chronic headaches, irritability, hypertension, chronic headaches, learning difficulties, and motor tics (Shannon, 2007). According to Seifert et al. (2011), 46% of 5,448 caffeine overdoses in 2007 in the United States occurred in individuals younger than 19. The amount of caffeine in energy drinks can improve attention in adolescents and young children, but can also increase blood pressure and sleep difficulties. Seifert and colleagues (2011) also highlight the negative cardiovascular effects of energy drinks on young children and adolescents, including ion channelopathies and hypertrophic cardiomyopathy. These potentially problematic and fatal effects of energy drinks are shown among children and adolescents, and incident rates among these age groups are increasing.

Although this research allows for consumers to better understand the rates among various age groups and risks associated with consumption of energy drinks, with or without alcohol, limited research regarding consumption rates among older adults exists. Park, Onufrak, Blanck, and Sherry (2013) conducted one of the only known studies that assessed a wide range of ages and consumption of energy drinks, along with consumption of sports drinks. Park et al. (2013) found 14.6% of 25 to 39 year old participants, 8.1% of 40 to 59 year old participants, and 2.6% of 60 years and older participants consume sports and energy drinks one to three times a week.

Unfortunately, this research provides limited information yet highlights gaps in the literature regarding consumption among young adults and older adults.

Mechanisms Underlying Academic Performance

Perceived Academic Performance. Individuals' perception of their performance on academic tasks is a concept that some believe is important to actual academic performance. In 1997, Kaplan and Midgley conducted an experimental study providing little support for the perceived performance as a moderator between performance goals and academic performance. However, Samdal, Wold, and Bronis (1999) found results strongly supporting the idea of students' perception of their academic performance as a key for academic achievement. It was suggested for students to feel they will do well or have done well, they should feel satisfied with the academic environment, perceive teachers to have realistic expectations, and have positive peer relationships.

Perceived control regarding an individual's ability to influence or predict some facet of the environment is depicted as a concept that affects academic success (Perry, 1991). Stupnisky, Renaud, Daniels, Haynes, and Perry (2007) conducted a longitudinal study examining perceived control and critical thinking disposition among 1,196 first-year college students. Critical thinking is considered the ability to interpret, analyze, evaluate, infer, explain, and self-regulate information to make judgments and decisions, whereas critical thinking disposition is the tendency to use these abilities (Pascarella & Terenzini, 2005). Researchers found perceived control of academics had a stronger effect on students' grade point average than critical thinking disposition. As previously mentioned, Stringer and Heath (2008) did not find a causal relationship between perception of performance and academic performance, nor was perception the sole predictor of academic performance. The majority of this research shows perception of performance may important, but as Stringer and Heath (2008) and Kaplan and Midgley (1997) argued, it is not all that accounts for academic performance and success.

Academic Performance. Researchers have conducted surveys and experimental research to identify additional factors affecting academic performance beyond that which is accounted for by perceptions. Bandura (1993) believed self-efficacy helped students achieve academic success. However, he also found in his research that teachers' self-efficacy of their ability to motivate and promote learning plays a part in students' academic performance. Wenglinksy conducted a study in 2002 that further confirmed Bandura's (1993) findings regarding teachers' characteristics, specifically their increased knowledge of their subjects and willingness to motivate and promote learning for students. The same study also found classroom practices, including solving unique problems, avoiding reliance on authentic assessments, and hands-on-learning, when added to teachers' self-efficacy, are positively correlated with student academic performance.

Teachers' characteristics and classroom practices, similar to self-efficacy, are not the only components to academic performance and success. Pintrich and de Groot (1990) conducted a correlational study using a self-report measure from 173 seventh graders and found self-efficacy and inherent value to be positively correlated to academic performance and engagement. Chemers et al. (2001) discovered results supporting Pintrich and de Groot's (1990) findings. Specifically, academic self-efficacy was directly related to academic performance and indirectly related to handling stress, poor classroom performance, and health. Additionally, Chemers et al. (2001) found students' optimism is also directly related to academic performance and one's ability to cope.

Researchers extensively examined the impact of time management skills on academic performance. Macan, Shahani, Dipboye, and Phillips (1990) surveyed 165 college students regarding their primary coping strategies, specifically time management. Students who believed they had control of their time reported higher scores on their academic performance, better life and work satisfaction, greater role identity, and fewer tensions than those who had difficulty with time management. Britton and Tesser (1991) found similar results: time management predicted students' cumulative GPA. In contrast, Trueman and Hartley (1996) found little evidence to support time management as a key player for academic performance; however, a gender difference was revealed. Female students reported greater time management skills than male students. Again, conflicting evidence surfaced when Nonis and Hudson (2006) found time management for studying and working had no significant direct effect on academic performance. Given the conflicting nature of these results, leading researchers continue to investigate other links to academic performance.

Engagement in physical activity has been examined as a possible link to success in academics. In 2001, Dwyer, Sallis, Blizzard, Lazarus, and Dean examined physical activity and academic performance and found increased engagement in physical activity enhanced academic performance. However, results were presented with caution because of a cross-sectional design, which limited the causal interpretation. Trudeau and Shephard (2008) found comparable evidence to Dwyer et al. (2001) in a quasi-experimental study that showed additional physical activity at school does not negatively impact academic performance and could result in small grade point average gains. Furthermore, physical activity has been positively correlated with memory, concentration, and positive behavior in the classroom (Trudeau & Shephard, 2008). In contrast, Ahamed et al. (2007) conducted classroom trials of physical activity over the course of 16 months and discovered school-based physical activity did not influence academic performance. Despite this contradictory evidence, a majority of findings suggest physical activity positively impacts academic performance.

A large body of research supports the impact of personality traits on academic performance outcomes. Chamorro-Premuzic and Furnham (2003) examined the impact of “Big Five” personality factors on academic performance. Chamorro-Premuzic and Furnham (2003) found that Neuroticism (i.e., the tendency to experience negative emotions easily and have emotional lability) could hinder academic performance, whereas Conscientiousness (i.e., the will to achieve) could lead to greater academic performance. Individuals high in Neuroticism tend to experience anxiety, depression, anger, embarrassment, worry, and insecurity, whereas Conscientiousness individuals tend to be careful, responsible, planful, thorough, organized, hardworking, persevering, and achievement-oriented (Barrick & Mount, 1991). Poropat (2009) established similar results regarding how academic performance is positively correlated with Conscientiousness, as well as Agreeableness and Openness. Agreeableness is often known as likability or friendliness, and includes traits of being courteous, trusting, forgiving, tolerant, softhearted, and forgiving. Openness is also known as openness to experience, and includes traits of being creative, curious, intelligent, and cultured (Barrick & Mount, 1991). Extraversion was only partially linked to academic performance (Chamorro-Premuzic & Furnham, 2003). Extraversion is also known as being sociable, assertive, talkative, gregarious, and active (Barrick & Mount, 1991). Overall, these studies suggest that individuals high in Conscientiousness, Agreeableness, or Openness personalities are more likely to perform better on academic tasks than those who are high in Neuroticism or Extraversion personalities.

Research suggests factors beyond perception of performance affect academic performance, including self-efficacy among students and teachers, time management skills of students, engagement in physical activity, and individuals high in Conscientiousness, Agreeableness, and Openness personality traits. Although these factors have been found to impact academic performance, perception of performance could potentially be just as impactful. However, the impact of perceived performance in conjunction with other characteristics of students on academic performance remains questionable.

Importance of the Study

To date, no experimental or correlational study has examined the effects of energy drink consumption on perceived academic performance or actual academic performance. Additionally, little is known about the effect of energy drink consumption on actual academic performance beyond perceived academic performance. However, research provides some findings supporting perception of performance as a factor related to academic performance (Samdal et al., 1999). The purpose of this study is to further examine the effects of energy drinks, positive and negative, and levels of optimism and self-efficacy, specifically as it relates to perceived and actual academic performance among college students. Overall, this study sought to evaluate the relationship among energy drink consumption, self-efficacy, and academic performance. The aims of the current study were:

(1) Examining the extent that energy drink-related attitudes predict perceived performance and actual performance on an academic task. Based on previous research (e.g., Hidiroglu et al., 2013; Ivy et al., 2009; Mets et al., 2011; O'Dea, 2003), it was hypothesized those who hold positive energy drink expectancies and those who consume energy drinks for enhanced academic performance would endorse higher perceived performance scores on the academic task during Day II in comparison to those who do not hold positive energy drinks expectancies.

(2) Examining the extent to which energy drink consumption influences actual performance and perceived performance on an academic task. Based on the results of Pettit and DeBarr’s (2011) and Hidiroglu et al.’s (2013) work, it was expected consumption of an energy drink would decrease one’s actual performance on an academic task and increase one’s perception of performance on an academic task.

(3) Examining the extent to which energy drink consumption moderates the relationship between actual performance and perception of performance on an academic task. As a result of Pettit and DeBarr’s (2011) findings, it was expected energy drink consumption would moderate the relationship between actual performance and perceived performance on the academic task.

(4) Examining gender differences in energy drink consumption. Based on findings in the literature (e.g., Arria et al., 2010; Berger et al., 2011; Chiou, Wu, & Lee, 2013; Miller, 2008; Wells et al., 2014), it was hypothesized men would report higher consumption rates of energy drinks than women.

(5) Examining differences in energy drink consumption among those raised in rural areas during childhood in comparison to those raised in urban and suburban areas. Little research has explored geographical differences in energy drink consumption. Therefore, no hypothesis was made regarding geographical differences in energy drink consumption. Thus, this was an exploratory aim.

CHAPTER 3

METHOD

Participants

Participants were recruited from Georgia Southern University through SONA, an organizational system that allows participants to sign up for research studies via the Internet. Using Cohen and Cohen's (1975) power analysis, it was found 100 participants were needed to allow for sufficient power. A total of 124 participants participated in Day I and 100 participated in Day II of the study. After disregarding two participants' data (reasons described below), 122 undergraduate students completed Day I and 98 undergraduate students returned to complete in Day II of the study. The sample is a representative sample of several races and ethnicities, with 58.2 percent of participants identifying as Caucasian/White, 31.1 percent African American/Black, 4.9 percent Hispanic, 1.6 percent Asian, and 4.1 percent identified as "other" (either Pacific Islander, African American and Caucasian, Asian and Caucasian, Hispanic/Black, Pacific Islander/African, or West Indian). The study was conducted over two separate days (see Procedures section for further details). The students were compensated with research credit.

General exclusion criteria included those under the age of 18 for informed consent purposes and those who failed the manipulation checks (e.g., "Please select the word that says paper."); all participants passed the manipulation checks. Our participants consisted of 17- to 27-year-old students, with 34.1 percent reporting their age as 19-years-old. One participant reported being 17-years-old and their data was disregarded in the final analyses. Additionally, one participant fell asleep during Day II and did not complete the experiment; data was disregarded in final analyses. Participants included 38 men and 84 women, with 48.4% consisting of freshmen, 37.7% sophomores, 10.7% juniors, and 3.3% seniors. Out of 122 participants, 108 identified as heterosexual, 11 as bisexual, and three as other sexual minorities. Due to researcher oversight, an additional geographic item was added partway through data collection to assess rurality; therefore, 58 of the 122 participants were asked this demographic question. Sixteen participants reported living in a rural area during childhood and 42 reported living in an urban/suburban area during childhood.

Additionally, those who took a stimulant within the past 24 hours (n = 19), those who have a personal history of cardiovascular disease, tachycardia, palpitations, cardiac arrhythmia, hyperthyroidism, seizure disorder, a disorder that causes electrolyte imbalance, renal disease, or have a first degree family member known to have died before the age of 50 from a sudden heart death (n = 10), and those who have any known allergies or intolerances to any substances administered as part of the study (n = 2) were placed in a water condition rather than an energy drink condition for Day II. Upon signing up to participate, participants were asked to avoid consumption of caffeine for 24 hours prior to completing the study. Therefore, those who indicated they consumed caffeine in the past 24 hours during Day I of the study (n = 20) were placed in a water condition rather than an energy drink condition per medical IRB recommendations. Only those who participated in both days of data collection are included in final analyses.

Measures

Demographics. Participants completed a measure of demographics during Day I. Participants responded to questions related to gender, age, year in college, sexual identity, and ethnicity. Participants were also asked to answer questions concerning consumption of soda, coffee, energy drinks, and alcohol on a regular basis to determine their exposure to various beverages. These items were specifically constructed for the purpose of this study.

Caffeine Consumption. To assess caffeine consumption among participants, the Caffeine Consumption Questionnaire-Modified (CCQ-M; Berg, 2011) was administered during Day I. The CCQ-M is a seven-item measure of average soda, coffee, and energy drink consumption on any given day. All items in the soda (caffeinated) question allow participants to answer with the number of cans, cups, small bottles, and bottles they consume during any given week. Participants provided the number of cans or cups of coffee they consume. All items in the energy drink question allowed participants to answer with the number of energy drinks they consume per type of energy drink. Results of the current study revealed CCQ-M to have a Cronbach's α of .41.

Optimism. To assess individual's general optimism and pessimism, the Life Orientation Test-Revised (LOT-R; Scheier, Carver, & Bridges, 1994; Carver, Sheier, & Segerstrom, 2010) was administered during Day I. The LOT-R is a 10-item measure assessing a person's levels of optimism and pessimism on a continuum. Each item is rated on a 5-point Likert-scale, ranging from "I agree a lot" (1) to "I disagree a lot" (5). Of the 10 items, three measure optimism (e.g., "In uncertain times, I usually expect the best."), three measure pessimism (e.g., "If something can go wrong for me, it will."), and four questions are filler items (e.g., "I enjoy my friends a lot."). The LOT-R has demonstrated sufficient validity and reliability, with the optimistic views scale producing a Cronbach's α of .70 and the pessimistic views scale producing a Cronbach's α of .74 (Scheier et al., 1994; Carver et al., 2010). For the current study, LOT-R optimism scale produced a Cronbach's α of .58 and LOT-R pessimism scale produced a Cronbach's α of .68.

Self-Efficacy. The Personal and Academic Self-Concept Inventory (PASCI; Fleming & Whalen, 1990) assessed participants' concept of themselves within their personal and academic performance during Day I. The PASCI consists of 45 items. However, for the purposes of this study, only 12 questions were administered to assess participants' perceived self-confidence as it pertains to their perceived academic ability (e.g. "Do you think of yourself as a generally competent person who can do most things well?). The 12 items were measured with a 5-point Likert-scale, ranging from "Never" (1) to "Always" (5). Indices of reliability and validity were not available for this measure, thus a pilot study was conducted in the AMP Health Laboratory and revealed adequate reliability for the Positive Self-perception (Cronbach's $\alpha = .72$) and Negative Self-perception (Cronbach's $\alpha = .70$) subscales, respectively. For the current study, the Positive Self-perception (Cronbach's $\alpha = .51$) and Negative Self-perception (Cronbach's $\alpha = .47$) subscale revealed a Cronbach's Alpha lower than 0.70

In addition to the 12 items from the PASCI, questions from the Academic Self-Perception subscale from the School Attitudes Assessment Survey (McCoach, 2002) further assessed self-efficacy. The Academic Self-Perception subscale consists of 5 items (e.g., "I am confident in my ability to succeed in school.") measured on a 5-point Likert-type scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). It was administered during Day I. Indices of reliability and validity of this measure were not available, thus a pilot study was conducted in the Alcohol Mental and Physical (AMP) Health Laboratory and revealed adequate reliability with a Cronbach's α of .87. The current study revealed a Cronbach's α of .81.

Lastly, a Math subscale of the PASCI (PASCI-m; Fleming & Whalen, 1990; Gifford, 2005) assessing participants' self-concept related to mathematics was administered during Day I. This questionnaire consists of 4 items (e.g., "Compared with others, how confident do you feel in your mathematical abilities?") measured on a 5-point Likert-scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). Indices of reliability and validity of this measure were not available, thus a pilot study was conducted in the AMP Health Laboratory and revealed adequate reliability with a Cronbach's α of .71. The current study found the Academic Self-Perception subscale to have a Cronbach's α of .59.

Perceived Test Performance. For the purpose of this study, a brief measure entitled "Self-Perception of Performance on a Math Test" was created to assess how participants' feel they performed on the provided math task on Day I and Day II (AMP Health Lab, 2015). The measure consists of two items: "I completed the task to the best of my ability," and "I believe I did well on the task." These items were measured using a 5-point Likert-scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). This measure produced a Cronbach's α of .64 for Day I and .71 for Day II.

Goal Orientation. The Goal Orientation Scales (GOS; Elliot & McGregor, 2001) assesses participants' goals when performing a task. This measure was modified for the purposes of the study. It consists of 20 items (e.g., "It's very important for me that I don't look stupid in this study.") measured on a 5-point Likert-scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). These items were administered during Day I questionnaires following completion of the Math Task. Indices of reliability and validity were not available for this measure, thus a pilot study was conducted in the AMP Health Laboratory and revealed adequate reliability across two of the three subscales. Specifically, the Mastery Approach (GOS mapp: "I want to learn as much as possible from this study."), Mastery Avoidance (GOS mavo: "I am often concerned that I may not learn all that there is to learn in this study."), and Performance Approach (GOS perfap: "I want to do better than the other participants in this study.") subscales demonstrated adequate reliability, with Cronbach's α of .74, .80, and .88, respectively. The Performance Avoidance (GOS perfavo: "It's very important for me that I don't look stupid in this study.") demonstrated insufficient reliability with a Cronbach's α of .58. The current study produced adequate reliability for GOS mavo (Cronbach's α = .70), GOS perfap (Cronbach's α = .84), and GOS perfavo (Cronbach's α = .74); however, GOS mapp produced a Cronbach's α of .63.

Energy Drink Attitudes. To assess participants' attitudes toward energy drinks, the Attitudes toward Energy Drinks Questionnaire (Asiraphot & Waleetorncheepsawat, 2009) was administered during Day II. This questionnaire consists of 10 items (e.g., "Energy drinks make me feel fresh and alert.") measured on a 5-point Likert-scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). Indices of reliability and validity of this measure were not available in current research, thus a pilot study was conducted in the AMP Health Laboratory and revealed sufficient reliability, with a Cronbach's α of .88. The current study produced a Cronbach's α of .73.

Effects of Caffeine. To assess participants' retrospective (or current) experiences of the effects of caffeine, the Caffeine Effects Questionnaire (CEQ; Berg, 2011) was administered during Day II. This questionnaire consists of 13 items measured on a 5-point Likert-scale ranging from "Not at all" (1) to "Very often" (5). The questionnaire assesses typical (e.g., "I would feel more awake.") and atypical (e.g., "I would feel more anxious.") effects of caffeine. Indices of reliability/validity for this measure were not available in current research, thus a pilot study was conducted in the AMP Health Laboratory and revealed an unacceptable level of reliability for items assessing Typical Features (Cronbach's α = .61) and an acceptable level of reliability for items assessing Atypical Features (Cronbach's α = .91); whereas Typical Features had a Cronbach's α of .90 and Atypical Features had a Cronbach's α of .42 for the current study.

Academic Task. For this study, Basic Operations Practice Questions (O'Connor, 2016) were used to assess performance on an academic task (see Appendices III and IV; Jacobsen, 2013b, 2013c). A math test is sufficiently challenging for researchers to accurately gauge participants' performance. It is also a test that can easily be tested and retested with different items using similar concepts over time, better controlling for practice effects. Study materials (see Appendices I and II; Jacobsen, 2013a, 2013d) can be relatively straightforward, as a result of using a math test that focuses on specific operations. The academic tasks used for Day I and Day II are similar in difficulty, but contain different items to better control for practice effects.

Materials

Water. Participants were randomly assigned to one of four conditions prior to participation: (1) Water-Academic Task delayed condition; (2) Water-Academic Task immediate condition; (3) Energy-drink Academic Task delayed condition; and (4) Energy-drink Academic Task immediate condition. During Day I, participants in the Water Conditions (see Procedures section for further detail) did not receive water. During Day II, those participants in the Water Conditions and those participants excluded from the Energy Drink Conditions were provided 8 ounces of Aquafina water. This water was chosen because it could easily be purchased in bulk.

Energy Drink. During Day I, participants in the Energy Drink Conditions (see Procedures section for further detail) did not receive an energy drink. However, during Day II, if these participants were not excluded from the Energy Drink Conditions, they were provided 8 ounces of Monster Energy Drink. Participants were informed during the informed consent portion of the study of the possibility they may have to consume caffeine; they were not informed of the type of drink and the drink was provided in a clear plastic cup. This energy drink was chosen because it could easily be purchased in bulk and is one of the most consumed energy drinks.

Study Materials. Study materials were provided to participants in all conditions. During Day I, each participant received an Academic Task Study Guide (see Appendix I; Jacobsen, 2013a). The study materials were similar during Day II, to help reduce practice effects, while also providing material targeting the same information on the Academic Task (see Appendix II; Jacobsen, 2013d).

Design

A longitudinal, experimental design was used to determine if students' consumption of energy drinks impacts students' perceptions of their performance on an academic task, which in turn may impact actual performance in these individuals in comparison to those who consume water. The dependent variable in this study was students' actual performance on the academic task. The first independent variable was drink type (energy drink or water). The second independent variable was students' perceived performance on the academic task. A covariate of interest in this study was self-efficacy in math. The questionnaires and administration of the academic test were counterbalanced to control for ordering effects across groups. Participants were assigned to one of four conditions: (1) Water-Academic Task delayed condition; (2) Water-Academic Task immediate condition; (3) Energy Drink-Academic Task delayed condition; (4) Energy Drink-Academic Task immediate condition. During Day I, participants in conditions 1 (Water-Academic Task delayed condition) and 3 (Energy Drink-Academic Task delayed condition) completed informed consent, studied test materials, completed questionnaires before completing a math test, completed additional questionnaires, and were debriefed. Participants in conditions 2 (Water-Academic Task immediate condition) and 4 (Energy drink-Academic Task immediate condition) completed informed consent, studied test materials, completed a math test, completed questionnaires, and were debriefed.

Day I participants did not receive any type of drink in order to establish a baseline (see Table 1). During Day II, participants in conditions 1 (Water-Academic Task delayed condition) and 3 (Energy Drink-Academic Task delayed condition) completed informed consent, studied test materials, complete questionnaires before completing a math test, completed additional questionnaires, and were debriefed. Participants in conditions 2 (Water-Academic Task immediate condition) and 4 (Energy Drink-Academic Task immediate condition) completed informed consent, studied test materials, completed a math test, completed questionnaires, and were debriefed (see Appendix VI, Table 2). While studying test materials, each participant consumed the beverage they were assigned (water or energy drink).

Procedures

Day I. Each participant completed Day I individually and in-person in the AMP Health Lab located on the campus of Georgia Southern University. Prior to completing Day I, each participant was randomly assigned to one of four conditions: (1) Water-Academic Task delayed condition (n = 24); (2) Water-Academic Task immediate condition (n = 26); (3) Energy Drink-Academic Task delayed condition (n = 35); (4) Energy Drink-Academic Task immediate condition (n = 37). Of note, participants did not receive the type of drink until Day II in order to establish a baseline for each participant during Day I. After informed consent was completed, each participant constructed a participant code in order to ensure anonymity, using the first initials of their first and last name, followed by their day of birth, and lastly their birth month (e.g., AH1612). This allowed data to be linked from Day I to Day II without using identifying information. A research assistant then provided study materials for solving various math problems for each participant to review for 30 minutes (see Appendix V, Table 1). During that time, the researcher gave a five-minute warning to finish studying the material before beginning the next phase of the study. The questionnaires during Day I took approximately 15 minutes to complete and the math task took an additional 30 minutes to complete. This day took approximately 75 minutes to complete. Those who participated in Day I were compensated 1.5 credit hours for research.

Day II. Each participant completed Day II individually and in-person seven days after completing Day I in the AMP Health Lab, with the exception of a few participants due to unexpected closure of the University (see Results section for further information). A research assistant instructed the participants to complete the condition to which they were assigned during Day I, with the exception of those excluded from the Energy Drink Conditions. During Day II, 25 participants were in condition 1, 29 in condition 2, 23 in condition 3, and 21 in condition 4. Those who were excluded from conditions 3 and 4 due to their responses on the exclusion questions were assigned to conditions 1 and 2 for Day II participation. Each condition consisted of the same order of tasks and questionnaires as the conditions in Day I. However, the questionnaires and drink conditions differed. After informed consent was completed, participants were instructed to provide their code from Day I to a research assistant. A research assistant then provided new study material for solving different math problems for each participant to review for 30 minutes, along with the drink. Participants in conditions 1 and 2 consumed eight ounces of Aquafina water and participants in conditions 3 and 4 consumed eight ounces of Monster Energy Drink while studying material (see Appendix VI, Table 2). Twenty-five minutes into the study session, the researcher gave a five-minute warning to finish their drink before beginning the next phase of the study. Each participant was expected to consume eight ounces of the drink. The questionnaires during Day II took approximately 15 minutes to complete and the math task took approximately 30 minutes to complete. This day took approximately 60 minutes, on average, to complete. Those who participated in Day II received an additional one credit hour for research.

Statistical Analyses

A series of descriptive statistics were used to analyze the demographics of the sample, including age range, race/ethnicity, gender, and average caffeine and energy drink consumption. A preliminary analysis, including bivariate correlations, was conducted to determine if any significant correlations exist among students who drink energy drinks, levels of optimism and self-efficacy, and self-reported perceptions of performance on an academic task.

To test Aim 1, two multiple regression analyses determined the extent to which energy drink-related attitudes (predictor variable) predict perceived performance (outcome variable) and actual performance (outcome variable) on an academic task during Day II.

To test aim 2, two repeated measures factorial mixed Analysis of Variance (ANOVA) analyses were conducted to determine the extent to which perceived and actual performance changes significantly over time (Day I to Day II), depending on beverage condition (water or energy drink). The between groups analysis consists of the condition to which each participant is assigned (water or energy drink) and the within groups analysis consists of time (Day I to Day II). The intervention in this analysis is the drink type (water or energy drink).

To test hypotheses of Aim 3, a moderation analysis using hierarchical multiple regression (HMR) determined if consumption of energy drinks moderates the relationship between actual performance and perceived performance on an academic task. The outcome entered in the HMR was participants' actual performance score during Day II on the academic task. In step 1, perceived performance score on the academic task during Day II was entered. In step 2, the condition (water and energy drink) was entered as a dichotomous variable (i.e., 0 = water; 1 =

energy drink). It is important to note the four conditions included in the research design were intended to account for ordering effects by counterbalancing the administration of surveys and tasks; however, statistically these groups were treated as two conditions (water and energy drink conditions).

Two independent t-tests examined Aims 4 and 5, respectively, to determine the extent to which differences exist in energy drink consumption levels between genders (women vs. men), as well as differences in energy drink consumption between childhood geographic statuses (rural vs. urban/suburban).

CHAPTER 4

RESULTS

Relationship between Energy Drink Consumption, Perception, and Academic Performance

A preliminary analysis, including bivariate correlations, determined if any significant correlations exist among students who drink energy drinks, levels of optimism and self-efficacy, and self-reported perceptions of performance on an academic task on an academic task. From the total sample of 122 participants, higher levels of self-efficacy in academics were positively correlated with beliefs in mathematics ability, $r(120) = .36$, $p < 0.01$. Higher levels of self-efficacy were negatively correlated with beliefs of positive self-efficacy, $r(120) = -0.60$, $p < 0.01$, and negative self-efficacy, $r(120) = .40$, $p < 0.01$. Although this is contrary to what was predicted, these results could occur because of PASCI positive self-perception measures' and negative self-perception measures' Cronbach's Alpha of .51 and .47. Actual performance on an academic task during Day I was positively correlated with actual performance on an academic task during Day II, $r(120) = 0.62$, $p < 0.01$. Avoidance of mastering academic skills was positively correlated with having negative self-efficacy, $r(120) = 0.52$, $p < 0.01$, and avoidance of performing academic skills, $r(120) = 0.55$, $p < 0.01$. Additionally, avoidance of performing academic skills was positively correlated with approaching performance of academic skills, $r(120) = 0.72$, $p < 0.01$.

Predicting Academic Performance

To address aim 1, a multiple regression analysis determined the extent to which energy drink-related attitudes predict *perceived* performance on an academic task generally. The predictors in the analysis were beliefs of typical features of energy drinks, atypical features of energy drinks, and attitudes toward energy drinks. The analysis revealed results contradictory to the hypothesis that those who hold positive expectations of energy drinks and those who consume energy drinks for enhanced academic performance would endorse higher perceived performance scores on the academic task. In total, the three predictor variables accounted for 1.8% of the variance, $R^2 = .02$, adjusted $R^2 = -.01$, $F(3, 95) = .59$, $p = .63$. Individually, beliefs of typical features of energy drinks ($B = -.028$, $p = .440$), beliefs of atypical features of energy drinks ($B = .030$, $p = .633$), and attitudes toward energy drinks ($B = -.030$, $p = 0.497$) failed to significantly predict perceived performance.

A second multiple regression analysis determined the extent to which energy drink-related attitudes predict *actual* performance on an academic task over time. The predictors in the analysis were beliefs of typical features of energy drinks, atypical features of energy drinks, and attitudes toward energy drinks. The analysis revealed results contradictory to the hypothesis that those who hold positive expectations of energy drinks and those who consume energy drinks for enhanced academic performance would endorse higher perceived performance scores on the academic task. In total, the three predictor variables accounted for 4.5% of the variance, $R^2 = .05$, adjusted $R^2 = .015$, $F(3, 95) = 1.51$, $p = .22$. Individually, beliefs of typical features of energy drinks ($B = .033$, $p = 0.655$), beliefs of atypical features of energy drinks ($B = .197$, $p = 0.118$), and attitudes toward energy drinks ($B = -.156$, $p = .079$) failed to significantly predict actual performance on an academic task.

Energy Drink Consumption

Two separate 2 x 2 repeated measures (mixed model) ANOVA analyses determined the extent to which perceived and actual performance changed significantly over time (Day I to Day II), depending on beverage condition (water or energy drink). The between groups analysis consisted of the condition each participant was assigned (water or energy drink) and the within groups analysis consisted of time (Day I to Day II). The intervention in this analysis was the drink type (water or energy drink).

The first mixed model ANOVA assessed changes in *actual* performance between conditions from Day I to Day II. A significant main effect was obtained for test score, F (1, 96) = 4.723, p = .03, partial η^2 = .05, with test scores declining from Day I (M = 15.10; SD = 3.68) to Day II (M = 14.40; SD = 3.40). A significant main effect of condition was not found, F (1, 96) = 0.41, p = .75, partial η^2 = .01. Lastly, an interaction effect between condition and actual performance scores was not found, F(1, 96) = 0.66, p = .42, partial η^2 = .01. Examination of the means indicated that although there was a small decrease in performance scores in participants from Day I to Day II overall, consumption of an energy drink had no effect on actual performance [Day I test score (M = 14.77; SD = 3.92); Day II test score (M = 14.14; SD = 3.44)], nor did water [Day I test score (M = 15.35; SD = 3.48); Day II test score (M = 14.14; SD = 3.70)].

The second mixed model ANOVA assessed changes in *perceived* performance between conditions from Day I to Day II. A significant main effect was not obtained for perceived performance, F (1, 96) = 1.50, p = .22, partial η^2 = .02. A significant main effect of condition was not found, F (1, 96) = .46, p = .50, partial η^2 = .01. Lastly, an interaction effect between condition and perceived performance was not found, F (1, 96) = .43, p = .52, partial η^2 = .00. Examination of the means indicated no significant increase in perception of performance from Day I to Day II in the condition in which a participant consumed an energy drink [Day I perception (M = 8.61; SD = 1.13); Day II perception (M = 8.25; SD = 1.77)], nor did water [Day I perception (M = 8.33; SD = 1.29); Day II perception (M = 8.22; SD = 1.62)].

Energy Drink Consumption on Prediction of Actual Academic Performance

A moderation analysis using hierarchical multiple regression (HMR) determined if consumption of energy drinks moderates the relationship between actual academic performance and perceived performance on an academic task (Aim 3). The outcome entered in the HMR was participants' actual performance score during Day II on the academic task. In step 1, perceived performance score on the academic task during Day II and condition were entered separately, note the conditions (water and energy drink) were entered as a dichotomous, dummy coded variable (i.e., 0 = water; 1 = energy drink). These variables—perceived performance and condition—accounted for a significant 10.6% of variance in actual test performance, $R^2 = .11$, F (2,95) = 5.61, $p = .005$. An interaction term of condition by test score was created and entered into Step 2 of the regression model, which accounted for a significant 3.5% of variance in actual test performance, $\Delta R^2 = .04$, ΔF (1, 95) = 3.85, $b = -.49$, $t(95) = 1.96$, $p = .05$. Examination of the interaction plot showed that perceived performance influenced actual performance on the math test specifically for the energy drink condition; that is, those who consumed an energy drink and rated their perceived performance as low on the math test indeed performed the worst in comparison to all other participants. In contrast, those who consumed an energy drink and also rated their perceived performance on the math test as strong produced the highest scores in comparison to all other participants (see Figure 1 in Appendix VII).

Gender, Geographic Status, and Energy Drink Consumption

Two independent-samples t-tests were used to determine the extent to which differences exist in energy drink consumption levels between genders (women vs. men) and childhood geographic statuses (rural vs. urban/suburban). The first independent-samples t-test analysis revealed a significant difference of energy drink consumption between genders, $t(120) = 1.61$, p

= .001. Men (*n* = 38) reported higher consumption rates of energy drinks (*M* = .66, *SEM* = .21) than women (*n* = 84; *M* = .29, *SEM* = .13). The second independent-samples t-test analysis revealed a significant difference of energy drink consumption between childhood geographic statuses, $t(56) = 1.33$, $p = .03$. These results indicate those who reported living in rural areas during childhood (*n* = 16) also reported higher consumption rates of energy drinks (*M* = .97, *SEM* = .59) compared to those who reported living in urban/suburban areas during childhood (*n* = 42; *M* = .38, *SEM* = .16).

CHAPTER 5

DISCUSSION

The current study sought to examine the extent to which energy drink consumption and perceptions of ability in academics influence actual academic performance. The social stress model and conditioning model of substance use are theories guiding the present study. The social stress and condition models hypothesize motivations for substance use, including energy drink consumption. Specific motivations include coping with stress from school (e.g., succeeding on an exam) and succumbing to peer pressure (e.g., drinking AmED at a party because friends are drinking AmEDs). Although researchers have assessed other motivations for drinking energy drinks specifically, little research has been aimed at understanding how energy drink consumption affects perceived and academic performance. In order to answer this research question, a longitudinal, experimental design was employed to assess whether students' consumption of energy drinks impacts students' perceptions of their performance on an academic task, which in turn may impact actual performance.

Energy Drink Consumption and Academic Performance

Little attention has been placed on academic performance, perceived academic performance, and energy drink consumption, particularly in the experimental context. The current findings yielded mixed results on the impact of perception and consumption of energy drinks on actual performance.

Results of a mixed model ANOVA to determine the extent to which perceived and actual performance changes significantly over time (Day I to Day II), depending on beverage condition (water or energy drink), revealed a significant main effect of test scores, specifically a decline in test scores from Day I to Day II in general. However, no significant main effect was found for condition or an interaction effect between condition and actual performance scores. These results are contradictory to previous research findings and theories suggesting energy drinks provide cognitive benefits (e.g., increased attention) and could improve memory, performance, alertness, and mood (Attila & Cakir, 2010; Braganza & Larkin, 2007). It is possible the nature of the study's design is the reason for the lack of significant results. For instance, the dose administered in the current study may have impacted the results. Participants only consumed 8 oz. of an energy drink, when the standard can size is 16 oz.; therefore, if participants are used to consuming energy drinks at a higher dosage, it is possible significant effects may not be revealed at lower dosages. Moreover, the studying portion of the experiment may not have been sufficiently stressful or realistic. According to the social stress model, individuals consume substances to cope with external stressors (e.g., expectations of academic performance), which impacts their ability to cope and perform (Rhodes & Jason, 1990). Participants in this study may not have felt adequately pressured to do well on the academic task because they were receiving research credit for participation, not how well they performed on the academic task.

While the mixed-model ANOVA results indicated participants' performance generally decreased from Day I to Day II despite consumption of water or energy drinks, a moderation analysis using HMR revealed energy drink consumption as moderator of the relationship between perceived performance and actual performance on an academic task. Interestingly, for only those in the energy drink condition, the better one believed they did on the academic task was correlated with higher scores on the actual math test. Moreover, for those in the energy drink condition only and those who rated their perceived performance as poorer also produced lower actual scores on the math test. In contrast, stronger perceptions of performance for those in the water group did not lead to significantly better test scores in comparison to those who rated their perceived performance as lower.

While Pettit and DeBarr (2011) are the only researchers to provide evidence for the negative impact of energy drink consumption on academic performance in a laboratory setting, perception of academic performance was overlooked. Separately, Samdal, Wold, and Bronis (1999) research provides support for perception of academic performance as a key factor for academic achievement. Taken together, it stands to reason that both perceived performance and the consumption of energy drinks should result in differences in actual performance. Although further work in this area is necessary to draw any definitive conclusions, the results of the current study provide evidence for the importance of perception of performance on actual performance on an academic task, as well as evidence supporting energy drinks as a factor moderating the perceived performance-actual performance relationship. Although speculative, it is possible metacognition was effected after consuming an energy drink. As a result, participants could have placed more attention on their perceptions of performance, therefore affecting their actual performance. For example, participants might have held positive perceptions of their ability to perform the academic task and those positive perceptions were increased after consuming an energy drink. These perceptions possibly increased because of the energy drink affects (e.g., increased attention), which resulted in performing well on the academic task.

Examining Influence of Perceptions on Academic Performance

Contrary to expectations, no significant increase in perception of performance was found from Day I to Day II, depending on condition (water or energy drink). Perceptions of performance did not increase after consuming an energy drink. However, Samdal, Wold, and Bronis (1999), along with Perry (1991), and Pascarella and Terenzini (2005), found perceived performance as an important factor in academic performance, suggesting higher perception produces better academic performance. While it is possible the lack of significant findings is the result of the lack of importance participants placed on the experiment, these findings are suggestive of an absence of relationship between perceived performance and actual performance outcomes. The work of Kaplan and Midgley's (1997) and Stringer and Heath's (2008) is consistent with the current findings, indicating little support for perceived performance as a moderator between academic performance and performance goals.

Gender and Geographic Status

In support of the hypothesis of Aim 4, men reported higher levels of energy drink consumption than women. These results are consistent with research findings in Pettit and DeBarr (2011), Berger et al. (2011), Gallimberti et al. (2013), and Mann et al.'s (2016) research. In 2011, Pettit and DeBarr investigated energy drink consumption and academic performance. Results of their study revealed males consumed more energy drinks than females. In 2016, Mann et al. also found higher rates of energy drink consumption among males compared to females. Because participants consisted of college students, Olson's (2015) suggestion regarding males feeling more pressured to complete more courses and assignments, and make more money after college than females, could apply to the results found in this study. Therefore, it is possible males in college consume more energy drinks than females to conform to gender role stereotypes.

Aim 5 was an exploratory aim as a result of lack of research regarding rural versus urban/suburban rates of energy drink consumption. Results revealed those who grew up in rural areas consumed more energy drinks than those who reported growing up in urban/suburban areas. Although research does not suggest higher rates of energy drink consumption in rural areas compared to urban/suburban areas, Sci, Toumbourou, Miller, Staiger, Hemphill, and Catalano (2011) found rural students use substances more often than urban students. Similarly, Lambert, Gale, and Hartley (2008) found higher substance use among rural youth and young adults compared to urban youth and young adults. Additionally, they found an increased risk for continued substance use in adulthood among rural participants compared to urban participants (Lambert, Gale, & Hartley, 2008). As a result, these findings show support for higher consumption rates of substances, including energy drinks (caffeine as a substance), among rural individuals compared to urban/suburban individuals.

Limitations

While this study is thought to contribute useful information to the growing body of research on energy drinks, several limitations can be found throughout the study. In hindsight, it may have been useful to have all participants complete the task in the morning or all in the afternoon to control for time of day effects on energy drink consumption. Additionally, the questionnaire assessing rural/urban backgrounds was not implemented until the latter half of data collection due to an oversight by the researchers. As a result of a smaller sample size for this item (n = 58), the data collected and analyzed regarding energy drink consumption differences among rural/urban backgrounds is not a strong representation of differences found among these populations. Also, the sample size of men (n = 38) compared to women (n = 84) women could have affected the results as well. Another limitation was the inability to ensure participants did not consume caffeine 24 hours before completing the study during Day I or Day II. Lastly, potential limitation is the lack of reliability of existing measures to assess self-efficacy, levels of optimism, and energy drink-related attitudes. As a result, the data may not be a strong representation of energy drink-related attitudes, perceptions of self, or levels of optimism among participants.

Clinical Implications

Clinically, results from this study suggest energy drink consumption affects academic performance. Additionally, men and individuals who identify as growing up in a rural area are more likely to consume more energy drinks than their counterparts. Therefore, it will be important to discuss the negative impacts of energy drink consumption when combined with lower perception of performance. Moreover, focusing on individuals, specifically males, who grew up in rural areas is necessary, as rurality appears to be a key factor in increased risk for substance use, including caffeine use. Overall, realistic effects of energy drinks need to be discussed in a way that will promote greater physical wellness and academic well-being.

Future Directions

Although this study provides new information regarding energy drink research, more research must begin focusing on explaining why consuming an energy drink plays such an important role in academic performance. If perception does not change after consuming an energy drink, what affects are occurring after consuming an energy drink to ultimately affect actual academic performance? Additionally, other factors can be examined to assess energy drink consumption on academic performance, including time of day. For example, if a student drinks an energy drink in the morning and believes they are more awake, they may perform better on a task than a student who drinks an energy drink in the afternoon and believes less in the effects because they are already awake. Moreover, metacognition after consuming an energy drink could be further examined to determine if the increase in metacognition accounts for the moderating effect of energy drinks in the perceived performance-actual performance relationship.

To strengthen this study, it would be important to control for time of day effects by having all participants participate in the study during the morning or all in the afternoon. Additionally, a urine test could be added to determine if participants actually consumed caffeine before the study. By adding a urine test, researchers could control for caffeine effects interfering with a baseline study or consumption of caffeine during the study. Researchers will also need to strengthen the reliability of several measures used in this study (i.e., CCQ-M, LOT-R, PASCI, PASCI-m, Self-Perception of Performance on a Math Test, GOS, and CEQ). To strengthen the reliability of these measures, researchers may have to modify the items in each questionnaire. Researchers may also consider creating new measures to target information in a more reliable way.

Conclusion

Overall, these findings indicate energy drink consumption negatively impacts academic performance when combined with negative perceptions of performance. Results revealed academic performance was affected by energy drink consumption and perception of performance, showing individuals who endorsed higher levels of perception after consuming an energy drink had higher academic performance than those who endorsed lower levels of perception after consuming an energy drink and those who consumed water. This suggests energy drink consumption, in general, affects academic performance, whereas water has no affect. Additionally, energy drink consumption, when combined with greater perceived performance, results in better results on academic tasks.

In summary, the current study used an experimental design to further understand the effects of energy drink consumption and perceived performance on academic performance. Through a carefully designed longitudinal, experimental study, detailed information was gathered related to energy drink consumption, self-efficacy, effects of caffeine, energy drink attitudes, motivation to succeed, levels of optimism and pessimism, and perceived performance. This information was then used to determine what was most salient in understanding the relationship between energy drink consumption, perceptions of academic performance, and actual academic performance. In doing so, this study was able to begin filling a research gap related to identifying the effects of energy drinks on academic performance, accounting for perceptions of performance. Moreover, results provide evidence of energy drink consumption moderating the relationship between perceived academic performance and actual academic performance. Therefore, future research focusing on reasons for the moderating affect of energy drinks needs to be conducted. A possible reason could be energy drink consumption increases attention to one's perception of abilities, which ultimately affects actual performance. As this is one of the first studies to examine these concepts together within an experimental context, the findings of the study must be further examined to continue building research supporting the idea that energy drink consumption negatively impacts academic performance.

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APPENDIX I

Academic Task Study Guide Day I

Materials available for public use (Jacobsen, 2013a).

Numbers, Sequences, Factors

In terms of:	For example, if $6a + 12b = 3a + 6b – 9c +15$, and you are asked to solve for a in terms of b and c, then simply solve for a with all other variables and numbers on the other side of the equation. Here, you would get $3a = 15 – 6b – 9c$ so that $a = 5 – 2b – 3c$.
Less, fewer:	Think of *subtraction*. For example, "y is three less than twice x" is equivalent to $y = 2x – 3$. Another example: "Aubrey has 6 fewer cabbages than Bill does" could be written in equation form as $A = B – 6$. Note that the number or expression that comes before "less" or "fewer" appears *after* the minus sign in the equivalent expression.
Integers:	Integers are numbers without a fractional part (and that is why they are often called the *whole* numbers)…., -3, -2, -1, 0, 1, 2, 3, … Even integers: can be divided by two without a remainder. The even integers include 0, 2, 4, 6, 8, 10, 12, …, along with -2, -4, -6, … Odd integers: can not be divided by two without a remainder. The odd integers include 1, 3, 5, 7, 9, 11,…, along with -1, -3, -5, …
Reals:	Real numbers are all the numbers on the number line, including the integers, the rational numbers, and everything else, which includes for example the *irrational* numbers such as intergers $\sqrt{2}$, π, etc. Not to be confused with the *fake* numbers.
Remainder:	When an integer is divided by another, the remainder is the *integer* amount that is left over. For example, when 66 is divided by 7, the remainder is 3, since 7 goes into 66 a total of 9 times, with 3 left over: $66 = 7 \times 9 + 3$.
Domain:	The domain of a function is all of the possible values that can be used as input to the function, so that the function returns a real value. If the function is written as $y = f(x)$, the domain is all possible values of x such that y is a real number. For example, the domain of the function $f(x) = 1/(1 – x)$ is all real numbers except for $x = 1$, since if $x = 1$, the denominator is 0 and the function

	"blows up." The domain of $f(x) = \sqrt{x}$ is all positive real numbers, along with zero.
Positive, Negative:	A positive number is greater than zero, and a negative number is less than zero. Zero itself is neither positive nor negative. Note that a negative number raised to an even power is positive, and when raies to an odd power is negative. For example, $(-1)^{374} = 1$ but $(-1)^{373} = -1$.
Multiple:	A multiple of a number is the result of multiplying that number by an integer. For example, the multiples of 15 include 15, 30, 45, 60, … but also 0, -15, -30, …
Rational:	A rational number is any number than can be written as a fraction: a ratio of two integers. Rational numbers include 1/2, 3/4, 5 (since 5 = 5/1), 22/7, 1/3, and so on. These numbers can always be written as a finite decimal or as an infinite decimal that repeats. For example, 2/5 = 0.4.
Order of Operations:	PEMDAS (Parentheses / Exponents / Multiply / Divide / Add / Subtract)
Arithmetic Sequences:	each term is equal to the previous term plus d Sequence: $t_1, t_1 + d, t_1 + 2d, \ldots$ The nth term is $t_n = t_1 + (n - 1)d$ Number of intergers from i_n to $i_m = i_{m} - i_n + 1$ Sum of n terms $S_n = (n/2) * (t_1 + t_n)$ (optional)
Geometric Sequences:	each term is equal to the previous term times r Sequence: $t_1, t_1 * r, t_1 * r^2, \ldots$ The nth term is $t_n = t_1 * r^{n-1}$ Sum of n terms $S_n = t_1 * (r^n - 1) / (r - 1)$
Factor:	A factor of a number is any integer that can divide that number without a remainder. For example, the factors of 12 are 1, 2, 3, 4, 6, and 12; the factors of 29 are just 1 and 29.
Prime:	A prime number is a positive integer that has only two factors: itself and 1. The prime numbers include 2, 3, 5, 7, 11,… but do *not* include 1 (the number 1 only has one factor, not two). The *prime factors* of a number are the factors of the number that also are prime. For example, the prime factors of 12 are 2 and 3 and the only prime factor of 29 is 29.
Prime Factorization:	break up a number into prime factors (2, 3, 5, 7, 11, …) 200 = 4 x 50 = 2 x 2 x 2 x 5 x 5

52 = 2 x 26 = 2 x 2 x 13

Greatest Common Factor: multiply common prime factors
200 = 2 x 2 x 2 x 5 x 5
60 = 2 x 2 x 3 x 5
GCF (200,60) = 2 x 2 x 5 = 20

Least Common Multiple: check multiples of the largest number
LCM (200,60): 200 (no), 400 (no), 600 (yes!)

Percentages: use the following formula to find part, whole, or percent

$$\text{part} = \frac{\text{percent}}{100} \times \text{whole}$$

Averages, Counting, Statistics, Probability

Average: sum of terms / number of terms

Average speed: total distance / total time

Sum: average * (number of terms)

Mode: value in the list that appears most often

Median: middle value in the list (which *must* be sorted)
Example: median of {3, 10, 9, 27, 50} = 10
Example: median of {3, 9, 10, 27} = (9 + 10)/2 = 9.5

Range: all of the possible values that can be generated (output) by the function

Fundamental Counting Principle:

> If an event can happen in N ways, and another, independent event can happen in M ways, then both events together can happen in N x M ways. (Extend this for three or more: $N_1 \times N_2 \times N_3 \ldots$)

Probability: number of desired outcomes / number of total outcomes

Power, Exponents, Roots

$$x^a \cdot x^b = x^{a+b} \qquad x^a / x^b = x^{a-b} \qquad 1/x^b = x^{-b}$$

$$(x^a)^b = x^{a \cdot b} \qquad (xy)^a = x^a \cdot y^a \qquad (-1)^n = \begin{cases} +1, & \text{if } n \text{ is even;} \\ -1, & \text{if } n \text{ is odd.} \end{cases}$$

$$x^0 = 1 \qquad \sqrt{xy} = \sqrt{x} \cdot \sqrt{y}$$

$$\text{If } 0 < x < 1, \text{ then } 0 < x^3 < x^2 < x < \sqrt{x} < \sqrt[3]{x} < 1.$$

Factoring, Solving

$$(x+a)(x+b) = x^2 + (b+a)x + ab \qquad \text{"FOIL"}$$

$$a^2 - b^2 = (a+b)(a-b) \qquad \text{"Difference Of Squares"}$$

$$a^2 + 2ab + b^2 = (a+b)(a+b)$$
$$a^2 - 2ab + b^2 = (a-b)(a-b)$$

$$x^2 + (b+a)x + ab = (x+a)(x+b) \qquad \text{"Reverse FOIL"}$$

You can use Reverse FOIL to factor a polynomial by thinking about two numbers *a* and *b* which add to the number in front of the *x*, and which multiply to give the constant. For example, to factor $x^2 + 5x + 6$, the numbers add to 5 and multiply to 6, i.e., $a = 2$ and $b = 3$, so that $x^2 + 5x + 6 = (x + 2)(x + 3)$.

To solve a quadratic such as $x^2 + bx + c = 0$, first factor the left side to get $(x + a)(x + b) = 0$, then set each part in parentheses equal to zero. For example, $x^2 + 4x + 3 = (x + 3)(x + 1) = 0$ so that $x = -3$ or $x = -1$.

To solve two linear equations in *x* and *y*: use the first equation to substitute for a variable in the second. E.g., suppose $x + y = 3$ and $4x - y = 2$. The first equation gives $y = 3 - x$, so the second equation becomes $4x - (3 - x) = 2 \rightarrow 5x - 3 = 2 \rightarrow x = 1, y = 2$.

Functions

A function is a rule to go from one number (*x*) to another number (*y*), usually written

$$y = f(x)$$

For any given value of *x*, there can only be one corresponding value *y*. If $y = kx$ for some number *k* (example: $f(x) = 0.5 * r$), then *y* is said to be *directly proportional* to *x*. If $y = k / x$ (example: $f(x) = 5/r$), then *y* is said to be *inversely proportional* to *x*.

The graph of $y = f(x - h) + k$ is the *translation* of the graph of $y = f(x)$ by (h, k) units in the plane. For example, $y = f(x + 3)$ shifts the graph of $f(x)$ by 3 units to the left.

Absolute value:

$$|x| = \begin{cases} +x, & \text{if } x \geq 0; \\ -x, & \text{if } x < 0. \end{cases}$$

$$|x| < n \quad \Rightarrow \quad -n < x < n$$

$$|x| > n \quad \Rightarrow \quad x < -n \quad \text{or} \quad x > n$$

Parabolas:

A parabola parallel to the y-axis is given by

$$y = ax^2 + bx + \text{c}.$$

If $a > 0$, the parabola opens up. If $a < 0$, the parabola opens down. The y-intercept is c, and the x-coordinate of the vertex is $x = -b/2a$.

Lines (Linear Functions)

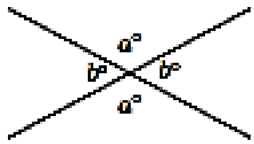
Consider the line that goes through points $A(x_1, y_1)$ and $B(x_2, y_2)$

Distance from A to B:	$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
Mid-point of the segment $\overline{AB}$:	$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$
Slope of the line:	$\frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{rise}}{\text{run}}$

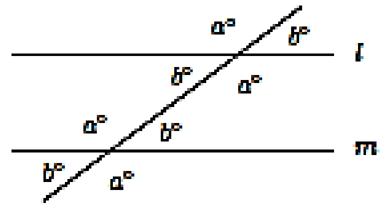
Point-slope form: given the slope m and a point (x_1, y_1) on the line, the equation of the lines is $(y - y_1) = m(x - x_1)$.

Slope-intercept form: given the slope m and the y-intercept b, then the equation of the line is $y = mx + b$.

Parallel lines have equal slopes. Perpendicular lines (i.e., those that make a 90^o angle where they intersect) have negative reciprocal slopes: $m_1 * m_2 = -1$.



Intersecting Lines



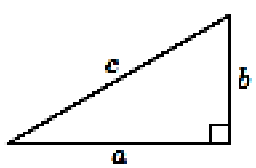
Parallel Lines ($l \parallel m$)

Intersecting lines: opposite angles are equal. Also, each pair of angles along the same line add to 180 ^{o}. In the figure above, $a + b = 180^{o}$.

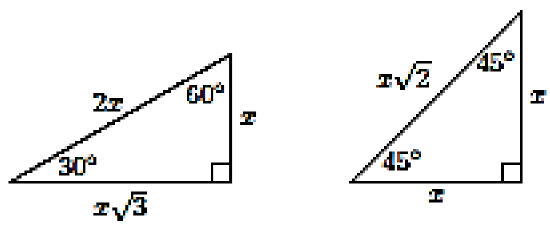
Parallel lines: eight angles are formed when a line crosses two parallel lines. The four big angles (a) are equal, and the four small angles (b) are equal.

Triangles

Right triangles:



$a^2 + b^2 = c^2$



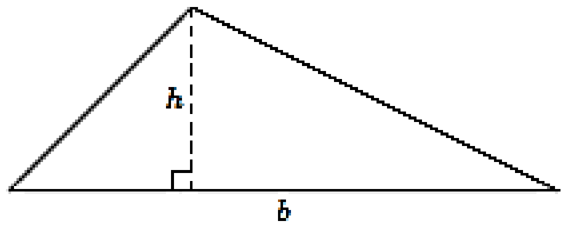
Special Right Triangles

The first triangle is called the Pythagorean Theorem ($a^2 + b^2 = c^2$).

A good example of a right triangle is one with $a = 3$, $b = 4$, and $c = 5$, also called a 3-4-5 right triangle. Note that multiples of these numbers are also right triangles.

The “Special Right Triangles” are needed less often than the Pythagorean Theorem. Here, “x” is used to mean any positive number, such as 1, ½, etc.

All triangles:



$$\text{Area} = \frac{1}{2} \cdot b \cdot h$$

The area formula above works for all triangles, not just right triangles.

Angles on the inside of any triangle add up to 180 ^{o}.

The length of one side of any triangle is always *less* than the sum of the lengths of the other two sides.

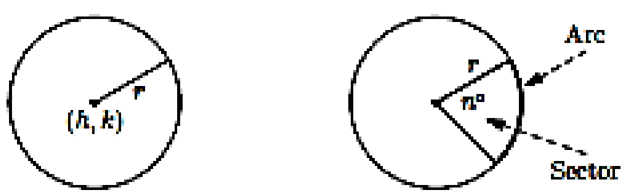
Other important triangles:

Equilateral: These triangles have three equal sides, and all three angles are 60 ^{o}.

Isosceles: An isosceles triangle has two equal sides. The "base" angles (the ones opposite the two sides" are equal. A good example of an isosceles triangle is the one with base angles of 45 ^{o}.

Similar: Two or more triangles are similar if they have the same shape. The corresponding angles are equal, and the corresponding sides are in proportion. For example, the 3-4-5 triangle and the 6-8-10 triangle from before are similar since their sides are in a ratio of 2 to 1.

Circles

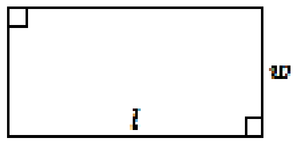


$\text{Area} = \pi r^2$
$\text{Circumference} = 2\pi r$
$\text{Full circle} = 360°$

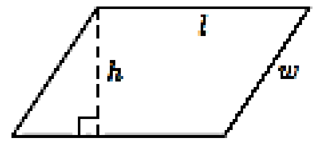
$\text{Length Of Arc} = (n°/360°) \cdot 2\pi r$
$\text{Area Of Sector} = (n°/360°) \cdot \pi r^2$

Equation of the circle (above left figure): $(x-h)^2 + (y-k)^2 = r^2$.

Rectangles and Friends

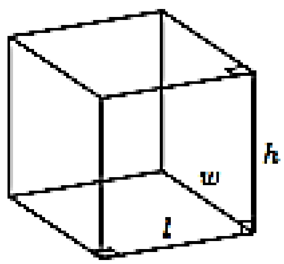


Rectangle
(Square if $l = w$)
Area $= lw$



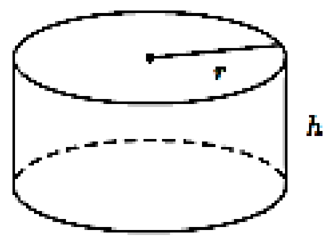
Parallelogram (Optional)
(Rhombus if $l = w$)
Area $= lh$

Solids



Rectangular Solid

Volume $= lwh$



Right Cylinder

Volume $= \pi r^2 h$

APPENDIX II

Academic Task Study Guide Day II

Materials available for public use (Jacobsen, 2013d).

Averages, Counting, Statistics, Probability

Mode: value in the list that appears most often

Median: middle value in the list (which *must* be sorted)
Example: median of {3, 10, 9, 27, 50} = 10
Example: median of {3, 9, 10, 27} = (9 + 10)/2 = 9.5

Average: sum of terms / number of terms

Average speed: total distance / total time

Sum: average * (number of terms)

Range: all of the possible values that can be generated (output) by the function

Fundamental Counting Principle:

If an event can happen in *N* ways, and another, independent event can happen in *M* ways, then both events together can happen in *N* x *M* ways. (Extend this for three or more: N_1 x N_2 x N_3 …)

Probability: number of desired outcomes / number of total outcomes

Numbers, Sequences, Factors

In terms of: For example, if 6*a* + 12*b* = 3*a* + 6*b* – 9*c* +15, and you are asked to solve for *a* in terms of *b* and *c*, then simply solve for *a* with all other variables and numbers on the other side of the equation. Here, you would get 3*a* = 15 – 6*b* – 9*c* so that *a* = 5 – 2*b* – 3*c*.

Less, fewer: Think of *subtraction*. For example, "*y* is three less than twice *x*" is equivalent to *y* = 2*x* – 3. Another example: "Aubrey has 6 fewer cabbages than Bill does" could be written in equation form as *A* = *B* – 6. Note that the number or expression that comes before "less" or "fewer" appears *after* the minus sign in the equivalent expression.

Integers:	Integers are numbers without a fractional part (and that is why they are often called the *whole* numbers)…., -3, -2, -1, 0, 1, 2, 3, … Even integers: can be divided by two without a remainder. The even integers include 0, 2, 4, 6, 8, 10, 12, …, along with -2, -4, -6, … Odd integers: can not be divided by two without a remainder. The odd integers include 1, 3, 5, 7, 9, 11,…, along with -1, -3, -5, …
Reals:	Real numbers are all the numbers on the number line, including the integers, the rational numbers, and everything else, which includes for example the *irrational* numbers such as intergers $\sqrt{2}$, π, etc. Not to be confused with the *fake* numbers.
Remainder:	When an integer is divided by another, the remainder is the *integer* amount that is left over. For example, when 66 is divided by 7, the remainder is 3, since 7 goes into 66 a total of 9 times, with 3 left over: 66 = 7 x 9 + 3.
Domain:	The domain of a function is all of the possible values that can be used as input to the function, so that the function returns a real value. If the function is written as $y = f(x)$, the domain is all possible values of x such that y is a real number. For example, the domain of the function $f(x) = 1/(1 – x)$ is all real numbers except for $x = 1$, since if $x = 1$, the denominator is 0 and the function "blows up." The domain of $f(x) = \sqrt{x}$ is all positive real numbers, along with zero.
Positive, Negative:	A positive number is greater than zero, and a negative number is less than zero. Zero itself is neither positive nor negative. Note that a negative number raised to an even power is positive, and when raies to an odd power is negative. For example, $(-1)^{374} = 1$ but $(-1)^{373} = -1$.
Multiple:	A multiple of a number is the result of multiplying that number by an integer. For example, the multiples of 15 include 15, 30, 45, 60, … but also 0, -15, -30, …
Rational:	A rational number is any number than can be written as a fraction: a ratio of two integers. Rational numbers include 1/2, 3/4, 5 (since 5 = 5/1), 22/7, 1/3, and so on. These numbers can always be written as a finite decimal or as an infinite decimal that repeats. For example, 2/5 = 0.4.
Order of Operations:	PEMDAS

(Parentheses / Exponents / Multiply / Divide / Add / Subtract)

Arithmetic Sequences: each term is equal to the previous term plus d
Sequence: t_1, $t_1 + d$, $t_1 + 2d$, …
The n[th] term is $t_n = t_1 + (n - 1)d$
Number of intergers from i_n to $i_m = i_{m} - i_n + 1$
Sum of n terms $S_n = (n/2) * (t_1 + t_n)$ (optional)

Geometric Sequences: each term is equal to the previous term times r
Sequence: t_1, $t_1 * r$, $t_1 * r^2$, …
The n[th] term is $t_n = t_1 * r^{n-1}$
Sum of n terms $S_n = t_1 * (r^n - 1) / (r - 1)$

Factor: A factor of a number is any integer that can divide that number without a remainder. For example, the factors of 12 are 1, 2, 3, 4, 6, and 12; the factors of 29 are just 1 and 29.

Prime: A prime number is a positive integer that has only two factors: itself and 1. The prime numbers include 2, 3, 5, 7, 11,… but do *not* include 1 (the number 1 only has one factor, not two). The *prime factors* of a number are the factors of the number that also are prime. For example, the prime factors of 12 are 2 and 3 and the only prime factor of 29 is 29.

Prime Factorization: break up a number into prime factors (2, 3, 5, 7, 11, …)
200 = 4 x 50 = 2 x 2 x 2 x 5 x 5
52 = 2 x 26 = 2 x 2 x 13

Greatest Common Factor: multiply common prime factors
200 = 2 x 2 x 2 x 5 x 5
60 = 2 x 2 x 3 x 5
GCF (200,60) = 2 x 2 x 5 = 20

Least Common Multiple: check multiples of the largest number
LCM (200,60): 200 (no), 400 (no), 600 (yes!)

Percentages: use the following formula to find part, whole, or percent

$$\text{part} = \frac{\text{percent}}{100} \times \text{whole}$$

Functions

A function is a rule to go from one number (x) to another number (y), usually written

$$y = f(x)$$

For any given value of x, there can only be one corresponding value y. If $y = kx$ for some number k (example: $f(x) = 0.5 * r$), then y is said to be *directly proportional* to x. If $y = k / x$ (example: $f(x) = 5/r$), then y is said to be *inversely proportional* to x.

The graph of $y = f(x - h) + k$ is the *translation* of the graph of $y = f(x)$ by (h, k) units in the plane. For example, $y = f(x + 3)$ shifts the graph of $f(x)$ by 3 units to the left.

Absolute value:

$$|x| = \begin{cases} +x, & \text{if } x \geq 0; \\ -x, & \text{if } x < 0. \end{cases}$$

$$|x| < n \quad \Rightarrow \quad -n < x < n$$

$$|x| > n \quad \Rightarrow \quad x < -n \quad \text{or} \quad x > n$$

Parabolas:

A parabola parallel to the y-axis is given by

$$y = ax^2 + bx + \text{c}.$$

If $a > 0$, the parabola opens up. If $a < 0$, the parabola opens down. The y-intercept is c, and the x-coordinate of the vertex is $x = -b/2a$.

Power, Exponents, Roots

$$x^a \cdot x^b = x^{a+b} \qquad x^a/x^b = x^{a-b} \qquad 1/x^b = x^{-b}$$

$$(x^a)^b = x^{a \cdot b} \qquad (xy)^a = x^a \cdot y^a \qquad (-1)^n = \begin{cases} +1, & \text{if } n \text{ is even;} \\ -1, & \text{if } n \text{ is odd.} \end{cases}$$

$$x^0 = 1 \qquad \sqrt{xy} = \sqrt{x} \cdot \sqrt{y}$$

$$\text{If } 0 < x < 1, \text{ then } 0 < x^3 < x^2 < x < \sqrt{x} < \sqrt[3]{x} < 1.$$

Factoring, Solving

$$(x+a)(x+b) = x^2 + (b+a)x + ab \qquad \text{"FOIL"}$$

$$a^2 - b^2 = (a+b)(a-b) \qquad \text{"Difference Of Squares"}$$

$$a^2 + 2ab + b^2 = (a+b)(a+b)$$
$$a^2 - 2ab + b^2 = (a-b)(a-b)$$

$$x^2 + (b+a)x + ab = (x+a)(x+b) \qquad \text{"Reverse FOIL"}$$

You can use Reverse FOIL to factor a polynomial by thinking about two numbers *a* and *b* which add to the number in front of the *x*, and which multiply to give the constant. For example, to factor $x^2 + 5x + 6$, the numbers add to 5 and multiply to 6, i.e., $a = 2$ and $b = 3$, so that $x^2 + 5x + 6 = (x + 2)(x +3)$.

To solve a quadratic such as $x^2 + bx + c = 0$, first factor the left side to get $(x + a)(x + b) = 0$, then set each part in parentheses equal to zero. For example, $x^2 + 4x + 3 = (x + 3)(x +1) = 0$ so that $x = -3$ or $x = -1$.

To solve two linear equations in *x* and *y*: use the first equation to substitute for a variable in the second. E.g., suppose $x + y = 3$ and $4x – y = 2$. The first equation gives $y = 3 – x$, so the second equation becomes $4x – (3 – x) = 2 \rightarrow 5x – 3 = 2 \rightarrow x = 1, y = 2$.

Lines (Linear Functions)

Consider the line that goes through points $A(x_1, y_1)$ and $B(x_2, y_2)$

Distance from A to B: $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

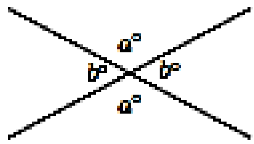
Mid-point of the segment $\overline{AB}$: $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

Slope of the line: $\frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{rise}}{\text{run}}$

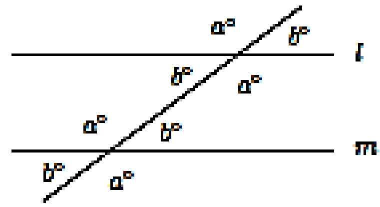
Point-slope form: given the slope *m* and a point (x_1, y_1) on the line, the equation of the lines is $(y – y_1) = m(x – x_1)$.

Slope-intercept form: given the slope *m* and the y-intercept *b*, then the equation of the line is $y = mx + b$.

Parallel lines have equal slopes. Perpendicular lines (i.e., those that make a 90° angle where they intersect) have negative reciprocal slopes: $m_1 * m_2 = -1$.



Intersecting Lines

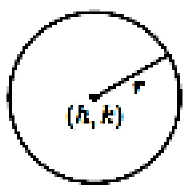


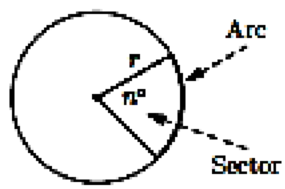
Parallel Lines ($l \parallel m$)

Intersecting lines: opposite angles are equal. Also, each pair of angles along the same line add to 180 °. In the figure above, $a + b = 180°$.

Parallel lines: eight angles are formed when a line crosses two parallel lines. The four big angles (a) are equal, and the four small angles (b) are equal.

Circles





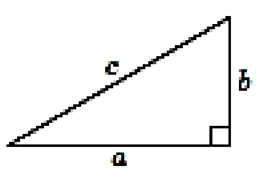
Area $= \pi r^2$
Circumference $= 2\pi r$
Full circle $= 360°$

Length Of Arc $= (n°/360°) \cdot 2\pi r$
Area Of Sector $= (n°/360°) \cdot \pi r^2$

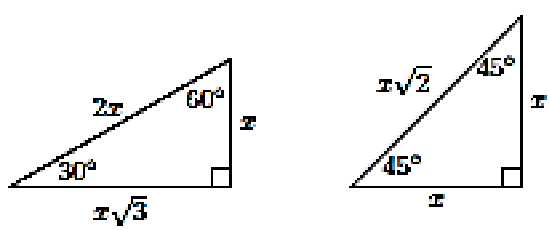
Equation of the circle (above left figure): $(x - h)^2 + (y - k)^2 = r^2$.

Triangles

Right triangles:



$a^2 + b^2 = c^2$



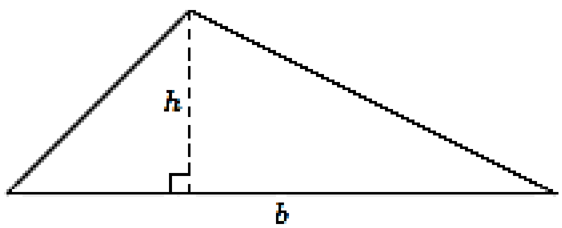
Special Right Triangles

The first triangle is called the Pythagorean Theorem ($a^2 + b^2 = c^2$).

A good example of a right triangle is one with *a* = 3, *b* = 4, and *c* = 5, also called a 3-4-5 right triangle. Note that multiples of these numbers are also right triangles.

The “Special Right Triangles” are needed less often than the Pythagorean Theorem. Here, “*x*” is used to mean any positive number, such as 1, ½, etc.

All triangles:



$$\text{Area} = \frac{1}{2} \cdot b \cdot h$$

The area formula above works for all triangles, not just right triangles.

Angles on the inside of any triangle add up to 180 ^{o}.

The length of one side of any triangle is always *less* than the sum of the lengths of the other two sides.

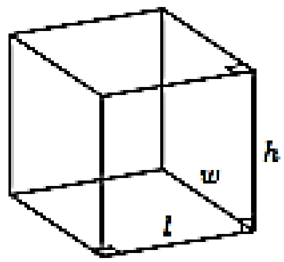
Other important triangles:

Equilateral: These triangles have three equal sides, and all three angles are 60 ^{o}.

Isosceles: An isosceles triangle has two equal sides. The “base” angles (the ones opposite the two sides” are equal. A good example of an isosceles triangle is the one with base angles of 45 ^{o}.

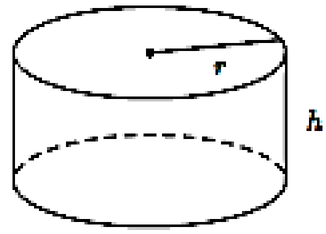
Similar: Two or more triangles are similar if they have the same shape. The corresponding angles are equal, and the corresponding sides are in proportion. For example, the 3-4-5 triangle and the 6-8-10 triangle from before are similar since their sides are in a ratio of 2 to 1.

Solids



Rectangular Solid

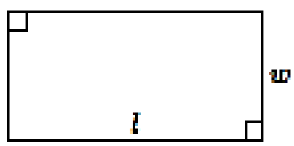
Volume = lwh



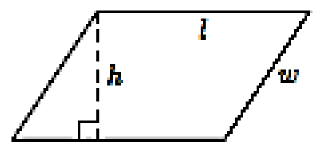
Right Cylinder

Volume = $\pi r^2 h$

Rectangles and Friends



Rectangle
(Square if $l = w$)
Area = lw



Parallelogram (Optional)
(Rhombus if $l = w$)
Area = lh

APPENDIX III

Academic Task Day I

Materials available for public use (Jacobsen, 2013b).

1. Aubrey can run at a pace of 6 miles per hour. Running at the same rate, how many miles can she run in 90 minutes?
    a. 4
    b. 6
    c. 8
    d. 9
    e. 12

2. Which of the following is a factor of 15 + 45?
    a. 18
    b. 25
    c. 30
    d. 35
    e. 45

3. Which of the following is NOT a positive multiple of 9 + 3?
    a. 3
    b. 12
    c. 24
    d. 48
    e. 60

4. A number is divided by four. The result is divided by three, for a final result of two. What was the original number?
    a. 6
    b. 12
    c. 18
    d. 24
    e. 36

5. Two consecutive integers m and n are prime numbers. Which of the following is equal to mn?
    a. 1
    b. 2
    c. 6
    d. 9
    e. 15

6. If $x + 1 = 23$, what is the value of $3x + 3$?
   a. 22
   b. 46
   c. 66
   d. 69
   e. 72

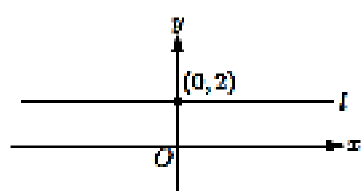
7. If $2a + 3b = 12$, and $3b – 4 = 2$, then what is the value of a?
   a. 2
   b. 3
   c. 4
   d. 6
   e. 8

8. If $x +1 = 7$, what is the value of $x^2 + 2x +1$?
   a. 36
   b. 37
   c. 48
   d. 49
   e. 81

9. Which of the following expressions is equivalent to 12 less than the product of x and y?
   a. $12 – xy$
   b. $xy – 12$
   c. $12 – (x + y)$
   d. $(x + y) – 12$
   e. $12xy$

10. If $2x = 5$, $3y = 4$, and $4z = 3$, what is the value of $24xyz$?
    a. 12
    b. 18
    c. 36
    d. 48
    e. 60

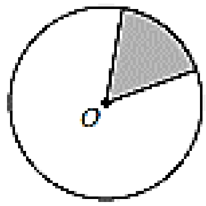
11. In the figure below, line l is perpendicular to the y-axis and a distance of two units from the x-axis. Which of the following points is on line l?



    a. (-1,2)

b. (-2,1)
c. (2,3)
d. (3,1)
e. (4,3)

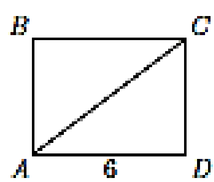
12. A portion of the circle with center *O* is shaded as in the figure below. If the area of the shaded region is 12π, and 1/6 of the circle is shaded, what is the area of the circle?



a. 2π
b. 10π
c. 24π
d. 48π
e. 72π

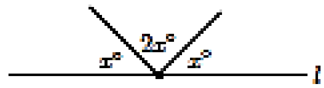
13. The area of a particular rectangle is 72. If the length of the rectangle is twice the width, what is the width of the rectangle?
a. 6
b. 8
c. 10
d. 12
e. 16

14. In the figure below, *ABCD* is a rectangle. If *AD* = 6, which of the following could be the length of *AC*?



a. 3
b. 4
c. 5
d. 6
e. 7

15. In the figure below, two line segments meet at a point on line *l*. What is the value of *x*?



   a. 15
   b. 30
   c. 45
   d. 28
   e. 25

16. In the triangle below, what is the average (arithmetic mean) of *x*, *y*, and *z*?

   a. 30
   b. 45
   c. 60
   d. 75
   e. 90

17. If a number is selected at random from the list below, what is the probability that the number is divisible by 3?

   2, 4, 6, 8, 10, 12, 14, 16, 18

   a. 1/3
   b. 4/9
   c. 5/9
   d. 2/3
   e. 1

18. A basket contains turnips that are either red or white. If the total amount of turnips in the basket is 24, and the probability of choosing a red turnip at random is 5/6, how many red turnips are in the basket?
   a. 5
   b. 10
   c. 15
   d. 20
   e. 25

19. Let's set $M = (x, 2x, 4x)$ for any number x. If the average (arithmetic mean) of the numbers in set M is 14, what is the value of x?
   a. 2
   b. 6
   c. 7
   d. 10
   e. 12

20. A farmer can pick 12 cabbages in 1 hour. Working at the same rate, how long in hours would it take two farmers to pick 48 cabbages?
    a. 1
    b. 2
    c. 4
    d. 6
    e. 8

APPENDIX IV

Academic Task Day II

Materials available for public use (Jacobsen, 2013c).

1. A meter is a measure of length, and 10 decimeters is equal in length to one meter. How many decimeters are equal in length to 12.5 meters?
    a. 1250
    b. 125
    c. 12.5
    d. 2.5
    e. 1.25

2. The first term of the sequence below is 2, and each term after the first is 3 less than 3 times the previous term. What is the value of *n*?

    2, 3, 6, *n*, 42, …

    a. 9
    b. 12
    c. 15
    d. 18
    e. 21

3. Sixteen ounces is equal to one pound, and one ton is equal to 2,000 pounds. How many ounces equal two tons?
    a. 4,000
    b. 16,000
    c. 32,000
    d. 32,016
    e. 64,000

4. The sum of which of the following combinations of numbers must be even?
    a. One odd and one even number
    b. Two even numbers and one odd number
    c. Three odd numbers
    d. Three even numbers
    e. Five odd numbers

5. If *n* is a prime number, then 6*n* must be
    a. Odd
    b. Prime
    c. A multiple of 3
    d. A multiple of 12
    e. Equal to 12

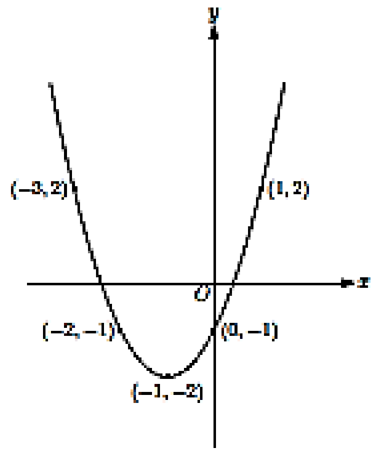
6. If $2x - 1 = 6$, what is the value of $2x + 1$?
   a. 7
   b. 8
   c. 9
   d. 10
   e. 12

7. Which of the following represents 3 times the sum of *x* and 8?
   a. $3(x + 8)$
   b. $3x + 8$
   c. $x + 8$
   d. $x + 24$
   e. $24x$

8. The function of *f* is defined by $f(x) = 3x + 1$. Which of the following is equal to $f(x) + 1$?
   a. $3x + 2$
   b. $3x + 3$
   c. $3x + 4$
   d. $4x + 1$
   e. $4x + 2$

9. If $2x < 9$ and $3x > 11$, which of the following is a possible value of *x*?
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5

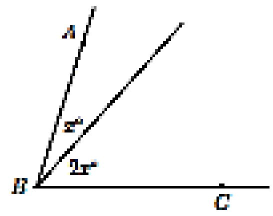
10. The graph shown in the figure below is a parabola. For points (x,y) that are on the graph, the minimum value of *y* is attained at what value of *x*?



   a. -3
   b. -2
   c. -1
   d. 0

e. 1

11. In the figure below, the measure in degrees of <*ABC* is 72º. What is the value of *x*?

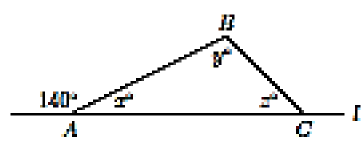


a. 18º
b. 24º
c. 27º
d. 30º
e. 45º

12. The area of a particular square is 16. A new square is formed by doubling the length of each side of the original square. What is the area of the new square?
    a. 24
    b. 32
    c. 48
    d. 64
    e. 72

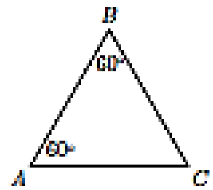
13. The diameter of a circle is 1. What is the area of the circle?
    a. π/8
    b. π/4
    c. π/2
    d. π
    e. 2π

14. Triangle *ABC* and line *l* are shown in the figure below. What is the sum of *y* and *x*?



a. 40
b. 80
c. 120
d. 130
e. 140

15. In the figure shown below, $AC = 6$. What is the length of segment $\overline{AB}$?



a. 3
b. 5
c. 6
d. 7
e. It cannot be determined from the information given.

16. What is the average (arithmetic mean) in degrees of the four angles in a rectangle?
a. 45
b. 75
c. 90
d. 180
e. 360

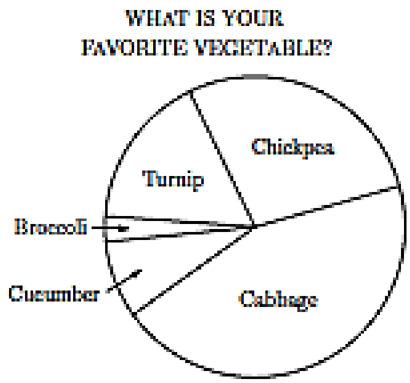
17. A number is chosen to at random from among the set of integers from 1 to 9, inclusive. What is the probability that the number chosen is a multiple of 4?
a. 1/9
b. 2/9
c. 1/3
d. 4/9
e. 1/2

18. The average (arithmetic mean) of the numbers listed below is 6. What is the value of *a*?

12, *a*, 6, 8, 2, 14

a. -36
b. -6
c. 0
d. 6
e. 36

19. The circle graph below shows the results of a telephone survey. In the survey, people were asked to choose their favorite vegetable from among a group of five choices. Which of the following was chosen as favorite vegetable by approximately 40% of the people surveyed?



a. Broccoli
b. Turnip
c. Chicken
d. Cabbage
e. Cucumber

20. A group of 5 integers is shown below. If the average (arithmetic mean) and median of the numbers is equal to *m*, what is the value of *m*?

$$2, 10, m, 12, 4$$

a. 7
b. 8
c. 9
d. 10
e. 11

APPENDIX V

Table 1

Layout of Day I. Table represents an outline of Day I of the study, including measures completed by each condition.

Day I – No Drink	1	2	**3**	**4**	5	6
Condition 1 (**Water-math test delayed**)	Informed Consent	Study	- Demographics - CCQM - LOT-R	Math Test	- PASCI - Academic Self-Perception -Self-Perception of Performance on a Math Test - PASCI subscale (Math Ability) - Goal Orientation Scales	Debriefing
Condition 2 (**Water-math test immediate**)	Informed Consent	Study	Math Test	- Demographics - CCQM - LOT-R	- PASCI - Academic Self-Perception -Self-Perception of Performance on a Math Test - PASCI subscale (Math Ability) - Goal Orientation Scales	Debriefing
Condition 3 (**Energy drink-math test delayed**)	Informed Consent	Study	- Demographics - CCQM - LOT-R	Math Test	- PASCI - Academic Self-Perception -Self-Perception of Performance on a Math Test - PASCI subscale (Math Ability) - Goal Orientation Scales	Debriefing
Condition 4 (**Energy drink-math test immediate**)	Informed Consent	Study	Math Test	- Demographics - CCQM - LOT-R	- PASCI - Academic Self-Perception -Self-Perception of Performance on a Math Test - PASCI subscale (Math Ability) - Goal Orientation Scales	Debriefing

APPENDIX VI

Table 2

Layout of Day II. Table represents an outline of Day II of the study, including measures completed by each condition.

Day II	1	2	**3**	**4**	5	6
Condition 1 (**Water-math test delayed**)	Informed Consent	Study and Drink (8 ounces of Water)	- Attitudes Toward Energy Drinks Questionnaire - Caffeine Effects Questionnaire	Math Test	-Self-Perception of Performance on a Math Test	Debriefing
Condition 2 (**Water-math test immediate**)	Informed Consent	Study and Drink (8 ounces of Water)	Math Test	- Attitudes Toward Energy Drinks Questionnaire - Caffeine Effects Questionnaire	-Self-Perception of Performance on a Math Test	Debriefing
Condition 3 (**Energy drink-math test delayed**)	Informed Consent	Study and Drink (8 ounces of Energy Drink)	- Attitudes Toward Energy Drinks Questionnaire - Caffeine Effects Questionnaire	Math Test	-Self-Perception of Performance on a Math Test	Debriefing
Condition 4 (**Energy drink-math test immediate**)	Informed Consent	Study and Drink (8 ounces of Energy Drink)	Math Test	- Attitudes Toward Energy Drinks Questionnaire - Caffeine Effects Questionnaire	-Self-Perception of Performance on a Math Test	Debriefing

APPENDIX VII

Figure 1

Figure represents results from the moderation analysis using HMR.