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Energy Drink Consumption in College Students: Report of Physical and Psychological Symptoms in Association with Chronic Consumption Habits

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ENERGY DRINK CONSUMPTION IN COLLEGE STUDENTS: REPORT OF PHYSICAL AND PSYCHOLOGICAL SYMPTOMS IN ASSOCIATION WITH CHRONIC CONSUMPTION HABITS

by

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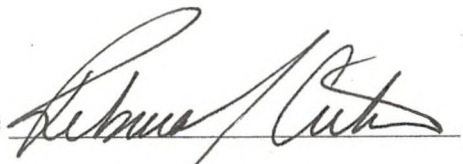
Signature 

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To the Cicha and Roberts families

ABSTRACT

Within the past decade, energy drink consumption has increased, particularly within young adult populations. Though current studies have investigated the acute effects of energy drink consumption, little data exists in regards to consumption patterns amongst college students, particularly differentiating acute vs. chronic consumers. As caffeine is recognized as the main acting ingredient in energy drinks, the effects of acute and chronic energy drink consumption may be related to that of general acute and chronic caffeine consumption. To date, much literature has highlighted a connection between caffeine intake and general pathology, specifically, that caffeine is highly correlated with the endorsement of various physical and psychological symptoms.

Two hundred and six college students were given caffeine and energy drink consumption questionnaires to assess consumption habits along with State-Trait Anxiety Inventory, Beck Depression Inventory II and Symptom Checklist 90 Revised self report inventories to assess for report of physical and psychological symptoms. The results of this investigation indicate differential reporting of psychological symptoms as a potential function of energy drink consumption. Specifically, low-consumers reported fewer symptoms related to anxiety and depression than non-consumers. Findings indicate a possible effect of energy drink consumption on psychological wellbeing, however additional research is necessary to fully address the issue.

CHAPTER I

INTRODUCTION

Caffeine is popularly described as one of the most frequently consumed psychoactive substances in the world; its projected daily consumption has been estimated at about 80% of the world's population (James, 1997) with the average daily consumption of 3mg/kg in adults in the United States and Canada (Hughes & Oliveto, 1997). Within the past decade, energy drinks, products that contain comparatively large amounts of caffeine have quickly become a popular, multi-billion dollar industry; approximately 500 new brands of energy drinks were put on the market in 2006 alone (Worcester, 2007).

Most commonly marketed toward adolescent and young adult populations, energy drink advertisements particularly involve claims of enhancing mental (e.g. attention, concentration, memory) and physical performance upon consumption (Meadows-Oliver & Ryan-Krause, 2007). Furthermore, with slogans such as "Red Bull gives you wings," energy drinks are popularly promoted as giving individuals an "edge," and are often coupled with extreme activities such as skateboarding, wakeboarding, racing, skydiving, and aerobatic flying (www.redbull.com). In a recent study, Miller (2008) examined the relationship between energy drink consumption and various risk-taking behaviors in college students. Overall, individuals who frequently drank energy drinks (> 6EDs/mo) tended to engage in risky and extreme behaviors (e.g. drug and alcohol use, wearing

seatbelts, physical aggression, risky sexual practices) more so than individuals who generally abstained (< 6EDs/mo) from energy drinks (Miller, 2008). Though the relationship demonstrated was not causal, it highlights a potentially important association between energy drink consumption and negative health behaviors.

Energy Drink Ingredients and General Effects

Energy drinks are typically sold in 8oz cans, though cans of larger sizes have become increasingly available; Monster energy drinks popularly come in 16oz cans whereas Rockstar energy drinks come in 8oz, 15oz, and 24oz cans (www.monsterenergy.com; www.rockstar69.com). Energy drinks also contain varying ingredients; therefore the effects of which are difficult to compare directly. However, most commercially available energy drinks contain a number of common ingredients including: taurine, an amino acid known to influence metabolic processes; guarana, the extracts of which contain high levels of caffeine; and ginseng, an herb popularly consumed to enhance memory and concentration (Babu, Church, & Lewander, 2008). The most ubiquitous ingredient in energy drinks, however, is caffeine; the effects of which have been widely documented in the existing literature. Caffeine is known to impact the nervous system by facilitating the release of neurotransmitters, including norepinephrine, dopamine, and serotonin that contribute to increased heart rate, muscle tone, and an overall stimulating effect (Benowitz, 1990).

Sugar-free energy drinks are also commercially available, though they typically contain higher amounts of caffeine and are often packaged in larger containers, potentially leading to increased caffeine intake (McCusker, Goldberger, & Cone, 2006). This finding may be of particular importance when taking into account possible differential consumption patterns based upon gender. Specifically, in a study examining energy

drink consumption patterns in college students, females were significantly more likely to report energy drink consumption than males and were more likely to report consumption of sugar-free versions of energy drinks (Malinuskas, Aeby, Overton, Carpenter-Aeby, & Barber-Heidal, 2007). This finding may have relevant implications regarding differential caffeine intake based upon gender; considering a possible preference of sugar-free energy drinks in females and the greater levels of caffeine present in the sugar-free versions of energy drinks, females may consume greater levels of caffeine than males and may thus be more prone to its effects.

Acute Psychological Effects of Energy Drink Consumption

Currently, much of the existing literature has documented the various physiological and psychological effects of acute energy drink consumption and has included a wide variety of participants including pilots, truck drivers, and college athletes. Overall, a number of effects of low-dose and acute consumption have been demonstrated, including increased cognitive abilities (e.g. attention, vigilance, reaction time, and concentration), the counteraction of sleepiness, and enhanced athletic performance.

In a study examining the acute effects of Red Bull energy drink on cardiovascular activity, mood, and cognitive performance (e.g. reaction time, subjective alertness, etc.) significant results were found that supported the enhancing effect of energy drink consumption. Specifically, there was a significant effect of the energy drink: heart rate, subjective feelings of alertness, memory recall (number of words recalled), aerobic and anaerobic endurance, and concentration were increased while choice reaction time was significantly lower when compared to carbonated water and a "dummy" energy drink (i.e. a drink consisting of carbonated, low calorie, flavored water) (Alford, Cox, & Wescott, 2001).

Other studies have examined the acute influence of energy drinks on cognitive performance and mood state, indicating "revitalizing," "alerting," and "energizing" effects during simple reaction time tests, and subjective self report of enhanced mood after a task of sustained attention (Smit & Rogers, 2002). Kennedy and Scholey (2004) obtained similar results in a

study designed to test the effects of glucose and caffeine on performance on demanding cognitive tasks (e.g serial threes, serial sevens, rapid visual information processing task). Overall, drinks containing caffeine (46mg) attenuated the effects of mental fatigue in all tasks involving sustained and complex attention, particularly rapid visual information processing (Kennedy & Scholey, 2004). In addition to improving performance, the drink with caffeine also contributed to participants responses of decreased mental fatigue after a period of heavy cognitive demand (Kennedy & Scholey, 2004).

Reyner and Horne (2002) also investigated potential performance-enhancing effects of energy drink consumption on driver performance upon induced sleep deprivation and cognitive demand. Energy drink consumption appeared to improve simulated driving performance (e.g. decrease driving-related error), particularly within the first 90 minutes of the driving exercise (Reyner & Horne, 2002). Similar results were obtained by Deixelberger, Tischler, and Kallus (2003) where pilots, upon consumption of 250mL of an energy drink, evidenced heightened performance (i.e. decreased reaction time and performance errors) after two hours of fatiguing mental exercises. Overall, the aforementioned studies indicate a potential positive influence of energy drink consumption in terms of cognitive enhancement.

Energy drink consumption and its effects on reaction time has also been examined. Mucignat-Caretta (1998) took a sample of occasional caffeine consumers (less than 1 cup coffee per day) and tested the effects of energy drink consumption on reaction time. The results of the study indicate significant effects of Red Bull consumption on simple reaction time in males and go-no-go reaction time in females. As a whole, though males

responded significantly faster than females, improved performance in females was evidenced as a function of task complexity; the more difficult go-no-go reaction task required both speed of response and differential decision making (Mucignat-Caretta, 1998).

As mentioned previously, energy drinks, though varying in specific ingredients, contain a number of common components, including caffeine and taurine that may have a significant physiological impact when consumed. In a study examining event related potentials (ERPs), caffeine, taurine, and glucuronolactone were administered to participants upon whom an auditory identification task was implemented (Seidl, Peyrl, Nicham, & Hauser, 2000). Consumption of these ingredients led to shortened ERP latencies and reaction time when compared to pretreatment observations. Overall, there were significant effects which suggest that the combination of caffeine, taurine, and glucuronolactone contribute to increased cognitive performance in terms of speed and attention capacity under stressful situations (Seidl et al., 2000). Participant mood was also assessed and indicated that, in contrast to the placebo condition, the experimental group did not evidence a decline in actual mood or subjective feelings of well-being by the end of the experiment (Seidl et al., 2000). Overall, these results suggest positive cognitive and affective effects of the consumption of these three ingredients commonly found in energy drinks.

Acute Physical Effects of Energy Drink Consumption

In addition to influencing mental processes, other studies have examined the effects of energy drink consumption on physical attributes, spanning from basic physiological arousal to athletic performance and endurance. Considering that energy drinks are often

advertised to heighten physical performance, Specterman et al. (2005) examined the influence of energy drink consumption (Lucozade) on human corticospinal activity, particularly motor evoked potentials (MEPs), which play a significant role in initiating and engaging muscle action. Overall, increased corticospinal excitability was evidenced, indicating an important physiological role that glucose and caffeine levels play, which may have indications for mental and athletic performance changes after consumption (Specterman, Bhuiya, Kuppuswamy, Strutton, Catley, & Davey, 2005).

Counterevidence to the notion that energy drinks enhance performance was provided by Carvajal-Sancho and Moncada-Jimenez (2005) in a study that examined the effects of energy drink consumption on athletic performance and mood in male soccer athletes. The results did not indicate beneficial post-consumption effects on physical performance and mood; the authors argue that recommending athletes to consume energy drinks for the purpose of improving performance was not supported (Carvajal-Sancho and Moncada-Jimenez, 2005). Other researchers have also failed to detect an effect of energy drink consumption on athletic performance. Silk, Weatherby, and Zou (2004) reported no significant differences between experimental and control groups when examining the effect of energy drink consumption on performance enhancement, namely the time to exhaustion on a bicycling task.

Furthermore, other studies have cited specific negative health outcomes following energy drink consumption. Adverse physical side effects of acute energy drink consumption have been sited, further contributing to the notion that heavy usage may be detrimental to the consumer's health. Generally speaking, caffeine toxicity has the potential to negatively impact a number of bodily systems, including the cardiovascular,

renal, nervous, and musculoskeletal systems (Babu, Church, & Lewander, 2008). Specifically, caffeine intake has been associated with a number of physical symptoms including: sinus and superventricular tachycardia, cardiac arrhythmias, a single case of myocardial infarction, irritability, coma, renal hypokalemia, and rhabdomyólysis (Babu, Church, & Lewander, 2008; Nagajothi, Khraisat, Velazquez-Cecena, & Arora, 2008).

Other case reports have suggested that consumption of energy drinks in conjunction with the administration of certain medications can potentially lead to cardiovascular-related health complications. Tai and Serwonska (2003) cite a single case of a 24 year old who, after consuming an energy drink and shortly thereafter self administered Primatene mist for the alleviation of asthma symptoms, experienced chest tightening, nausea, dizziness, hypertension, tachycardia, and was subsequently found unconscious. Malinauskas, Aeby, Overton, Carpenter-Aeby, and Barber-Heidal (2007) also described a number of physical complaints associated with energy drink consumption, including "jolt and crash episodes," headaches, and heart palpitations.

Seizures have also been cited upon acute energy drink consumption. In 2007, Iyadurai and Chung described four case reports in which patients, upon consuming large amounts of energy drinks, presented with tonic-clonic seizures and were subsequently hospitalized. Three of the four cases sited presented with additional cardiovascular symptoms of acute hypertension and sinus tachycardia (of which normalized within 6 hours of hospitalization). Though the authors do not claim a causal relationship between energy drink consumption and the observed physical symptoms, all cases included reports of an extensive history of caffeine consumption (including energy drinks) and recent consumption of a large amount of commercially-available energy drinks including Monster and Rock Star (Iyadurai & Chung, 2007).

Cerebral vasculopathy has also been linked to energy drink consumption in a single case of a 21 year old man. After consuming a phenylpropanoid compound-containing energy drink (i.e. 250mL of XS Cranberry-Grape Blast), complaints of severe headache were made prior to subsequent hospitalization where cranial examinations of the patient revealed acute brainstem infarction and bilateral subarachnoid hemorrhage (Worrall, Phillips, & Henderson, 2005). Though the patient reported a history of diabetes which may have increased vulnerability to vascular damage, the authors conclude the present case study may have revealed a potential direct relationship between energy drink consumption and cerebral vasculopathy (Worrall, Phillips, & Henderson, 2005).

Most severely, in a single case, caffeine has also been directly attributed to death; Cannon, Cooke, and McCarthy (2001) report that, upon excessive caffeine intake a 25 year old woman experienced cardiac arrhythmia, myocardial infarction, and subsequent death. As a whole, though these data do not delineate a causal relationship between energy drink consumption and adverse physical symptoms, they indicate a possible temporal relationship that warrants further investigation.

Psychological Effects of Caffeine Consumption

Though the current literature has demonstrated the effects of acute energy drink consumption, no study to date has examined possible physical and psychological effects of intense or chronic energy drink consumption. As caffeine is widely accepted as the major active ingredient in energy drinks, it may be appropriate to expect similar effects as described within the existing caffeine literature. A number of studies have examined the associations between caffeine consumption and physical and psychological pathology and have indicated a number of possible adverse consequences correlated with caffeine consumption.

A number of studies have demonstrated consistent associations between caffeine consumption and the endorsement of psychological symptoms, particularly in regard to the anxious, depressive, and psychotic spectra. A complication of these findings is that of bi-directionality; though caffeine consumption and endorsement of psychological symptoms are often tightly correlated, few studies have been able to establish a distinct timeline in terms of which phenomena precedes which.

A current model of the link between anxiety and caffeine consumption incorporates a diathesis-stress conception: caffeine exacerbates pre-existing anxious features by activating physiological systems involved with specific manifestations of anxiety (e.g. increased heart and respiratory rate, increased blood pressure) (Kruger, 1996). In this sense, as caffeine activates the sympathetic nervous system (i.e. increasing heart rate and blood pressure), which places the body in the trademark heightened state of fight or flight (Kruger, 1996). Within the context of present-day society, unfortunately the options of fighting or fleeing are not readily available to individuals upon caffeine consumption (i.e. in psychiatric settings, or other situations where said behavior may not be socially sanctioned), and instead, may manifest in symptoms of psychopathology (Kruger, 1996).

In this sense, a number of psychological symptoms have been linked to the consumption of caffeine, particularly symptoms which fall on the anxiety spectrum including panic attacks, jitteriness, and irritability (Veleber & Templer, 1984; Uhde, 1990; James & Crosbie, 1987; Griffiths et al., 2003). Furthermore, many research studies suggest that caffeine consumption may exacerbate anxious, manic, and psychotic symptoms (i.e. increasing incidence of panic attack, disorganized speech and thought) (Benowitz, 1990; Lucas et al., 1990).

Hillary (1995) demonstrated that increases in caffeine consumption increased autonomic responses (e.g. increased blood pressure, heart rate) and was also associated with increased anxiety in participants. Furthermore, there was a demonstrated interaction between caffeine consumption and stress; particularly that increases in stress and caffeine served to increase the number of anxious symptoms endorsed by participants (Hillary, 1995). However, it was found that increases of caffeine appeared to decrease endorsed depressive symptoms, which may provide support for the theory that caffeine consumption may serve as a self-medicating means of mood regulation (Hillary, 1995). In this sense, individuals with pre-existing dispositions to mood difficulties may increase caffeine consumption to alleviate negative affect and fatigue, increase initiative, energy, and other depressive symptoms. Furthermore, in the context of agoraphobia with panic attacks, caffeine was found to be a contributing factor to the presence and maintenance of anxious symptoms (Breier, Charney, & Heninger, 1986).

Other psychological symptoms have also been documented to be exacerbated upon caffeine consumption. As caffeine has also been speculated to impact dopamine pathways in the brain; chronic caffeine consumption may disrupt normal levels of dopamine released, which may potentiate or exacerbate symptoms of psychosis (Waldeck, 1971; Lucas et al., 1990).

Some researchers describe the direct influence of excessive caffeine intake on individuals mental processing; Stillner, Popkin, and Pierce (1978) cite a man who, upon ingesting 1000mg of caffeine (roughly equal to that contained in 10 cups of coffee), exhibited symptoms closely approximating psychosis, including tremors, hallucinations, disorientation, and depersonalization. Additionally, in a case study conducted by Stein

(1989), depersonalization disorder was found to be exacerbated by caffeine consumption. In this sense, a possible common etiological pathway with anxious disorders and caffeine consumption was demonstrated, disorders with symptoms that are understood as potentiated by caffeine consumption (Stein, 1989). Overall, it is apparent that excessive caffeine consumption may contribute to the exacerbation of a number of psychological disorders.

Conversely, other reports have indicated that, in light of the anxious symptoms exhibited by inpatients, upon the cessation of caffeine consumption, the reported anxious symptoms often recede to the point where anxiolytic medications are deemed unnecessary and are subsequently discontinued (Kruger, 1996). The positive effects of abstinence from caffeine consumption have been further indicated within inpatient settings; by limiting patient access to caffeine, decreased aggression, suspiciousness, hostility, and anxiety was noted (De Freitas & Schwartz, 1979).

Caffeine consumption has also been demonstrated to influence other factors that may contribute to psychological distress. Specifically, the stimulating effects of caffeine are widely known to disrupt sleep; individuals who consume caffeine often report having more disrupted sleep in the immediately following night, and often report having difficulty falling asleep and generally poorer sleep quality than when not consuming. (Kruger, 1996). Jay, Petrilli, Ferguson, Dawson, and Lamond (2006) also reported disrupted subsequent sleep upon energy drink consumption; night shift workers who drank energy drinks during their shift slept an average of 29 minutes less with less efficient sleep during the daytime. As sleep is considered a significant influencing factor of a number of psychological conditions; depressed individuals report having sleep

disruptions, and sleep hygiene practices have also seen to be highly recommended treatments for a number of psychological conditions (Dawson & Lamond, 2006). With this in mind, the sleep disrupting effects of caffeine consumption, though may not necessarily preclude psychopathology, may play a factor in symptom severity and longevity (Kruger, 1996).

Caffeine Dependence

The close connection between caffeine consumption and psychological symptoms is clearly demonstrated by the inclusion of Caffeinism within the DSM diagnostic framework. In this sense, heavy consumption of caffeine has been shown to elicit symptoms often indistinguishable from anxiety disorders, including sleep disruptions, nervousness, tension, irritability, affective disturbance, and other physical complaints (Greden, 1974). Often, this connection has been popularly indicated in psychiatric settings as many healthcare settings have not consistently regulated patient access to caffeine (via soda, coffee); as caffeine intake has been linked to exacerbation of pre-existing symptoms of psychopathology, the availability of caffeine may complicate diagnostic and treatment protocols (Greden, 1974).

Another experiment examined evidence of caffeine dependence in a number of case reports; despite the notion that the DSM-IV does not specifically recognize caffeine abuse or dependence, the authors argued for the existence of caffeine dependence in a subset of adult patients (Ogawa & Ueki, 2007). Outside of the presentation of caffeine abuse and dependence symptoms, the authors reported secondary mania, characterized by euphoria, feelings of versatility, talkativeness, hyperactivity, anxiety, and sleep disturbance induced from chronic consumption of energy drinks. Also, symptoms of

tachycardia, tremors, cold sweats, strong anxiety, and agitation were evident in another patient upon ingestion of caffeine pills (containing 500 mg caffeine) presenting with acute caffeine intoxication (Ogawa & Ueki, 2007).

Other studies have also indicated that a significant subset of the adult population meets DSM-IV substance dependence criteria for caffeine. In a telephone survey, roughly 44% of adults met mild to severe dependence criteria for caffeine consumption (Hughes, Oliveto, Helzer et al., 1992). Most recently, caffeine dependence was also met for a number of pregnant, caffeine-consuming women in which 57% of the sample met lifetime dependence criteria for caffeine (Svikis, Berger, Haug, & Griffiths, 2005).

Caffeine Consumption Associated with Psychological Disorders

In addition to exacerbating pre-existing psychological conditions, caffeine intake has been associated with an increased lifetime prevalence of a number of psychological disorders. Kendler, Myers, and Gardner (2006) examined caffeine intake and risk for psychiatric disorders in monozygotic twin pairs; seven major psychiatric disorders and substance use syndromes were significantly associated with caffeine intake including major depression, generalized anxiety disorder, panic disorder, alcohol dependence, cannabis abuse/dependence, cocaine abuse/dependence, and adult antisocial personality disorder. Effects of gender were also examined; males were significantly more likely to consume caffeine, have significantly higher levels of caffeine consumption during times of "maximal use," and were significantly more likely to report symptoms of caffeine dependence (Kendler et al., 2006). However, women were more likely to have comorbid associations between caffeine intake and major depression, cannabis abuse, and caffeine dependence (Kendler et al., 2006). As a whole, though there were significantly different

consumption behaviors between the sexes, no sex differences were evident between the author's caffeine variables and adult psychopathology (Kendler et al., 2006).

Furthermore, in addition to the association between caffeine consumption and the lifetime prevalence of psychological disorders, it has been demonstrated that individuals with a history of mental illness are more likely to consume caffeine and consume larger amounts of caffeine when compared to individuals without a history of mental illness. Specifically, in comparison to the average 200mg of caffeine consumed daily by American adults, a sample of 21 psychiatric inpatients consumed, on average, seven times more caffeine on a daily basis (Larson & Carey, 1998). Other studies have also indicated heightened caffeine consumption rates of individuals in inpatient settings when compared to non-clinical controls (Koczapski, Paredes, Kogan, Ledwidge, & Higenbottam, 1989; Greden, Fontaine, Lubetsky, & Chamberlain, 1978; Hamera, Schneider, & Deviney, 1995), further implicating the potential role of psychopathology on the consumption of caffeine.

Other literature suggests that, given the propensity for individuals with mental illness to consume psychoactive substances, the consumption of energy drinks in this population may be particularly hazardous. Three case reports of individuals with previous mental health concerns (e.g. cluster B personality features, bi polar disorder, schizophrenia) show a close temporal relationship between heavy consumption of taurine-containing energy drinks and negative psychological symptoms that lead to subsequent hospitalization (Chelben, Piccone-Sapir, Ianco, Shoenfeld, Kotler & Strous, 2008). Specifically, the individuals exhibited symptoms of hypervigilance, psychomotor, unease, verbal and physical aggression, impulsive behavior, insomnia,

self mutilation ideation, and intensive preoccupation with thoughts of death (Chelben et al., 2008). Overall, the authors concluded that it may be important to consider a possible diathesis-stress model; individuals with prior mental health conditions (e.g. mania, psychosis) may be particularly vulnerable to the effects of energy drinks and may react more adversely when compared to individuals without a history of mental health illness (Chelben et al., 2008).

Furthermore, it has been speculated that individuals with pre-existing psychological illness may not only be more at risk for consuming caffeine, they may be more sensitive to the effects of caffeine. Bruce and Lader (1989) reported a particular case study of an individual whose symptoms of Generalized Anxiety Disorder with panic attacks were maintained with an average of two cups of coffee a day (roughly 200mg of caffeine), which falls well below that of "normal" consumption.

Physiologically, consumption of caffeine has been shown to elicit anxious reactions in consumers through the blockage of benzodiazepine receptor sites in the brain; by interfering with said receptor sites, the sedative effect of medication is potentially neutralized or negated (Kaplan, Tai, Greenblatt, & Shader, 1990). In this sense, the consumption of caffeine, in addition to exacerbating negative psychological states, is also linked to the interference of the effectiveness of psychiatric medications. Research has indicated that caffeine may also impact absorption rates of other medications, including lithium and antipsychotics (Rush, Higgins, Bickel, & Hughes, 1994; Mester, Toren, Mizrachi, Wolmer, Karni, & Weizman, 1995); indicating that the consumption of caffeine may lead to significant difficulties regarding patient diagnosis, symptom management, and overall treatment.

Effects of Chronic Caffeine Consumption

Overall, few studies have distinguished between light and heavy caffeine users; however the existing literature indicates differential endorsement of symptoms, depending on the degree of reported caffeine consumption. Differential findings have been published in regard to longitudinal caffeine intake in conjunction with reported health problems, particularly hypertension and cancer. Grossarth-Maticek (1991) reported a heightened risk of hypertension and 4x decreased risk of cancer mortality in individuals who regularly consumed two to three liters of Coca-Cola over the course of ten years. Winkelmayer, Stampfer, Willett, and Curhan (2005), on the other hand, reported no association between the incidence of hypertension and regular consumption of coffee. However, individuals who reported regular consumption of soda (sugared or diet) were at greater risk for hypertension (Winkelmayer et al., 2005). As is apparent, the source of caffeine (i.e. coffee vs. soda) may have a significant influence on the various effects of chronic caffeine consumption.

Similarly, limited studies have investigated habitual consumption in association with reported psychological symptoms and features. Winstead (1976), examined self reported anxiety levels in inpatients in relation to their status as low vs. high caffeine consumers. Overall, high caffeine consumers were seen to endorse increased levels of state anxiety in comparison to low caffeine consumers; however differences in trait anxiety were not evidenced (according to scores on the STAI-S, STAI-R) (Winstead, 1976). The author concluded by illustrating an issue of bi-directionality: it is unclear as to whether higher levels of state anxiety motivate individuals to consume greater levels of caffeine or if consumption of greater levels of caffeine result in increased levels of trait anxiety.

However, Winstead (1976) postulated that both factors (i.e. prexisting anxiety leading to increased caffeine consumption and caffeine consumption leading to increased endorsement of anxious symptoms) may be operant in the relationship between caffeine consumption and anxiety.

Additional investigations have yielded differential psychological performance and report of subjective mood altering effects of caffeine when comparing users vs. nonusers of caffeine (Kuznicki & Tanner, 1986). Specifically, caffeine users were seen to perform better on tests of psychological ability (e.g. rotary pursuit task) relative to nonconsumers during periods in which blood plasma caffeine levels were high. Moreover, nonconsumers were also less likely to report mood elevation upon acute consumption of caffeine (Kuznicki & Tanner, 1986).

Lyvers, Brooks, and Matica (2004) also examined the relationship between light and heavy caffeine users with differential responses to acute caffeine consumption. Converse to previous predictions of a positive correlation between psychopathology and caffeine consumption, the authors postulated that, due to observed anxiogenic effects of caffeine consumption in anxious or neurotic individuals (Meyer, 1996), said individuals may consume less caffeine. As was found by Winstead (1976), no difference in trait anxiety (as measured by the STAI) was evident between high caffeine consumers (HCC > 400mg caffeine/day) and light caffeine consumers (LCC < 500mg caffeine/week) (Lyvers, Brooks, & Matica, 2004). A difference between LCCs and HCCs was evident on the measure of state anxiety (As measured by the STAI and BAI): LCCs reported significantly higher levels of state anxiety than HCCs after a moderate caffeine dose (300mg) and performed significantly better on the Wisconsin Card Sorting Test than LCCs in a placebo condition (Lyvers, Brooks, & Matica, 2004).

Motivations Behind Caffeine and Energy Drink Consumption

Considering the literature suggesting a number of potential negative physical and psychological outcomes to acute and chronic caffeine use, specifically energy drink consumption, one of the aims of this research is to inquire further into possible factors associated with energy drink consumption. Caffeine consumption has been implicated as a means of deliberate self-medication for individuals. Specifically, clinicians have noted deliberate usage of caffeine within psychiatric inpatient populations with the intent of counteracting the sedating side effects of a number of prescribed neuroleptic medications (Dalby & Williams, 1989). Furthermore, caffeine has been documented to produce a pain relieving effect; physiologically, the ingestion of caffeine may activate stress responses, thereby increasing a natural release of endorphins (Spindel & Wurtman, 1984). All of which can also be a contributing factor motivating individuals to consume caffeinated beverages for the intent of self medication.

Other researchers have examined possible motivating factors behind caffeine and energy drink consumption within non-patient populations. Malinauskas, Aeby, Overton, Carpenter-Aeby, and Barber-Heidal (2007) conducted a study that examined the consumption habits of college students, particularly in regard to motivating factors behind consumption. Half of the students sampled reported consuming energy drinks at least once a month, with females reporting higher consumption rates, albeit predominantly (35% of females vs. 12% of males) of the sugar-free variety (Malinauskas et al., 2007). Females, however, were found to consume higher levels of energy drinks that did not contain sugar. Sleep was also a factor examined; one of the main motivating factors reported for energy drink consumption was to increase mental

energy, particularly after having little sleep the night before (Malinauskas et al., 2007). Specifically, 71% of the respondents reported having little sleep for 5 out of the previous 7 days (Malinauskas et al., 2007). Overall, despite the lack of evidence suggesting that caffeine consumption can increase academic performance, the college students sampled in this experiment reported consuming energy drinks to combat the effects of sleep deprivation, particularly resulting from college demands such as working on course projects and studying for exams (Malinauskas et al., 2007).

Similarly, O'Dea (2003) examined psychological factors contributing to the consumption of energy drinks and other nutritional supplements in adolescents. Of the perceived benefits contributing to energy drink consumption, those that involved energy, taste, sports performance, soft drink substitute, peer group pressure, and attractive packing were seen as most prominent among the sample. The author also mentioned that a majority of individuals who consumed energy drinks (or other substances containing caffeine) had recently consumed caffeine-containing products which served as a major motivation for future consumption of caffeine (O'Dea, 2003). In this sense, the individuals were directly motivated by previous experience with the stimulating effects of caffeine and deliberately sought a desired "energy boost" from caffeine-containing substances (O'Dea, 2003).

Motivation behind general caffeine consumption has also been directly associated with positive caffeine expectancies and general psychological variables. Bradley and Allen (1990) demonstrated a positive relationship between positive expectancies of caffeine consumption with subsequent consumption behavior in college students; individuals that were seen to endorse a relatively greater amount of caffeinism

symptoms were also scored highly on positive caffeine expectancy measures (i.e. Expectations of Caffeine Enhanced Performance, EP-CAFF). Overall, the literature suggests that low to moderate doses of caffeine have been found associated with positive mood whereas higher doses of caffeine and habitual heavy use of caffeine is associated with negative mood symptoms including anxiety and depression (Lieberman, 1992; Greden, Fontaine, Lubestsky, & Chamberlain, 1978). Again, the research has been limited to the consumption of other traditional caffeine-containing products and has not examined the effects of energy drink consumption on psychological symptoms.

A number of studies have also implicated desire for weight loss as a possible motivating factor in the consumption of caffeine-containing products. Specifically, caffeine has been known influence weight loss by suppressing appetite, acting as a diuretic and increasing metabolism (Arluck, 2001). In a study conducted by Westerterp-Plantenga, Lejeune, and Kovacs (2005), the effects of caffeine consumption on weight loss were examined in adults. Over a three month period, significant weight loss was evidenced in all individuals, particularly those with high baseline habitual caffeine intake (> 300 mg/d) (Westerterp-Plantenga et al., 2005).

CHAPTER II

HYPOTHESES

In the current investigation, in light of the aforementioned literature regarding the influence of caffeine on psychological variables, it is hypothesized that individuals who report chronic, moderate-heavy acute consumption of energy drinks will report greater physical and psychological symptoms, particularly on the anxiety, mood, and psychotic spectra than non or light-consumers.

Overall, the negative physical and psychological effects of excessive caffeine consumption have been well documented. Particularly, though much research has been conducted in regard to general caffeine consumption, the literature is limited to the consumption of coffee, tea, and soda. However, though previous research has examined the acute effects of energy drinks and the overall effects of caffeine containing products, to the knowledge of this author, no experimentation to date has examined the potential impact of excessive or chronic intake of energy drinks on physical and psychological well-being or the factors associated with chronic energy drink consumption in college students. As such, a specific examination of energy drink consumption behaviors within the context of psychopathology and related physical symptoms is warranted for the current investigation. Additionally, a number of motivating factors have been described within the context of energy drink and general caffeine consumption; considering said literature, the present investigation aims to replicate previous findings and highlight relevant motivating factors behind energy drink consumption.

In light of previous literature implicating greater incidence of anxiety, depression, sleep, and cardiovascular-related symptoms in individuals who consume greater levels of caffeine, in this particular investigation, energy drink consumption behaviors are hypothesized to correlate with self reported psychological and physical symptoms. As such, an investigation examining energy drink consumption habits in conjunction with endorsement of symptoms may shed light onto the possible proclivity of individuals exhibiting psychological symptoms to engage in substance use or, conversely, the potential for energy drink consumption to elicit or exacerbate existing psychological conditions. Ultimately, this information may provide valuable insight to the psychological community regarding the possible bi-directional relationship between psychological distress and energy drink consumption.

CHAPTER III

METHOD

Participants

Two hundred and six individuals participated in this study: of those, two hundred and four participants, 152 female and 52 male, fully completed the demographic questionnaire. The participants were recruited from undergraduate psychology courses at the University of North Dakota in which extra course credit was offered for their participation.

Measures

The participants were given a number of surveys that included demographic information, a caffeine consumption questionnaire, an energy drink consumption questionnaire, a sleep habits questionnaire, and a number of instruments that address self report of symptoms on a variety of specific psychological domains.

Demographics

A demographic survey was administered to the participants that contained questions regarding basic personal information including age, gender, race, grade level, and expected GPA. In light of data suggesting significant heritability of particular psychological disorders, and by extension, a possible hereditary connection of psychological symptoms, the participants were also asked to indicate if they or immediate family members have currently or ever been diagnosed with a mental health disorder.

Caffeine Consumption Questionnaire

A caffeine intake survey was administered that includes a list of commercially available sources of caffeine (e.g. variations of coffee, tea, soda, and energy drinks). The participants were asked to denote the products they typically consume, the typical quantity of the product consumed in a sitting, how frequently it is consumed (i.e. per sitting, per week, and for how many months), and the typical time of day in which the product is consumed. For the participants that endorsed energy drink consumption, an additional questionnaire, modified from Malinauskas, Aeby, Overton, Carpenter-Aeby, and Barber-Heidal (2007), was given that briefly queried motivations behind energy drink consumption behavior as well as reported subjective side effects of energy drink consumption.

Psychological Assessment Questionnaires

The participants were given a packet of inventories that covered basic physical and mental health-related self-report items including the Symptom Checklist 90 Revised (SCL-90-R), Beck Depression Inventory, 2nd edition (BDI-II), State Trait Anxiety Inventory (STAI), and a sleep habits questionnaire.

SCL-90R. The SCL-90-R is a questionnaire that includes items that assess self-reported physical and mental symptoms over the most recent one-week period. The SCL-90-R contains 90 symptom-based items in which the participants will rank in terms of perceived severity (0 = Not at all, 4 = Extremely). Overall, endorsement of symptoms can be grouped into a nine dimensions including: somatization, obsessive-compulsive behaviors, interpersonal sensitivity, depression, anxiety, phobic anxiety, hostility, paranoid ideation, and psychoticism. The reliability of the SCL-90R is widely seen as

good; internal consistency coefficients range from .77 to .90, and test-retest reliability coefficients are consistently within the mid .80 range (Groth-Marnatt, 2003). Validity measures indicate that the SCL-90R highly correlates with other measures (e.g., General Health Questionnaire, Minnesota Multiphasic Personality Inventory) on expected dimensions. Studies examining the divergent validity of the SCL-90R, however, suggest tentative interpretation of the nine dimensions as its factor structure appears equivocal; not all dimensions have demonstrated consistent statistical independence (Groth-Marnatt, 2003).

STAI. The STAI is a brief assessment that includes 20 items related to the endorsement of various anxious symptoms. The inventory breaks down the self reported symptoms into state (i.e. transitory symptoms) and trait (i.e. stable, chronic symptoms) symptoms of anxiety and takes about 10 minutes to complete. Test-retest reliability for the STAI varies; though trait anxiety coefficients demonstrate sufficient reliability (rtt = .73 to .86), state anxiety reliability coefficients are somewhat lower (rtt = .51 males; rtt = .36 females) (Groth-Marnatt, 2003). However, given the fluid nature of state anxiety, lower test-retest reliabilities are to be expected when compared to more stable trait anxiety coefficient values. Furthermore, the STAI has demonstrated sufficient content and concurrent validity as evidenced by significant correlations (r = .73 to .75) amongst other anxiety measures (e.g. Manifest Anxiety Scale and Anxiety Scale Questionnaire) (Groth-Marnatt, 2003).

BDI-II. The BDI-II is a brief instrument that assesses the degree to which the participants endorse symptoms or behaviors indicative of depression. The BDI-II typically takes 10 to 15 minutes to complete and includes 21 items reflecting general

symptoms of depression including sadness, pessimism, loss of pleasure, agitation, and disturbances in sleep and appetite. Through extensive evaluation, the BDI-II is regarded as statistically valid and reliable instrument: internal consistency values have ranged from .73 to .92; and intercorrelation values amongst similar scales (e.g., Hamilton Psychiatric Rating Scale for Depression) range from .68 to .88, indicating favorable discriminant validity (Groth-Marnatt, 2003). Though test retest reliability values have ranged from .48 to .86, researchers believe that, due to the fluctuating nature of depressive symptoms and variable lapses between measurements, decreased score consistency may be expected (Groth-Marnatt, 2003).

Sleep Habits Questionnaires

The participants will also be given sleep questionnaires that query acute and chronic specific sleep patterns. The Acute Sleep Questionnaire- Adults contains 7 free-response and Likert items relating to sleep behaviors of the previous night (e.g., what time the participant went to bed, what time the participant awoke the next morning, if the participant dreamed, etc.). The Long Term Sleep Habits-Adults questionnaire contains 20 free response, Likert, and true-false items that primarily query sleep habits relating to typical sleep routines (e.g. perceived reasons for instances of sleep disruption, if sleep routine predictably changes, and perceived consequences of sleep disruption). These measures were independently developed at the University of North Dakota and, to date, have no specific reliability or validity data available.

CHAPTER IV

RESULTS

Demographics

Of the 204 participants that fully completed the demographic questionnaire, 152 female and 52 male, the majority of the participants reported Caucasian ethnicity (n = 198; 97% of the sample), a mean age of 19.4, and an average of 1.8 years in school. Twenty two participants indicated a current or previous history of a personal psychiatric diagnosis, and 45 indicated a current of previous history of psychiatric diagnoses in immediate family members.

Caffeine Consumption Questionnaire

Two hundred and five participants responded on the Caffeine Consumption Questionnaire. On the caffeine consumption measure, 92.2% of the participants reported regular consumption of caffeinated beverages per month: 79% reported regular monthly caffeinated soda consumption, 47.8% reported regular monthly caffeinated coffee consumption, 32.2% reported regular monthly caffeinated tea consumption, and 35.6% reported regular monthly caffeinated energy drink consumption. Of the participants that reported caffeine consumption (see Table 1 and Figure 1), the average consumption of caffeine was 638.852 mg/week [Standard Deviation (SD) = 1161.440] total with an average of 193.227 mg/week from soda (SD = 310.566), 315.220 mg/week from coffee (SD = 859.741), 38.782 mg/week from tea (SD = 139.847), and 91.634 mg/week from energy drinks (SD = 263.240).

Table 1. Caffeine Consumption Questionnaire: Mean Weekly Milligrams of Consumed Caffeine by Source and Gender.

	Males (n = 52)		Females (n = 152)	
	$\bar{X}$	*SD*	$\bar{X}$	*SD*
Total Mgs/Week	731.23	781.79	610.98	1270.39
Energy Drink Mgs/Week	196.07**	453.88	57.80**	143.03
Soda Mgs/Week	292.20*	440.87	161.40*	247.72
Coffee Mgs/Week	212.45	467.21	350.10	959.39
Tea Mgs/Week	30.51	65.37	41.69	65.37

* Indicates significant mean gender differences, $p < .05$
** Indicates significant mean gender differences, $p < .01$

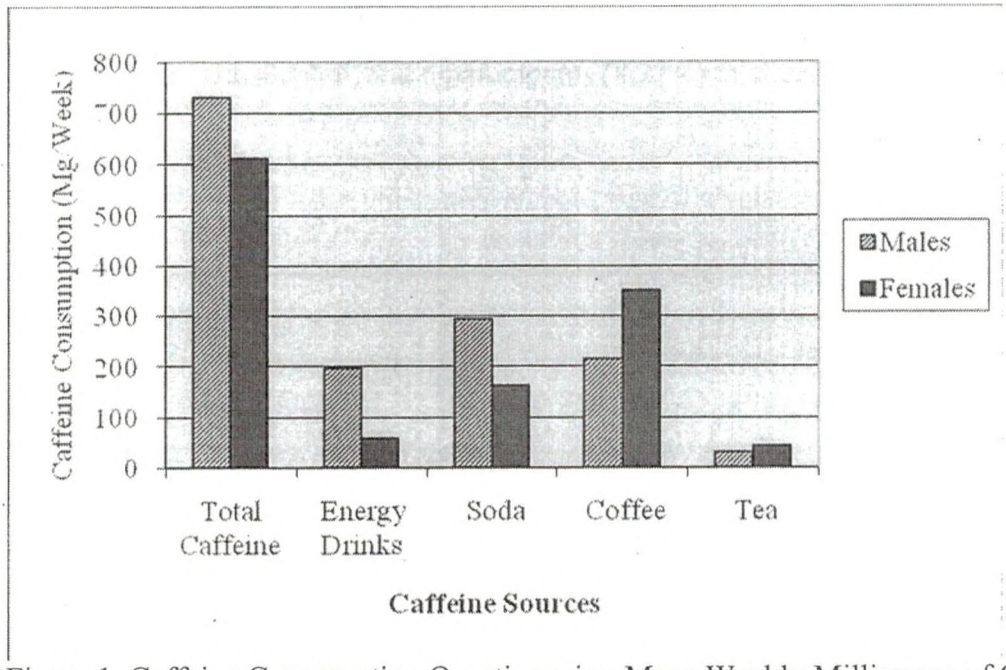

Figure 1. Caffeine Consumption Questionnaire: Mean Weekly Milligrams of Consumed Caffeine by Source of Caffeine and Gender

Energy Drink Consumption Questionnaire

Two hundred and six participants completed the Energy Drink Consumption Questionnaire, in which the participants indicated motivations behind energy drink consumption behavior and subjective correlated physical symptoms related to consumption. Specifically, of those that reported regular energy drink consumption (n = 73), 15 participants (20.55%) reported headaches and 16 participants (21.92%) reported

heart palpitations as perceived side effects of consumption. With regard to motivations behind regular energy drink consumption (see Figures 2 and 3), participants reported drinking energy drinks at least once a month for the following reasons: 53 participants (72.61% of energy drink consumers) to alleviate symptoms of general sleep deprivation, 59 participants (79.45%) to increase energy and alleviate general fatigue, 43 participants (58.90%) during nights in which school-related activities interfered with regular sleep patterns (e.g. working on class projects and studying for exams), 39 participants (53.42%) to aid in performance while driving a vehicle, 28 participants (38.36%) mixed energy drinks with alcohol, and 6 participants (8.22%) to alleviate symptoms of hangover.

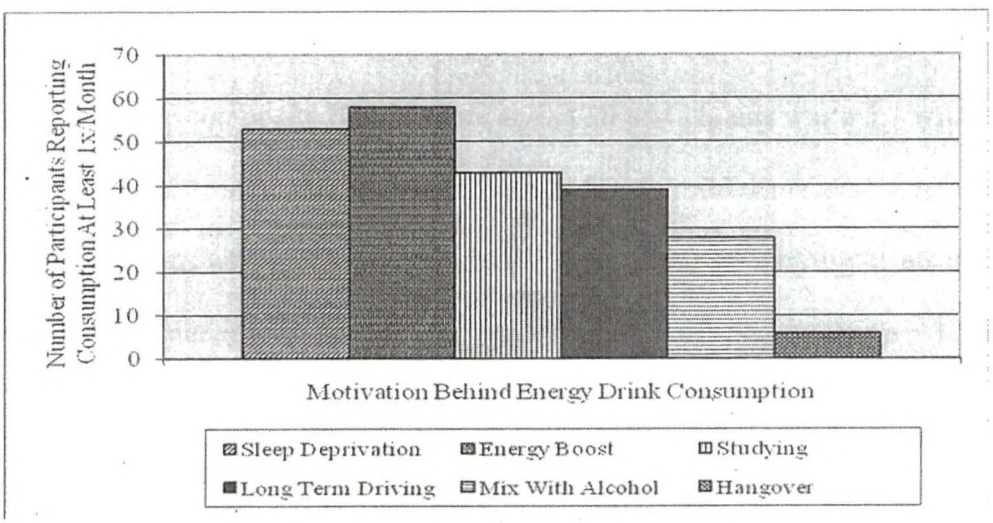

Figure 2. Energy Drink Questionnaire: Motivation for Energy Drink Consumption I.

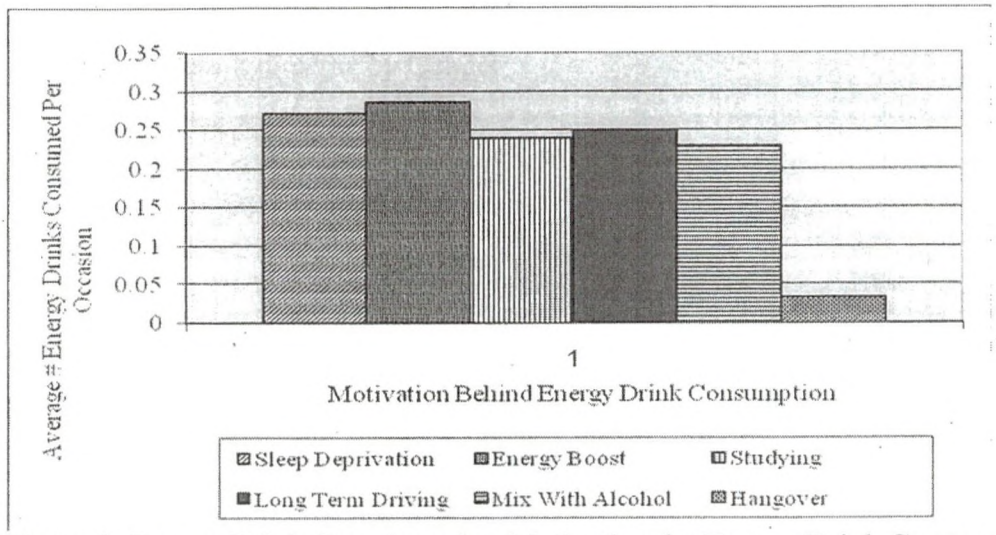

Figure 3. Energy Drink Questionnaire: Motivation for Energy Drink Consumption II.

Psychological Assessment Questionnaires

Two hundred and six participants responded to the BDI-II and SCL-90R measures whereas two hundred and five participants completely responded to the STAI measure (one participant declined to provide responses related to state anxiety), see Table 2. On the BDI-II the average composite BDI-II score across all participants was a 5.7 with a standard deviation of 6.5, indicating an overall trend of no to mild depression across all subjects. Of the participants who met recommended BDI-II criteria for varying levels of depression, 13 participants met criteria for mild depression (BDI-II Composite Score = 14-19), 7 participants met criteria for moderate depression (BDI-II Composite Score = 20-28), 2 participants met criteria for severe depression (BDI-II Composite Score = 29 and above), and 11 participants reported past or present suicide ideation, as indicated by responses on item 9. Individuals meeting criteria for moderate to severe depression and those who reported current or previous suicidal ideation were subsequently contacted, informed of their assessment results, and provided contact information for local psychological services facilities.

Table 2. BDI-II, STAI, SCL-90R Questionnaires: Psychological Symptom Report and Clinical Distress Indicators by Gender

	Score				
	Males (n = 52)°		Females (n = 152)°		Clinical Distress
	$\bar{X}$	*SD*	$\bar{X}$	*SD*	*(n =)*
BDI-II*	4.25	4.53	6.22	7.00	22
STAI **					
State	43.13	7.64	45.56	10.24	12
Trait	45.54	8.53	47.03	10.25	17
SCL-90R ***					
GSI	48.46	9.66	50.32	9.95	25
PST	47.35	9.83	49.67	10.19	22
PSDI	49.21	10.91	49.41	14.08	18
Anxiety	47.71	8.94	47.36	9.33	11
Depression	50.06	8.98	51.12	9.43	21
Hostility	49.54	8.50	50.08	8.10	16
Psychoticism	48.33	7.42	50.93	9.36	28

* Clinical Distress denoted by BDI Composite Score of 14 or Greater
** Clinical Distress denoted by scores greater than 2SD of normative group
***Clinical Distress denoted by t scores greater than 63
° no significant score differences observed when grouped by gender

On the SCL-90R, an obtained T score of 63 or greater is considered to indicate clinically significant distress on any of its particular indices, see Table 2 (Groth-Marnatt, 2003). Of the two hundred and six individuals who responded to the SCL-90R measure, 25 participants met criteria for clinically significant general distress (Global Severity Index, GSI), 22 met criteria for reporting a clinically significant number of symptoms (Positive Symptom Total, PST), and 18 met criteria for reporting clinically significant degree of distress associated with the unique symptoms the participants reported (Positive Symptom Distress Index). The SCL-90R also contains specific indices that reflect the amount and severity of symptoms reported on a number of

psychological domains including depression, anxiety, psychoticism, and hostility. Similar to the recommended clinical cutoff criteria for the SCL-90R general indices, a score of 63T or higher on the domain-specific indices also indicate clinically significant levels of distress. On these indices, 21 participants met criteria for items loading on the Depression index, 11 met criteria for items loading on the Anxiety index, 28 reported significant symptoms loading on the psychoticism index, and 16 met criteria for hostility.

Two hundred and five individuals fully completed the STAI measure, with a mean standardized state anxiety score of 44.92 (SD = 9.68), and a mean standardized trait anxiety score of 46.65 (SD = 9.85). When taking into account normative sampling STAI data of male (State: mean = 36.47, SD = 10.02; Trait: mean = 38.30, SD = 9.18) and female (State: mean = 38.76, SD = 11.95; Trait: mean = 40.40, SD = 10.15) college students, a number of statements can be made about the distribution of anxiety scores in this investigation, see Table 2. As a whole, the majority of the scores from this investigation appear to fall within 1 SD of the normative population scores for both state and trait anxiety, indicating that the obtained sample appears to reflect the normative STAI data.

Additionally, by comparing the obtained data against STAI normative data, relative severity of symptoms can be addressed. In this investigation, 54 participants fell beyond 1 SD and 12 participants fell beyond 2 SDs of the normative mean of STAI-State anxiety, indicating that 32.2% of this sample reported high levels of state anxiety when compared to a sample of same-aged peers. On measures of STAI-Trait anxiety, 69 participants obtained scores in excess of 1 SD and 17 participants obtained scores in

excess of 2 SDs from the normative mean of trait anxiety, indicating that 42% of the current sample reported relatively high levels of trait anxiety when compared to a normative sample of male and female college students.

Statistical Analyses of Energy Drink Consumption

Prior to the statistical analysis of the obtained data, the participants were divided into three groups: individuals who reported no significant energy drink consumption, non-consumers, (i.e. less than one energy drink consumed per month, on average, n = 132); individuals who reported regular energy drink consumption below the 50th percentile of all energy drink consumers, low-consumers, (i.e. less than 90mg of caffeine from energy drinks consumed a week on average, n = 34); and individuals who reported regular energy drink consumption above the 50th percentile of all energy drink consumers, high-consumers, (i.e. more than 90mg of caffeine from energy drinks consumed a week on average, n = 39).

Multivariate Analysis of Variance and Covariance

To test the effect of energy drink consumption on the psychological assessment measures (e.g. the BDI-II, STAI, and SCL-90R), a multivariate analysis of variance was conducted to examine the relationship between energy drink consumption and psychological variables. Overall, a number of significant results and marginally significant trends of energy drink consumption on psychological symptom report were apparent in the current analyses, particularly within the domains of anxiety and depression. Additionally, to control for possible conflicting sources of variance on the dependent variables, an analysis of covariance was included in which the influence of total caffeine consumption (across all reported sources of caffeine consumption) was

taken into account in addition to the independent variable of energy drink consumption groupings. Furthermore, to reduce the risk of a type I error (i.e. falsely detecting effects in the absence of real effects), the Bonferroni post hoc test (BF) was utilized as a conservative estimate of estimated marginal mean differences.

When accounting for the covariate of total caffeine consumption independent of energy drink consumption, the multivariate analysis of variance of the energy drink consumption grouping variable yielded significant effects on a number of psychological assessment variables, see Table 3 for estimated marginal means and standard error estimates. Specifically, significant main effects were found for overall BDI-II score [$F(2, 201) = 3.29$, $p < .05$] where non-consumers (mean = 6.41, SD 7.24) reported higher levels of depression than high-consumers (mean = 4.69, SD = 4.40, BF: $p = .08$) see Figure 4, STAI-Trait anxiety percentile [$F(2, 201) = 3.62$, $p < .05$] in which non-consumers obtained significantly higher trait anxiety normative percentile rankings than low-consumers (BF: $p < .05$) see Figure 5, and SCL-90R Depression and Anxiety percentile rankings [$F(2, 201) = 3.22$, $p < .05$ and $F(2, 201) = 3.36$, $p < .05$, respectively] in which non-consumers obtained higher depression (BF: $p < .05$) and anxiety (BF: $p < .05$) percentile rankings than low-consumers, see Figure 6.

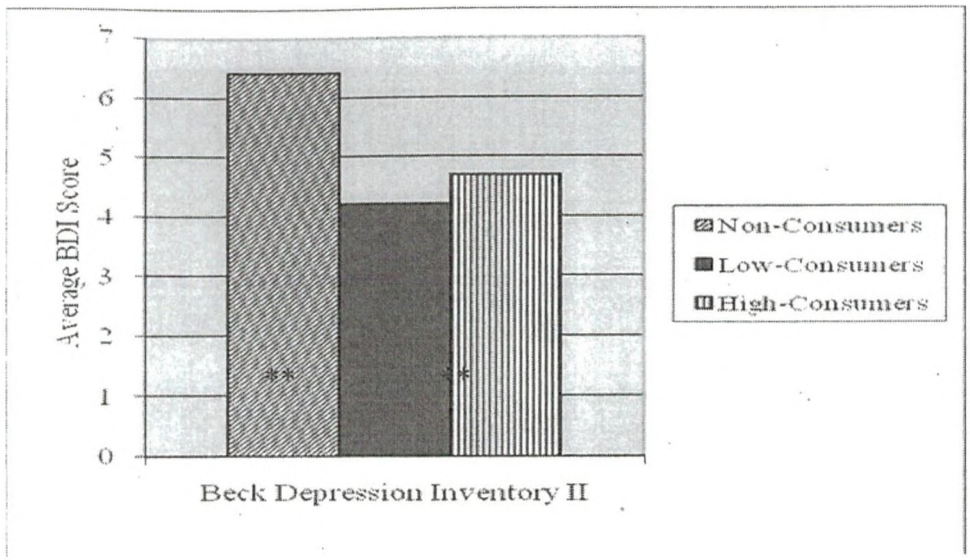

Figure 4. Beck Depression Inventory II: Composite Scores by ED Consumer Groupings.

** Indicates significant energy drink consumer group differences, $p < .05$

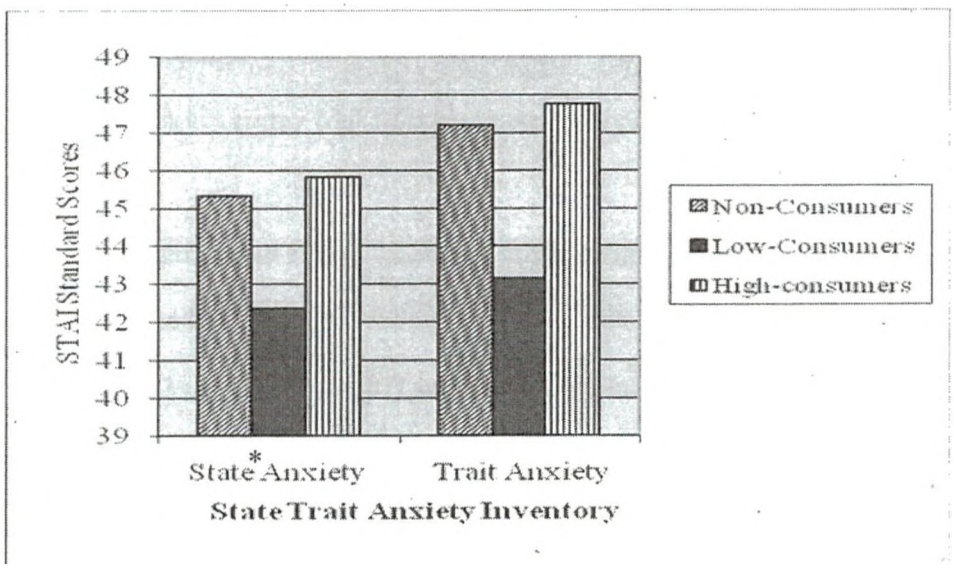

Figure 5. State-Trait Anxiety Inventory: Standard Scores by ED Consumer Groupings.

* Indicates marginal energy drink consumer group differences, $p < .10$

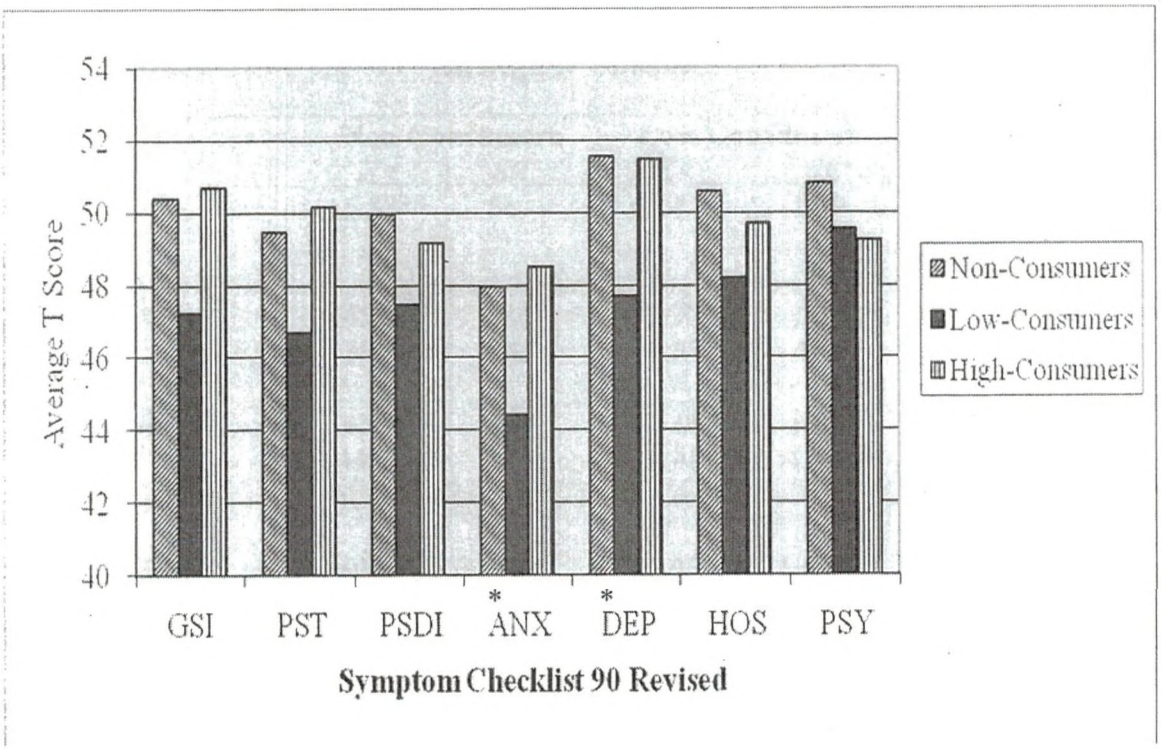

Figure 6. Symptom Checklist 90 Revised: Average T Scores by ED Consumer Groupings.

* Indicates marginal energy drink consumer group differences, $p < .10$

Marginal main effects for energy drink groupings were also found on a number of items in the STAI and SCL-90R psychological assessments. Specifically STAI-State anxiety standard scores [$F(2, 201) = 2.71$, $p = .07$] and STAI-State anxiety percentile rankings [$F(2, 201) = 2.37$, $p = .096$] in which low-consumers obtained lower state anxiety standard scores and percentile rankings than non-consumers (BF: $p = .06$ and $p = .08$ respectively), SCL-90R Anxiety index T score [$F(2, 201) = 2.40$, $p = .094$] in which non-consumers obtained higher anxiety scores than low-consumers (BF: $p = .08$) and SCL-90R Depression index T score [$F(2, 201) = 2.91$, $p = .057$] in which non-consumers obtained higher standardized depression scores than low-consumers (BF: $p < .05$).

Table 3. Multivariate Analysis of Variance and Covariance: ED Consumption Groupings & Estimated Marginal Means of Psychological Variables.

	Non Consumers		Low Consumers		High Consumers	
	$\bar{X}$°	*SE*	$\bar{X}$°	*SE*	$\bar{X}$°	*SE*
BDI	6.58**	.56	4.14	1.09	4.15**	1.04
STAI						
State	45.47*	.84	42.30*	1.65	45.34	1.57
%	39.57*	2.45	27.83*	4.80	37.40	4.58
Trait	47.93	.85	43.09	1.67	47.25	1.59
%	44.56**	2.49	30.48**	4.89	45.78	4.66
SCL-90R						
GSI	50.65	.85	47.13	1.67	49.78	1.60
%	57.07	2.58	45.24	5.06	54.86	4.82
PST	49.77	.87	46.59	1.71	49.14	1.63
%	55.29	2.56	43.94	5.02	54.44	4.79
PSDI	50.12	1.16	47.41	2.28	48.60	2.17
%	59.46	2.45	51.63	4.82	54.80	4.59
Anxiety	48.15*	.79	44.37*	1.56	47.90	1.48
%	50.74**	2.46	36.96**	4.82	50.30	4.60
Depression	51.81*	.79	47.61*	1.56	50.57	1.48
%	61.14**	2.38	47.84**	4.68	59.23	4.46
Hostility	50.69	.72	48.17	1.41	49.36	1.34
%	56.18	2.35	48.19	4.62	52.41	4.41
Psychoticism	51.04	.771	49.44	1.51	48.42	1.44
%	53.39	2.38	46.72	4.67	45.86	4.54

° Estimated marginal means displayed; when controlling for the influence of total milligrams of non-ED caffeine consumed monthly

* Indicates marginal energy drink consumer group differences, $p < 1.0$

** Indicates significant energy drink consumer group differences, $p < .05$

Multiple Regression Analyses

Concurrent analyses were conducted on the significant and marginally significant results obtained in the multivariate analysis of variance and covariance to rule out potential influences of demographic variables, particularly the impact of gender, on the dependent measures. Specifically, a stepwise multiple regression analysis was conducted in which the energy drink groupings (i.e. non-consumer, low-consumer, high-consumer) were entered as predictors in the first step and gender was subsequently entered as a predictor in the second step on the criteria of: BDI-II score, SCL-90R Depression index t score and percentile ranking, STAI-Trait percentile ranking, STAI-State standardized score and percentile ranking, and the SCL-90R Anxiety index t score and percentile ranking. To determine the relative contributions of each predictor, the obtained standardized Beta coefficients of the multiple regression equation were examined to allow for the direct comparison of the predictor variables. Overall, higher relative magnitudes of the Beta coefficients indicate a greater relationship between the predictor (i.e. energy drink groupings and gender) and the associated psychological assessment variables.

On measures of depression, when examining the unique contributions of gender to the regression equation, the predictive power of the model for the BDI-II scores decreased; the second model evidenced relatively smaller standardized slope coefficients than the energy drink groupings (Beta = -.100 ED groupings; Beta = -.095 gender). The SCL-90R Depression index t score regression equation yielded similar results in which gender and the ED groupings had comparable predictive power with respective Beta coefficients of -.031 (ED groupings) and -.035 (gender). Conversely, a

regression analysis of the SCL-90R Depression index percentile rankings indicated a relatively stronger effect of gender on the dependent variable (Beta = -.036) when compared to the ED groupings (-.023).

On measures of anxiety, the predictive power of gender appeared as relatively stronger than the ED groupings on the STAI-State standard score, with respective Beta coefficients of .013 (ED groupings) and - .094 (gender). Similar effects were found with the STAI-State percentile rankings in which the relative predictive power of gender was seen as -.12 (Beta) when compared to the ED groupings (Beta = -.01). Likewise, the multiple regression analysis of the STAI-Trait percentile rankings yielded similar results in which gender appeared to have greater predictive power (Beta = -.04) when compared to ED groupings (Beta = .01). Similar relationships were found on the SCL-90R Anxiety index measure, with gender contributing somewhat more to the regression equation with respective Beta coefficients of .024 (gender) and -.019 (ED groupings). Lastly, similar effects were found with the SCL-90R Anxiety index percentile rankings; gender was seen with marginally higher relative contributions (Beta = .053) to changes in the percentile rankings than ED groupings (Beta = -.031).

Exploratory Analyses

Demographic Variables Caffeine Consumption By Source of Caffeine

Demographic characteristics were examined in relation to consumption habits of all sources of caffeine and psychological variables. In a Pearson correlation analysis, participant age was positively correlated with a number of variables including: having a current or past personal psychiatric diagnosis ($r = .18$, $p < .05$), and general caffeine consumption independent of energy drink consumption. Specifically, age was positively

associated with total milligrams of caffeine a week regardless of its source ($r = .27$, $p < .01$), be it from soda ($r = .26$, $p < .01$), coffee ($r = .20$, $p < .05$), or tea ($r = .26$, $p < .01$).

Additionally, a one way analysis of variance was conducted to examine the association between gender and total caffeine consumption by source. Significant group relationships were apparent on energy drink and soda consumption as a function of gender, see Table 1 and Figure 1 (p. 28); male participants reported significantly higher consumption of caffeine per week from energy drinks than females with respective means of 196.07 mg/week (SD = 453.88) and 57.80 mg/week (SD = 143.03), $F(2, 203) = 5.54$, $p < .01$. Consumption of soda also significantly varied by gender with males reporting significantly higher milligrams of weekly caffeine (mean = 292.20, SD = 440.87) than females (mean = 161.40, SD = 247.72), $F(2, 203) = 3.46$, $p < .05$. Considering unequal group sizes by the gender grouping factor (female n = 152, male n = 52), tests of homogeneity of variance were conducted; significant heterogeneity of variance was evident on both energy drink and soda consumption by gender groupings with respective Levene's Test statistics of 16.48, $p < .01$ and 5.08, $p < .05$. These results indicate a violation of the homogeneity of variance assumption for the analysis of variance, and that the obtained results described above must be interpreted cautiously.

Statistical Analyses of General Caffeine Consumption

When taking into account the previous literature examining the relationship between general caffeine consumption and various psychological variables, additional correlational analyses were conducted to highlight potential relationships between general caffeine consumption (independent of energy drink consumption), report of psychological symptoms, and sleep health variables. A Pearson correlation analysis yielded a number of

significant correlations between caffeine consumption (of various caffeinated beverages) and psychological variables including scores on psychological assessments, see Table 4.

Table 4. Pearson Correlation Analysis: General Caffeine Relationships on Sleep and Psychological Assessment Variables

	Average Milligrams of Caffeine Per Week			
	Total	Soda	Coffee	Tea
Sleep (r =)				
Sleep Quality Rating	.17**	.03	.24***	.06
Hrs on School Night	-.04	-.04	-.03	-.02
Hrs to Feel Best	.06	.06	.04	.04
Hrs to Function	-.19**	-.14**	-.17**	-.06
Mornings Feeling Best	-.12*	-.07	-.13*	-.10
Unsatisfactory Sleep	.05	.03	.04	.02
Sleep Disruption	.03	-.04	.06	.07
Bad Dreams	.13*	.04	.11	.12
General Daily Fatigue	.05	-.04	.08	.11

	Average Milligrams of Caffeine Per Week			
	Total	Soda	Coffee	Tea
Psychological Variables (r =)				
BDI Score	.12*	.10	.10	.24***
Suicide	.29***	.15**	.23***	.40***
STAI				
State	.09	-.01	.11	.15**
Trait	.10	.08	.08	.10***
SCL-90R				
GSI	.17**	.10	.15**	.21***
PST	.19***	.09	.18**	.24***
PDSI	.06	.09	.04	.10
DEP	.17**	.15**	.14	.24***
ANX	.13*	-.01	.13*	.22***
HOS	.05	.15**	.00	.18**
PSY	.13*	.05	.15**	.21***

* Indicates marginal relationship, $p < .10$
** Indicates significant relationship, $p < .05$
*** Indicates significant relationship, $p < .01$

Overall, greater weekly consumption of general caffeine was significantly associated with greater report of suicidal ideation as measured by endorsement of "1" or higher on item #9 on the BDI-II ($r = .29$, $p < .001$) in which report of greater tea and coffee consumption were most highly associated ($r = .40$, $p < .001$ and $r = .23$, $p < .001$, respectively), greater reports of general distress on the SCL-90R GSI index ($r = .17$, $p < .05$), greater number of symptoms reported as measured by the SCL-90R PST index ($r = .19$, $p < .01$), and higher scores on the SCL-90R depression index ($r = .17$, $p < .05$). Additionally, marginal relationships were also apparent: general caffeine consumption was associated with higher scores on the SCL-90R anxiety index ($r = .13$, $p = .065$), higher scores on the SCL-90R Psychoticism index ($r = .13$, $p = .060$), and higher overall BDI-II scores ($r = .12$, $p = .096$).

CHAPTER V

DISCUSSION

The purpose of this study was to examine the possible relationship between energy drink consumption patterns and the report of psychological symptoms and secondary sleep patterns in college students. The results of this investigation indicate a number of potential associations between habitual energy drink consumption on psychological variables including dimensions of overall distress, general symptom report, and report of specific symptoms within anxious, depressive, and psychotic domains, and associated sleep habit variables. Specifically, energy drink consumption was associated with lower report of trait and generalized anxiety as measured by the STAI and SCL-90R assessments, and was marginally associated with lower report of state anxiety and depression, as measured by the STAI, BDI-II and the depression index of the SCL-90R.

These findings deviate from previous investigations of caffeine consumption patterns (independent of energy drink consumption) in adults; other investigations have highlighted a positive relationship between caffeine consumption and report of anxious state and trait symptoms when examining differential performance and subjective mood report of heavy vs. low-consumers (Winstead, 1976). Other investigations, however, have postulated accounts for differential caffeine consumption and self report of psychological symptoms as a function of motivation; individuals with higher levels of anxiety may systematically avoid caffeine consumption to avoid its anxiogenic

properties (Meyer, 1996). Other studies that have examined habitual caffeine consumption in relation to psychological variables have included participants that consumed significantly higher amounts of caffeine overall. Liyvers, Brooks, and Mattica (2004), defined low and high consumers as consuming less than 500 mg of caffeine a week and greater than 400 mg/day respectively; these consumption levels deviate from the consumption patterns evidenced in the current sample, with the average amount of energy drink consumption of 90 mg/week. Lastly, these studies are limited in number and also restricted caffeine consumption to caffeinated beverages independent from energy drink consumption, which may also account for the findings in the current investigation.

Furthermore, when taking into account the marginally lower depression scores in individuals with high energy drink consumption patterns when compared to non-consumers, these results could potentially be explained by a self-medication model of caffeine consumption (Hillary, 1995). Specifically, it is well documented that individuals who experience heightened levels of psychological distress may be more likely to consume substances in an attempt to control their distressing psychological symptoms (Hillary, 1995). Within this theoretical framework, a self-medication model may explain the lower rates of anxiety and, to a lesser extent, depression, if the influence of energy drink consumption were to effectively minimize the subjective sense and report of psychological distress. As a whole, however, additional research is necessary to shed further light on the validity of this explanatory model and the potentially conflicting findings of this investigation when compared to previous research efforts.

Overall, the aforementioned findings have highlighted a potentially significant discrepancy in psychological symptom and severity report between non-consumers and low-consumers of energy drinks; the relationship between moderate to heavy consumers in comparison to non-consumers remains unclear. As lower energy drink consumption was associated with less psychological distress when compared to both non-consumers and high consumers, these findings may reflect a potentially inherent Yerkes-Dodson effect of energy drink consumption on psychological symptom report. Specifically, the Yerkes-Dodson principle outlines a curvilinear relationship between arousal and performance; individuals who experience moderate levels of arousal during specific tasks evidence better performance on a variety of cognitive tasks when compared to individuals experiencing relatively lower or higher levels of stress (Stennett, 1957).

Considering that caffeine is well documented to increase overall arousal by stimulating the sympathetic nervous system (Kruger, 1996), and additional investigations have linked heightened autonomic responses (by means of caffeine consumption) to increased levels of anxiety (Hillary, 1995), differential caffeine consumption may have varying psychological consequences. Perhaps, similar to the Yerkes-Dodson model describing the optimal effects of a moderate level of stress on performance when compared to no stress and high stress, a potentially optimal level of psychological wellbeing is attained through low to moderate regular caffeine consumption via energy drinks when compared to non-consumption and heavy consumption. Again, additional research is needed to further examine an explanatory model of a possible optimal energy drink consumption pattern on psychological wellbeing.

When examining general caffeine consumption in the sample (i.e. consumption of various caffeinated beverages including soda, coffee, and tea), a number of potential associations were highlighted between consumption patterns and psychological symptom report and long term sleep patterns. Overall, general caffeine consumption patterns, as measured by weekly milligrams of caffeine consumption from any type of caffeinated beverage was significantly associated with report of suicidal ideation, higher scores on depression as measured by the SCL-90R (and, to a marginal extent, the BDI-II), greater level of general psychological distress as measured by the GSI of the SCL-90R, and greater number of reported psychological symptoms as measured by the PST of the SCL-90R. Marginally significant relationships were found between general caffeine consumption and greater report of anxiety and psychotic symptoms as measured by respective indices on the SCL-90R as well.

The present results differ from the findings in relation to energy drink consumption in this investigation; the nature of the relationship between caffeine consumption and symptom report is essentially reversed in the general caffeine analyses. A number of explanatory models may account for this finding: firstly, a potential drawback of this investigation was an observed increase in heterogeneity of variance as a function of different non-low-high consumer group sizes with $n = 132$, $n = 34$, and $n = 39$, respectively. In this sense, group size differences may have influenced the findings, though measures were taken to minimize the influence of differential group size. Post hoc power analyses were conducted that indicated moderate to high levels of power across all group comparisons (i.e. the present study design is powerful enough to detect actual group differences) and modified F tests were employed to decrease the

impact of heterogeneity of group variance (by means of unequal group size) on significance estimates of effect. As indicated, despite group differences, the methods employed in this investigation appear to demonstrate sufficient robustness to detect actual group differences and have found a number of significant and marginally significant differences on the variables of interest.

Alternatively, this finding may also be due to the difference and variance of ingredients across caffeinated beverages. Specifically, energy drinks contain a number of ingredients that are not consistently present across other caffeinated beverages, including taurine, guarana, vitamin (e.g. B complex), and ginseng (Babu, Church, & Lewander, 2008). Though speculation of active ingredients and physiological mechanisms of change on overt, observable, and subjective psychological symptoms and behaviors is beyond the scope of this investigation, this issue may be more fully addressed in future research endeavors.

Considerations

A number of specific considerations should be made about the possible conclusions that may be drawn from the relationships delineated between energy drink consumption and psychological symptom report. Firstly, additional multiple regression analyses of the obtained significant and marginally significant results yielded differential findings when compared to the multivariate analysis of variance and covariance. Specifically, a potentially significant impact of gender was implicated when taking into account the influence of energy drink consumption on the psychological assessment variables as gender was seen to have relatively higher Beta coefficients (i.e. contributing to relatively greater change on the psychological variables) than the energy

drink grouping variables. It is important to note that, though differences in predictive power between gender and the ED groupings within the regression equation was evidenced, the difference in coefficients were often comparable, with an average of 4% difference between the gender and ED Betas amongst all significant and marginally significant psychological variables. In this sense, when taking into account the comparable predictive power on the psychological symptom report when compared to ED groupings, this investigation may have highlighted a potentially important role of gender on psychological wellbeing in addition to energy drink consumption behavior.

Furthermore, though significant differences and marginal trends of psychological symptom report were found amongst groups of energy drink consumers vs. non-consumers, the group means did not exceed normative cutoffs for clinical significance; though the group means differed, none of the means reflected what would be considered as clinically significant distress on general and specific psychological indices. In this sense, though the obtained results indicate significant group differences and potential trends for groups to differentially respond on various measures of psychological symptom report, these differences may not effectively reflect observable or meaningful group differences.

Also, when examining the distribution of BDI-II scores, though the majority of the participants did not meet criteria for depression, a sizable number of scores may pose validity concerns. Particularly, in the interpretation of BDI-II scores, some authors indicate that scores falling below a composite score of 4 may indicate possible underreporting of symptoms, which may suggest compromised validity of test results (Groth-Marnatt, 2003). In light of this qualification, 57% (n = 118) of participants in

this investigation obtained scores that do not meet clear criteria for valid interpretation of BDI-II test results. All things considered, significant and marginally significant relationships have been indicated in this study, though these findings should be cautiously interpreted.

Though, to the author's knowledge, this study represents a first attempt at establishing the relationship between habitual energy drink consumption and the presence psychopathology, a number of weaknesses are present in the current investigation that may be addressed. A potential drawback of this study is a primary emphasis on retrospective estimates for the caffeine consumption questionnaire. Specifically, as the participants were instructed to estimate average weekly intake of caffeinated beverages and provide average associated serving sizes, human error on behalf of the participants may have influenced the accuracy of the self report estimates.

In this sense, the accuracy of the caffeine milligram estimation and the breakdown of non-low-high consumer groups is subject to the overall accuracy of the participant's retrospective account of typical consumption behavior. A number of investigations have demonstrated and discussed the potential inaccuracies of self report of substance consumption rates: Harris, Griffin, McCaffrey, and Morral (2008), describe significant inaccuracy of substance consumption report in that 77% of participants reported inaccurate consumption of at least 1 of 12 targeted substances in adolescents within a substance abuse context. Overall the literature indicates that retrospective accounts of caffeine consumption behavior must be methodologically addressed and, the results of which, should be interpreted cautiously (Adcock, 1996).

Secondly, the timeline and execution of this study's recruitment phases may have systematically accounted for differential symptom report. Two rounds of participant recruitment were conducted during the course of data collection in which the majority of the participants completed the study, namely, the first month and last month of the spring semester. Participants completing the study requirements during times of increased academic stress could potentially have reported increased levels of distress that may have varied as a function of the academic calendar than from caffeine consumption habits. In other words, participants who completed the study near the end of the semester (i.e. near finals week) may have reported a higher level of distress than participants who participated in the earlier recruitment phase in which academic stressors may be predictably less.

Future Directions

Considering the above, future studies can be informed to improve upon the current investigation in a number of ways. Firstly, the method of caffeine consumption report may be modified to enhance accuracy; the participants could be asked to fill out consumption diaries instead of estimate of "typical" consumption. In this sense, action can be taken to minimize the impact of participant estimation error; a more accurate estimation of consumption behavior may be gained using this methodology. Secondly, to address the potential issue of temporal influences on stress external to individual differences in energy drink-based caffeine consumption, future studies should either: balance recruitment phases over the academic calendar to avoid potentially confounding systematic differences in external stressors; include straightforward coding to take into account temporal trends in data collection; directly inquire participants of current

personal stressors which may influence self report of psychological distress external to the influence of energy drink and caffeine consumption.

Lastly, when considering the degree of variation of ingredients amongst energy drinks (i.e. the inclusion of vitamins, ginseng, herbs etc.), an empirical investigation of differences in psychological symptom report by brand of energy drink may provide useful insight to possible differential impact of various energy drink ingredients of varying psychological domains (Babu, Church, & Lewander, 2008). In this sense, examining differential combinations of ingredients along with self report of psychological symptoms (or lack thereof), may provide greater understanding as to the mechanisms that impact overall psychological health.

Clinical Implications

In light of the current state of the psychology literature base in regard to energy drink and general caffeine consumption patterns, this study provided an initial look into the global psychological roles of habitual energy drink consumption by highlighting associations between energy drink consumption and its relationship to psychological wellbeing. As mentioned previously, few published studies have specifically investigated the relationship between psychological symptom report and habitual caffeine consumption, and none, to date, have investigated the potential influence of energy drink consumption patterns on psychological wellbeing. Particularly, the literature is currently limited to studies examining acute psychological, behavioral, and physiological effects of isolated energy drink consumption, motivations behind energy drink consumption behavior, and behavioral associations of energy drink consumption patterns.

Considering the widespread availability of energy drinks and the demonstrated associations made between general caffeine consumption, caffeine consumption patterns, and psychological symptom endorsement, particularly in association with psychological disorders and symptoms related to anxiety, depression, mania, aggression, and psychosis, an understanding of the nature of energy drink consumption patterns and psychological symptoms will provide greater insight as to the impact of heavy energy drink consumption in a variety of populations. Specifically, previous investigations have outlined significant relationships between the availability of general sources of caffeine (e.g. coffee) for routine consumption and the report and observance of alleviation of psychological symptoms and decrease of disruptive behaviors in inpatient settings (Kruger, 1996; De Freitas & Schwartz, 1979). Furthermore, and more generally, as investigations have demonstrated an association between general caffeine consumption and the exacerbation of pre-existing disorders and symptoms (Veleber & Templer, 1984; Uhde, 1990; James & Crosbie, 1987), delineating potential relationships between a new, increasingly popular, heavily marketed, and relatively more potent form of caffeine (i.e. energy drinks) with psychological variables may have a valuable impact on our understanding of the etiology and perpetuation of psychological symptoms and disorders. As such, the current investigation represents a meaningful starting point from which further empirical light can be shed on the understanding of consumption patterns of energy drinks and its potential impact on clinical understanding of the physiological mechanisms underlying affect and behavior.

APPENDICES

APPENDIX A
Consent Form

INFORMED CONSENT

TITLE: Energy Drink Consumption In College Students: Report of Physical and Psychological Symptoms in Association with Acute vs. Chronic Consumption Habits.

PROJECT DIRECTOR: Rebecca Cicha, F. Ferraro
CONTACT INFO: **PHONE** # 701-740-7936 **EMAIL:** rebecca.cicha@gmail.com
DEPARTMENT: Psychology

STATEMENT OF RESEARCH

A person who is to participate in the research must give his or her informed consent to such participation. This consent must be based on an understanding of the nature and risks of the research. This document provides information that is important for this understanding. Research projects include only participants who choose to take part. Please take your time in making your decision as to whether to participate. If you have questions at any time, please ask.

WHAT IS THE PURPOSE OF THIS STUDY?

You are invited to be in a research study about caffeine consumption in relation to physical and psychological health because you are currently enrolled in an introductory psychology class that allows for this extra credit research opportunity.

The purpose of this research study is to investigate possible associations between caffeine consumption and physical and mental health. It is hypothesized that individuals who report lesser, short term caffeine consumption may report fewer physical and psychological symptoms than individuals who report greater, long term consumption of caffeinated substances. Overall, very little is known about short term vs. long term caffeine consumption in relation to physical and psychological health in young adults and this investigation is intended to broaden the general understanding of this topic.

HOW MANY PEOPLE WILL PARTICIPATE?

Approximately 160 undergraduate students are anticipated to take part in this study at the University of North Dakota.

HOW LONG WILL I BE IN THIS STUDY?

You will need to visit the Corwin-Larimore on the UND campus at the designated time and place you originally signed up for. Your participation in the study will last approximately 1 hour and no additional visits will be necessary.

WHAT WILL HAPPEN DURING THIS STUDY?

You will be asked to fill out a number of questionnaires that involve personal characteristics, typical consumption of caffeinated beverages, and items related to your physical and psychological health. Specifically, you will be given a number of paper-pencil self-report measures in a randomized order: Demographic questionnaire (2-5 minutes) involving documentation of personal information such as age, gender, ethnicity, and current/expected GPA; caffeine and energy drink consumption questionnaire (5-10 minutes) involving the detailed documentation of caffeinated substances that includes type/brand of substance (e.g. Red Bull energy drink), amount you typically consume, and how often you typically consume these substances; a brief questionnaire including items relating to motivations behind energy drink consumption and potential perceived side effects of consumption; the Acute and Long Term Sleep Habits Questionnaires (5-10 minutes) involving short term and long term sleep habits; State-Trait Anxiety Inventory; Beck Depression Inventory III (10-15 minutes) involving the report of a symptoms related to depression; Symptom Checklist 90 Revised self report (20-30 minutes).

You will also be given a FERPA privacy release requesting a release of information for the investigators to obtain your actual GPA. The release of information will serve to allow for maximally accurate data regarding GPA information (that you may or may not have access to at the time of this assessment) as well as obtaining final semester GPAs for each of the participants. Please note that you are not required to sign this release of information and that refusal to sign the form will not bar your participation in this study. Though your participation in this study will remain confidential, (your answers will in no way be connected with your personal identity), you are free to skip any questions that you would prefer not to answer.

WHAT ARE THE RISKS OF THE STUDY?

There may be some risk from being in this study. You may experience frustration that is often experienced when completing surveys. Some questions may be of a sensitive nature, and you may therefore become upset as a result. However, such risks are not viewed as being in excess of "minimal risk." If, however, you become upset by questions, you may stop at any time or choose not to answer a question. If you would like to talk to someone about your feelings about this study, you are encouraged to contact UND's Psychological Services Center at 701-777-3451.

WHAT ARE THE BENEFITS OF THIS STUDY?

You may not benefit personally from being in this study. However, we hope that, in the future, other people might benefit from this study because we hope to gain a greater understanding to the nature of caffeine consumption and physical and mental health.

ALTERNATIVES TO PARTICIPATING IN THIS STUDY

If you choose not to participate in this study, you may earn extra credit in your course in other ways. Please ask your instructor, who will provide you with comparable assignments that you may choose to complete (e.g. writing assignments, participation in other research experiments, etc.).

WILL IT COST ME ANYTHING TO BE IN THIS STUDY?

You will not have any costs for being in this research study.

WILL I BE PAID FOR PARTICIPATING?

You will not be paid for being in this research study; however you will be given one hour of extra credit for the psychology class in which you are enrolled upon completion of this study.

WHO IS FUNDING THE STUDY?

The University of North Dakota and the research team are receiving no payments from other agencies, organizations, or companies to conduct this research study.

CONFIDENTIALITY

The records of this study will be kept private to the extent permitted by law. In any report about this study that might be published, you will not be identified. Your study record may be reviewed by Government agencies, and the University of North Dakota Institutional Review Board Any information that is obtained in this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by keeping records of your personal identifying information separate from the surveys you respond to; your responses will in no way be connected to you. To aid in coding procedures, your responses will be identifiable by a random 4-digit number and will be kept in a separate, locked filing cabinet from your identifying information. Only the primary investigator and research assistants will have access to your responses. After 3 years, all documents will be shredded and destroyed. Furthermore, if we write a report or article about this study, we will describe the study results in a summarized manner so that you cannot be identified.

IS THIS STUDY VOLUNTARY?

Your participation is voluntary. You may choose not to participate or you may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Your decision whether or not to participate will not affect your current or future relations with the University of North Dakota.

CONTACTS AND QUESTIONS?

The researchers conducting this study are Rebecca Cicha and Dr. Ferraro (advisor). You may ask any questions you have now. If you later have questions, concerns, or complaints about the research please contact Rebecca Cicha at rebecca.cicha@gmail.com or 701-740-7936 or Dr. Ferraro at f_ferraro@und.nodak.edu or 701-777-3451.

If you have questions regarding your rights as a research subject, or if you have any concerns or complaints about the research, you may contact the University of North Dakota Institutional Review Board at (701) 777-4279. Please call this number if you cannot reach research staff, or you wish to talk with someone else.

Your signature indicates that this research study has been explained to you, that your questions have been answered, and that you agree to take part in this study. You will receive a copy of this form.

Subjects Name: _____

_____ _____

Signature of Subject Date

APPENDIX B
Demographic Questionnaire

DEMOGRAPHIC INFORMATION

1. Age: _____ years

2. Gender (circle): F M

3. Ethnicity (circle):

   A). African/American D). Hispanic/Latin American

   B). Asian/American E). Native American

   C). Caucasian F). Pacific Islander

   G). Other:_____

4. Grade (circle): Freshman Sophomore Junior Senior Other

5. Major : _____

6. Current/expected GPA **(circle)**: 4.0 - 3.7 3.6 - 3.0 2.9 – 2.0 1.9 or below

7. Have you ever been given a psychological/psychiatric diagnosis? Y N

8. Has a member of your immediate family ever been given a psychological/psychiatric diagnosis? Y N

APPENDIX C
Caffeine Consumption Questionnaire

- The following pages contain tables that include a variety of beverages; please indicate beverages that you drink ***at least*** once a month.

- Also indicate if the beverages are **sugar** or **caffeine free**, average daily ounces, average weekly intake, average yearly intake, and typical time of day the beverage is consumed.

- If you typically consume beverages that are not included in the list, please indicate that in the **"OTHER"** category.

- If you typically consume *specific* beverage varieties (for example: Java Monster RockStar Roasted) that are not listed, please indicate them in the **"OTHER"** category.

- This will take 5-10 minutes of your time. Your responses are appreciated!

SODA **(circle type)**	**Caffeine** **Caffeine Free?** **(check if yes)**	**Average** **Average Ounces Daily** **(1 can = 12 oz)**	**Average** **Average days per week**	**For** **For how many *Years***	**Time of day** **Time of day typically consumed** **M = morning** **N = afternoon** **E = evening**
Coca-Cola Classic Cherry Coke Diet Cherry Coke					M N E M N E M N E
Diet Coke (reg)					M N E
Mountain Dew /Diet/ Code Red					M N E M N E M N E
Dr. Pepper /Diet					M N E
Pepsi Diet Pepsi Wild Cherry					M N E M N E M N E
Mello Yellow					M N E
Tab					M N E
Sunkist Orange					M N E
A&W Root beer					M N E
Barq's Root beer					M N E
Other: _____ _____ _____ _____ _____					M N E M N E M N E M N E M N E

COFFEE	Caffeine Free? (check if yes)	Average ounces daily (1 cup = 8 oz)	Average days per week	For how many *Years*	Time of day typically consumed M = morning N = afternoon E = evening
Regular Brewed					M N E
Regular Instant					M N E
Espresso					M N E
Cappuccino					M N E
Other: _____ _____ _____ _____ _____					M N E M N E M N E M N E

TEA	Caffeine Free? (check if yes)	Average ounces daily (1 cup = 8 oz)	Average days per week	Years	Time of day typically consumed M = morning N = afternoon E = evening
Black Tea					M N E
Green Tea (Brewed)					M N E
SoBe Green Tea					M N E
Iced Tea					M N E
Chai Latte					M N E
Other: _____					M N E

ENERGY DRINKS	**Sugar Free?** (check if yes)	**Average ounces daily** (most cans = 16oz)	**Average days per week**	**Years**	**Time of day typically consumed** M = morning N = afternoon E = evening
Red Bull **(8oz)**					M N E
Monster Energy (reg)					M N E
Rock Star (reg)					M N E
Full Throttle (reg)					M N E
SoBe Adrenaline Rush					M N E
SoBe No Fear					M N E
AMP					M N E
Vault (8oz)					M N E
Shockwave					M N E
OTHER(S): please indicate specific varieties like ***Java Monster, Rock Star Roasted*** _____ _____ _____ _____ _____					M N E M N E M N E M N E M N E

APPENDIX D
Energy Drink Consumption Questionnaire

We are interested in finding out about consumption patterns of energy drinks among college students. Energy drinks refer to drinks like **Red Bull, Rock Star, and Amp.** Your responses are greatly appreciated. This will take about 5 minutes of your time.

1. **For the current semester do you drink more than 1 energy drink per month? (circle)**
   Yes No ***(end of survey, go on to next page)***

2. **Have you ever had headaches from drinking energy drinks? (circle)**
   Yes No

3. **Have you ever had heart palpitations from drinking energy drinks? (circle)**
   Yes No

4. **For the current semester, on an average day <u>when you haven't gotten enough sleep</u>, how many energy drinks do you have?** _____ per day

   a. **For the current semester, how many times do you do this in an average month ?** _____ per month

5. **For the current semester, on an average day <u>when you need more energy</u>, how many energy drinks do you have?** _____ per day

   a. **For the current semester, how many times do you do this in an average month ?** _____ per month

6. **For the current semester, on the average day, <u>when you are studying for an exam or a major project</u>, how many energy drinks do you have?** _____ per day

   a. **For the current semester, how many times do you do this in an average month?**_____ per month

7. **For the current semester, on the average day, <u>when you are driving for a long period</u>, how many energy drinks do you have?**_____ per day

   a. **For the current semester, how many times do you do this in an average month ?** _____ per month

8. **For the current semester, on an average night of partying, <u>how many energy drinks do you mix with alcohol</u> (example: Red Bull with vodka)** _____ per day

   a. **For the current semester, how many times do you do this in an average month ?** _____ per month

9. **For the current semester, on an average day <u>when you have a hangover</u>, how many energy drinks do you have?** _____ per day

   a. **For the current semester, how many times do you do this in an average month ?** _____ per month

APPENDIX E
Acute Sleep Questionnaire- Adults

Acute Sleep Questionnaire- Adults

We want you to respond to this questionnaire to the best of your knowledge. The questionnaire will ask about the quality of your sleep last night.

1. What time did you go to bed last night? (hours: minutes) _____:_____
2. How long did it take you to fall asleep last night? (hours: minutes) _____:_____
3. How many times did you wake up during the night last night? (write "0" for none) _____
    a. If you awoke, what was the total time you spent awake?
    (hours: minutes) _____:_____
4. How many dreams do you remember having last night? (write "0" for none)
    _____
5. How would you rate the quality of last night's sleep for you?
    (draw an "X" through the line below)

    Very Peaceful and Satisfying |_____|_____|_____|_____| Very fitful and restless
    Satisfied Normal Restless

6. What time did you wake up this morning? (hours: minutes) _____:_____
7. How many times did you nap during the day yesterday?
    (write "0" for none)
    a. If you napped, what was the total time you spent napping?
    (hours: minutes) _____:_____
8. Compared to usual, how rested did you feel this morning when you got up?
    (draw an "X" through the line below)

    Much Worse|_____|_____|_____|_____| Much Better
    A Little Worse Normal A Little Better

APPENDIX F
Long Term Sleep Habits-Adults

Long Term Sleep Habits- Adults

We want you to respond to this questionnaire to the best of your knowledge. The questionnaire will ask about your typical sleep patterns.

1. During the past month, when have you usually gone to bed on a school night? USUAL BED TIME: _____

2. During the past month, how long (in minutes) has it usually taken you to fall asleep on a school night? APPROXIMATE NUMBER OF MINUTES: _____

3. During the past month, when have you usually awoken on a school morning? USUAL GETTING UP TIME: _____

4. During the past month, how many hours of actual sleep did you get on a school night? (This may be different than the number of hours spend in bed). HOURS OF SLEEP PER NIGHT_____

5. During the past month, how often have you had trouble sleeping because you
   a. Cannot get to sleep within 30 minutes

      Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week___

   b. Wake up in the middle of the night or early morning

      Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week___

   c. Have to get up to use the bathroom

      Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week___

   d. Cannot breathe comfortably because of allergies, colds, other (explain)_____

      Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week___

   e. Cough or snore loudly

      Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week___

   f. Had bad dreams

      Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week___

6. During the past month, how would you rate your sleep quality?

   Very good_____ Fairly good_____ Fairly bad_____ Very bad_____

7. During the past month, how often have you had trouble staying awake while in a car, eating meals, engaging in social activities, at school, or doing schoolwork?

Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week___

8. What is your usual WEEKDAY time to:

    a. Go to bed? _____ pm/am (circle one)

    b. Fall asleep?_____pm/am (circle one)

    c. Awake in the morning? _____ am/pm (circle one)

    d. Get out of bed? _____ am/pm (circle one)

9. If you woke during sleep:

    a. How many times does this happen in a night?_____

    b. About how long (minutes) per awakening? _____

    c. What causes the awakening(s)?_____

    d. What do they do if you can't fall back to sleep? _____

10. On WEEKENDS, do you prefer to go to sleep and/or wake up? (check one):

    _____at the same time as weekdays _____ at a different times than on weekdays

11. If you answered "different" for question # 10, give times for:

    a. Bedtime:_____pm/am (circle one)

    b. Falling asleep:_____pm/am (circle one)

    c. Awakening:_____am/pm (circle one)

    d. Getting out of bed:_____am/pm (circle one)

12. Is there one night of the week during which you sleep the worst? (circle one)

    Yes No

    a. If yes, which night? _____

13. How many hours of sleep do you need to feel your best? _____

14. How many hours of sleep do you need to function (but may not feel their best)? _____

15. How many mornings each week do you awaken feeling your best? (check one)
    _____0 _____ 1-3 _____ 4-6 _____7

16. How many morning each week do you awaken feeling having slept poorly? (check one)
    _____0 _____ 1-3 _____ 4-6 _____7

For each of the following statements, please indicate whether the statement is TRUE or FALSE, or circle "?" if you are uncertain.

1. I feel that the quality of my sleep is unsatisfactory. **True** **False** **?**
2. I generally feel tired, sleepy, and/or fatigued all day. **True** **False** **?**
3. When I get a good night's sleep, I feel better the next day. **True** **False** **?**
4. When I sleep poorly, I worry about it the next day. **True** **False** **?**
5. If I sleep poorly, the next day is ruined. **True** **False** **?**
6. If I sleep poorly, I feel depressed, down, or blue. **True** **False** **?**
7. Sleeping poorly stops me from doing what I normally enjoy. **True** **False** **?**
8. When I try to fall asleep, my mind races with many thoughts. **True** **False** **?**
9. When I try to fall asleep, I become anxious or nervous worrying about whether or not I can sleep. **True** **False** **?**
10. I am a very light sleeper and am easily awakened by noises. **True** **False** **?**
11. When I try to fall asleep, I often feel hungry or thirsty. **True** **False** **?**
12. Generally, I will get up in the middle of the night for a snack. **True** **False** **?**
13. I wake up two or more times to urinate almost every night. **True** **False** **?**
14. If I wake up, I have problems falling back to sleep. **True** **False** **?**
15. I will often feel very sleepy before bedtime and then find myself wide-awake when I go to bed. **True** **False** **?**
16. I will often fall asleep while watching TV, at church, plays, movies, or concerts. **True** **False** **?**
17. I function best in the morning (before 12 noon). **True** **False** **?**
18. I function best in the evening (after 6 PM). **True** **False** **?**
19. I have frequent nightmares. **True** **False** **?**

REFERENCES

Adcock, R. J. (1996). Caffeine consumption in young adults: Measurement and determinants of self-administration. *Dissertation Abstracts International: The Sciences and Engineering, 56*, 5152.

Alford, C., Cox, H., & Wescott, R. (2001). The effects of Red Bull energy drink on human performance and mood. *Amino Acids, 21*, 139-150.

Amendola, C., Iannilli, I., Restuccia, D., Santini, I., & Vinci, G. (2004). Multivariate statistical analysis comparing sport and energy drinks. *Innovative Food Science and Emerging Technologies, 5*, 263-267.

Arluck, J. F. (2001). Effects of drive for thinness on caffeine consumption in university women. *Dissertation Abstracts International, 62*, 1563.

Attwood, A. S., Higgs, S., & Terry, P. (2007). Differential responsiveness to caffeine and perceived effects of caffeine in moderate and high regular caffeine consumers. *Psychopharmacology, 190*, 469-477.

Babu, K. M., Church, R. J., & Lewander, W. (2008). Energy drinks: The new eye-opener for adolescents. *Clinical Pediatric Emergency Medicine, 9*, 35-42.

Benowitz, N. L. (1990). Clinical pharmacology of caffeine. *Annual Review of Medicine, 41*, 277-288.

Bradley, J. R. & Petree, A. (1990). Caffeine consumption, expectancies of caffeine-enhanced performance, and caffeinism symptoms among university students. *Journal of Drug Education, 20*, 319-328.

Breier, A. (1986). Agoraphobia with panic attacks: Development, diagnostic stability, and course of illness. *Archives of General Psychiatry, 43*, 1029-1036.

Bruce, M. S. & Lader, M. (1989). Caffeine abstention in the management of anxiety disorders. *Psychological Medicine, 19*, 211-214.

Cannon, M. E., Cooke, C. T., & McCarthy, J. S. (2001). Caffeine-induced cardiac arrhythmia: An unrecognized danger of health food products. *Medical Journal of Australia, 174*, 520-521.

Carvajal-Sancho, A. & Moncada-Jimenez. (2005). The acute effect of an energy drink on the physical and cognitive performance of male athletes. *Kinesiologia Slovenica, 11*, 5-16.

Chelben, J., Piccone-Sapir, A., Ianco, I., Shoenfeld, N., Kotler, M., & Strous, R. (2008). Effects of amino acid energy drinks leading to hospitalization in individuals with mental illness. *General Hospital Psychiatry, 30*, 187-189.

Childs, E. & De Wit, H. (2008). Enhanced mood and psychomotor performance by a caffeine-containing energy capsule in fatigued individuals. *Experimental and Clinical Psychopharmacology, 16*, 13-21.

De Freitas, B. & Schwartz, G. (1979). Effects of caffeine on chronic psychiatric patients. *American Journal of Psychiatry, 136*, 1337-1338.

Dean, J. E. (2000). Dieting in a self-help population: A prospective analysis of dieting strategies and predictors of successful weight loss. *Dissertation Abstracts International, 61*, 1630.

Deixelberger-Fritz, D., Tischler, M. A., & Kallus, K. W. (2003). Changes in performance, mood state, and workload due to energy drinks in pilots. *International Journal of Applied Aviation Studies, 3*, 195-205.

Doyle, K. A. (1999). The relationship among caffeine consumption, eating disorder symptomology, and food deprivation in college students. *Dissertation Abstracts International, 60*, 1298.

Gellis, L. A. (2007). The link between education and sleeping difficulties: The role of sleep hygiene. *Dissertation Abstracts International, 67*, 5401.

Golding, J. F. (1987). Personality and life-style in medical students: Psychopharmacological aspects. *Psychology & Health, 1*, 287-301.

Goldrich, R. D. (2004). Caffeine expectancies in women with high and low levels of disordered eating. *Dissertation Abstracts International, 64,* 4614.

Greden, J. F., Fontaine, P., Lubetsky, M. & Chamberlain, K. (1978). Anxiety and depression associated with caffeinism among psychiatric inpatients. *American Journal of Psychiatry, 135*, 963-966.

Griffiths, R. R., Juliano, L. M., & Chausmer, A. L. (2003). Caffeine: Pharmacology and clinical effects. In A. W. Graham, T. K. Schultz, M.F. Mayo-Smith, R. K. Ries & B. B. Wilford's (Eds.) *Principles of Addiction Medicine*, (pp. 193-224). American Society of Addiction Medicine: Chevy Chase.

Grossarth-Maticek, R. & Eyesenck, H. J. (1991). Coca-Cola, cancers, and coronaries: Personality and stress as mediating factors. *Psychological Reports, 68*, 1083-1087.

Gurpegui, M., Jurado, D., Luna, J. D., Fernandez-Molina, C., Moreno-Abril, O., & Galvez, R. (2007). Personality traits associated with caffeine intake and smoking. *Progress in Neuro-Psychopharmacology & Biological Psychiatry, 31*, 997-1005.

Hamera, E., Schneider, J.K., & Deviney, S. (1995). Alcohol, cannabis, nicotine, and caffeine use and symptom distress in schizophrenia. *Journal of Nervous and Mental Disease, 183*, 559-565.

Harris, K. M., Griffin, B. A., McCaffrey, D. F., & Morral, A. R. (2008). Inconsistencies in self-reported drug use by adolescents in substance abuse treatment: Implications for outcome and performance measurements. *Journal of Substance Abuse Treatment, 34*, 347-355.

Heatherly, S. V., Hayward. R. C., Seers. H. E., & Rogers, P. J. (2005). Cognitive and psychomotor performance, mood, and pressor effects of caffeine after 4, 6, and 8h caffeine abstinence. *Psychopharmacology, 178*, 461-470.

Hewlett, P. & Smith, A. (2006). Correlates of daily caffeine consumption. *Appetite, 46*, 97-99.

Hillary, B. (1995). Caffeine dose effects at rest and during stress on heavy and light chronic caffeine consumers. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 56*, 2867.

Horrigan, L. A., Kelly, J. P., & Connor, T. J. (2006). Immunomodulatory effects of caffeine: Friend or foe? *Pharmacology & Therapeutics, 111*, 877-892.

Hughes, J. R., Oliveto, A. H., Helzer J. E. et al. (1992). Should caffeine abuse, dependence, or withdrawal be added to DSM-IV and ICD-10? *American Journal of Psychiatry, 149*, 33-40.

Hughes, J. R. & Oliveto, A. H. (1997). A systematic survey of caffeine intake in Vermont. *Experimental Clinical Psychopharmacology, 5*, 393-398.

Ishihara, K., Miyasita, A., Inugami, M., Fukuda, K., Yamazaki, K., & Miyata, Y. (1985). Differences in the time or frequency of meals, alcohol and caffeine ingestion, and smoking found between 'morning' and 'evening' types. *Psychological Reports, 57*, 391-396.

Iyadurai, S. J. P. & Chung, S. S. (2007). New-onset seizures in adults: Possible association with consumption of popular energy drinks. *Epilepsy & Behavior, 10*, 504-508.

James, J. E. (1997). *Understanding caffeine: A biobehavioral analysis*. Sage Publications, Thousand Oaks, CA.

James, J. E. & Crosbie, J. (1987). Somatic and psychological health implications of heavy caffeine use. *British Journal of Addiction, 82*, 503-509.

Jay, S. M., Petrilli, R. M., Ferguson, S. A., Dawson, D., & Lamond, N. (2006). The suitability of a caffeinated energy drink for night shift workers. *Physiology & Behavior, 87*, 925-931.

Jones, F., O'Connor, D. B., & McMillan, B. (2007). Impact of daily mood, work hours, and iso-strain variables on self-reported health behaviors. *Journal of Applied Psychology, 92*, 1731-1740.

Judelson, D. A., Armstrong, L. E., Sokmen, B., Roti, M. W., Casa, D. J., & Kellogg, M. D. (2005). Effect of chronic caffeine intake on choice reaction time, mood, and visual vigilance. *Physiology & Behavior, 85*, 629-634.

Kaplan, G. B., Tai, N. T., Greenblatt, D. J., & Shader, R. I. (1990). Separate and combined effects of caffeine and alprazolam on motor activity and benzodiazepine receptor binding *in vivo*. *Psychopharmacology, 101*, 539-544.

Kendler, K., Myers, J., & Gardner, C. O. (2006). Caffeine intake, toxicity and dependence and lifetime risk for psychiatric and substance use disorders: An epidemiologic and co-twin control analysis. *Psychological Medicine, 36*, 1717-1725.

Kennedy, D. O. & Scholey, A. B. (2004). A glucose-caffeine 'energy drink' ameliorates subjective and performance deficits during prolonged cognitive demand. *Appetite, 42*, 331-333.

Kiesges, R. C., Ray, J. W., & Kiesges, L. M. (1994). Caffeinated coffee and tea intake and its relationship to cigarette smoking: An analysis of the Second National Health and Nutrition Examination Survey (NHANES II). *Journal of Substance Abuse, 6*, 407-418.

Koczapski, A., Paredes, J., Kogan, C., Ledwidge, B., & Higenbottam, J. (1989). Effects of caffeine on behavior of schizophrenic inpatients. *Schizophrenic Bulletin, 15*, 339-344.

Kruger, A. (1996). Chronic psychiatric patients' use of caffeine: Pharmacological effects and mechanisms. *Psychological Reports, 78*, 915-923.

Kuznicki, J. T. & Turner, L. S. (1986). The effects of caffeine on caffeine users and non-users. *Physiology & Behavior, 37*, 397-408.

Larson, C. A. & Carey, K. B. (1998). Caffeine: Brewing trouble in mental health settings? *Professional Psychology: Research and Practice, 29*, 373-376.

Lieberman, H. R. (1992). Caffeine. In A.P Smith & D. M. Jones (Eds.) *Handbook of Human Performance*, Vol. 2, (pp. 49-72). Academic Press: London.

Lucas, P.B., Pickar, D., Kelsoe, J., Rapaport, M., Pato, C., & Hommer, D. (1990). Effects of the acute administration of caffeine in patients with schizophrenia. *BiologicalPsychiatry, 28*, 35-40.

Lyvers, M., Brooks, J., & Matica, D. (2004). Effects of caffeine on cognitive and autonomic measures in heavy and light caffeine consumers. *Australian Journal of Psychology, 56*, 33-41.

Machado-Vieria, R., Viale, C. I., & Kapczinski, F. (2001). Mania associated with an energy drink: The possible role of caffeine, taurine, and inositol. *The Canadian Journal of Psychiatry, 46*, 454-455.

Malinauskas, B. M., Aeby, V. G., Overton, R. F., Carpenter-Aeby, T. & Barber-Heidal, K. (2007). A survey of energy drink consumption patterns among college students. *Nutrition Journal*, 6, (n.p.).

McCusker, R. R., Goldberger, B. A., & Cone, E. J. (2006). Caffeine content of energy drinks, carbonated sodas, and other beverages. *Journal of Analytic Toxicology, 30*, 112-114.

Meadows-Oliver, M. & Ryan-Krause, P. (2007). Powering up with sports and energy drinks. *Journal of Pediatric Health Care, 21*, 413-416.

Mester, R., Toren, P., Mizrachi, I., Wolmer, L., Karni, N., & Weizman, A. (1995). Caffeine withdrawal increases lithium blood levels. *Biological Psychiatry, 37*, 348-350.

Meyer, F. P. (1996). Pharmacokinetic responses to caffeine in volunteers with higher scores for neuroticism. *Psychopharmacology, 126*, 275-276.

Miller, K. E. (2008). Energy drinks, race, and problem behaviors among college students. *Journal of Adolescent Health*. Article in press.

Mucignat-Caretta, C. (1998). Changes in female cognitive performance after energetic drink consumption: A preliminary study. *Progressive Neuro-Psychopharmacological & Biological Psychiatry, 22*, 1035-1042.

Murray, J. B. (1988). Psychophysiological aspects of caffeine consumption. *Psychological Reports, 62*, 575-587.

Nagajothi, N., Khraisat, A., Velazquez-Cecena, J. L. E., & Arora, R. (2008). Energy drink-related supraventricular tachycardia. *The American Journal of Medicine, 121*, e3-e4.

O'Dea, J. A. (2003). Consumption of nutritional supplements among adolescents: Usage and perceived benefits. *Health Education Research, 18*, 98-107.

Ogawa, N. & Ueki, H. (2007). Clinical importance of caffeine dependence and abuse. *Psychiatry and Clinical Neurosciences, 61*, 263-268.

Oteri, A., Salvo, F., Caputi, A. C., & Calapai, G. (2007). Intake of energy drinks in association with alcoholic beverages in a cohort of students of the school of medicine of the University of Messina. *Alcoholism: Clinical and Experimental Research, 31*, 1677-1680.

Paganini-Hill, A., Kawas, C. H., & Corrada, M. M. (2007). Non-alcoholic beverage and caffeine consumption and mortality: The Leisure World Cohort Study. *Preventative Medicine, 44*, 305-310.

Pilette, W. L. (1983). Caffeine: Psychiatric grounds for concern. *Journal of Psychosocial Nursing & Mental Health Services, 21*, 19-24.

Reyner, L. A., & Horne, J. A. (2002). Efficacy of a 'functional energy drink' in counteracting driver sleepiness. *Physiology & Behavior, 75*, 331-335.

Roberson, J. (2005). Fight!! Ippatsu!!: "Genki" energy drinks and the marketing of masculine ideology in Japan. *Men and Masculinities, 7*, 365-384.

Rush, C. R., Higgins, S. T., Bickel, W. K., & Hughes, J. R. (1994). Acute behavioral effects of lorazepam and caffeine, alone and in combination, in humans. *Behavioral Pharmacology, 5*, 245-254.

Seidl, R., Peyrl, A., Nicham, R., & Hauser, E. (2000). A taurine and caffeine-containing drink stimulates cognitive performance and well-being. *Amino Acids, 19*, 635-642.

Scher, A. I., Stewart, W. F., & Lipton, R. B. (2004). Caffeine as a risk factor for chronic daily headache: A population-based study. *Neurology, 63*, 2022-2027.

Scholey, A. B. & Kennedy, D. O. (2004). Cognitive and physiological effects of an "energy drink": an evaluation of the whole drink and of glucose, caffeine, and herbal flavouring fractions. *Psychopharmacology, 176*, 320-330.

Silk, A., Weatherby, R., & Zhou, S. (2004). Effect of an energy drink on endurance cycle performance of young active men. *Journal of Science and Medicine in Sport, 7*, 64.

Simmons, D. H. (1996). Caffeine and its effect on persons with mental disorders. *Archives of Psychiatric Nursing, 10*, 116-122.

Shohet, K. L. & Landrum, R. E. (2001). Caffeine consumption questionnaire: A standardized measure for caffeine consumption in undergraduate students. *Psychological Reports, 89*, 521-526.

Smit, H. J. & Rogers, P. J. (2002). Effects of 'energy' drinks on mood and mental performance; critical methodology. *Food Quality and Preference, 13*, 317-326.

Specterman, M., Bhuiya, A., Kuppuswamy, A., Strutton, P.H., Catley, M., & Davey, N.J. (2005). The effect of an energy drink containing glucose and caffeine on human corticospinal excitability. *Physiology & Behavior, 83*, 723-728.

Spindel, E. R. & Wurtman, R. J. (1984). Neuroendocrine effects of caffeine in rat and man. In P. B. Dews (Ed.), *Caffeine: Perspectives on Recent Research*. Berline: Springer-Verlag, (pp. 129-141).

Stein, M. B. (1989). Depersonalization disorder: Effects of caffeine and response to pharmacotherapy. *Biological Psychiatry, 26*, 315-320.

Stennett, R. G. (1957). The relationship of performance due to level of arousal. *Journal of Applied Psychology, 73*, 253-258.

Stillner, V., Popkin, M. K., & Pierce, C. M. (1978). Caffeine-induced delirium during prolonged competitive stress. *American Journal of Psychiatry, 135*, 855-856.

Svikis, D. S., Berger, N., Haug, N. A., & Griffiths, R. R. (2005). Caffeine dependence in combination with a family history of alcoholism as a predictor of continued use of caffeine during pregnancy. *American Journal of Psychiatry, 162*, 2344-2351.

Tai, F. M., & Serwonska, M. H. (2003). Adverse effects of Primatene mist used in combination with energy drink containing ephedra alkaloids. *Journal of Allergy and Clinical Immunology, 111*, S167.

Tepas, D. I. (1990). Do eating and drinking habits interact with work schedule variables. *Work & Stress, 4*, 203-211.

Uhde T. W. (1990). Caffeine provocation of panic: A focus on biological mechanisms. In J. C. Ballenger's *Neurobiology of Panic Disorder*, (pp. 219-242). Wiley-Liss: New York.

Umana-Alvarado, M, & Moncada-Jimenez, J. (2004). The effect of an energy drink on aerobic performance in male athletes. *Medicine & Science in Sports & Exercise, 36*, S174-S175.

Van Boxtel, M. P. J., Schmitt, J. A. J., Bosma, H., & Jolles, J. (2003). The effects of habitual caffeine use on cognitive change: A longitudinal perspective. *Pharmacology, Biochemistry and Behavior, 75*, 921-927.

Veleber, D. M. & Templer, D. L. (1984). Effects of caffeine on anxiety and depression . *Journal of Abnormal Psychology, 93*, 120-122.

Waldeck, B. (1971). Some effects of caffeine aminophylline on the turnover of catecholamines in the brain. *Journal of Pharmacy and Pharmacology, 23*, 824-830.

West, D. S., Bursac, Z., Quimby, D., Prewitt, T. E., Spatz, T., Nash, C., et al. (2006). Self-reported sugar-sweetened beverage intake among college students. *Obesity, 14*, 1825-1831.

Winkelmayer, W. C., Stampfer, M. J., Willett, W. C., & Curhan, G. C. (2005). Habitual caffeine intake and the risk of hypertension in women. *Journal of the American Medical Association, 294*, 2330-2335.

Winstead, D. K. (1976). Coffee consumption among psychiatric inpatients. *American Journal of Insanity, 133*, 1447-1450.

Worcester, S. (2007). Energy drink sales hit $3 billion—at what health cost? *Pediatric News, 41*, 1-4.

Worrall, B. B., Phillips, C. D., & Henderson, K. K. (2005). Herbal energy drinks, phenylpropanoid compounds, and cerebral vasculopathy. *Neurology, 65*, 1137-1138.

Zaslove, M. O., Russell, R. L., & Ross, E. (1991). Effect of caffeine intake on psychotic in-patients. *British Journal of Psychiatry, 159*, 565-567.