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# The Effect of Energy Drinks on Marksmanship

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MOUNTAIN TACTICAL INSTITUTE, JACKSON, WY

## The Effect of Energy Drinks on Marksmanship

Adam Scott, Rob Shaul and Sam McCue

### OBJECTIVE:

The purpose of this study was to evaluate the effects of a popular energy drink (*Monster Zero Ultra*) on non-stressed and stressed marksmanship drills.

### METHODS:

Fifteen full-time members of a state law enforcement (LE) tactical unit (age 29-43 years) were randomly divided into three treatment groups. All three groups completing a series of 24 baseline marksmanship drills. These drills were divided into two categories: 1. Non-stressed ([Video Link](#)) and 2. Stressed ([Video Link](#)). Each trial consisted of one magazine of 5 rounds (5.56mm). Subjects fired a total of 60 rounds during non-stressed baseline drills and 60 rounds during stressed baseline drills (120 total rounds).

After establishing baselines, subjects received their first of two treatments. Treatments consisted of either a 16oz Energy Drink or a 16oz placebo. A total of 8 non-stressed trials and 8 stressed trials were completed during the proceeding hour (approximately 2 trials every 15 minutes). After 60 minutes the second treatment was administered. Again, 8 non-stressed and 8 stressed trials were completed during the proceeding hour. Group 1 received two placebo treatments (PP). Group 2 received one placebo treatment and one energy drink treatment (EP). Group 3 received two energy drink treatments (EE). All subjects were blind to their treatments.

During each trial (baseline and treatment) HR data and marksmanship accuracy was tracked for all subjects.

### KEY FINDINGS:

#### *Non-Stressed Marksmanship*

- The single energy drink group (EP) was, by far, the best performing group. They performed above their baseline during every measured time period (with a peak of 12.5% over baseline during minutes 31-60).
- The two energy drink group (EE), significantly out performed the control group, but still finished at 3.6% below their baseline performance.
- The control group (PP) was the lowest performing group, with a decrease of 12.0% below baseline.

#### *Stressed Marksmanship*

- This single energy drink group (EP) and the double energy drink group (EE) both significantly out-performed the placebo group during the first hour of the study (0-60 minutes).
- However, by the end of study all three groups (PP, EP, EE) significantly improved over baseline. This was likely, partially attributable to an increased familiarity with the stressed drill.

### RECOMMENDATIONS:

In healthy tactical professionals, one no-calorie energy drink (similar to a *Monster Zero Ultra*), consumed approximately 30-60 minutes prior to marksmanship training can effectively be used to counteract some of the negative effects experienced during short (60 minutes) and long-term (>120 minutes) non-stressed and stressed drills.

## 1. INTRODUCTION

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The uncertain physical requirements, uncertain dangers and uncertain schedules of a tactical professional generate an environment where tactical athletes are constantly required to perform during times of fatigue.

To meet these demands many tactical athletes supplement their daily routines with caffeine, most of which is consumed in the form of energy drinks. Walter Reed Army Institute of Research conducted a study in 2012 which reported over 45 percent of combat troops consume at least one energy beverage each day. The study also reported that as many as 13 percent of combat troops consume three or more energy drinks in a day (1).

Energy drinks and caffeine are sought out because they act as a stimulants to the central nervous system (CNS) and have been shown to ward off lethargy and promote mental acuity (2).

Caffeine consumption is able to produce these effects because caffeine's structure is similar to that of a molecule called Adenosine - one of the key particles responsible for creating drowsy, fatigued sensations in the brain. Caffeine's similar structure allows it to replace Adenosine in a process called "competitive inhibition." Essentially, caffeine binds to Adenosine-receptors on neurons, stealing sites from the Adenosine molecules. This prevents the Adenosine molecule from binding to its receptors, thus preventing the fatigue sensations in the brain (2).

### 1.1 Previous Research (Caffeine)

The effects of caffeine have been fairly well established.

As an ergogenic stimulate caffeine has been repeatedly shown to improve long-term endurance performance (5). Recent studies have also shown the positive effect that caffeine can have on muscular strength and power in both men and women (7,8).

Caffeine has also been linked to positive effects on mental tasks and performance. Studies in the journals *Nutrition Reviews* and *Sleep* have shown that caffeine consumption has the ability to improve memory, reasoning, alertness and performance in sleep deprived individuals (9,10).

There is also a fairly large library of research looking at caffeine and the military (137 articles on PubMed.gov) and caffeine and marksmanship (9 articles on PubMed.gov). Nearly all of these studies have shown positive effects on military-type tasks.

In one study, sleep-deprived BUD/S students who took approximately 200mg of caffeine every 2 hours were more vigilant, more alert and better at speed and accuracy tasks (12).

In another study, NATO soldiers who were given caffeine supplementation performed better than soldiers who received placebos in vigilance, marksmanship and physical tasks (13).

A study from the U.S. Army Research Institute found that 200mg of caffeine helped improve a sentry's speed in target detection and did not impair accuracy (14).

And finally, Defense Research & Development Canada found that between 200-250mg of caffeine was sufficient to restore engagement times in mentally and physically fatigued soldiers. The study also found that caffeine doses of around 200-250mg did not negatively impact marksmanship (15).

### 1.2 Mission Direct Approach

Nearly every study we found used caffeine capsules or gum as their caffeine delivery method. While this allows for greater research control it overlooks the realities of a tactical athlete. For these professionals the most common form of caffeine supplementation is a beverage – specifically an energy drink.

While using energy drinks decreases research control, it represents a more realistic, mission direct application. This differentiation is important because the energy drinks consumed by our tactical professionals differ from the caffeine capsules and gums used in previous research in two major ways.

First, energy drinks contain an abundance of additional substances. Thus, caffeine is almost never consumed in isolation as is the case during most studies. Most energy drinks, like the one selected for this study, also contain

substances like guarana, taurine, ginseng, and B vitamins (16) . Each of these substances effects the potency of the energy drink and adds to the effect it will have on a tactical consumer.

Guarana is a South American plant which contains a caffeine compound called guaranine - one gram of which is equal to about 40mg of caffeine. This additional caffeine is not included in most reported caffeine levels (16,17). This means that energy drinks are often contain more caffeine than indicated.

Taurine is an amino acid often found in meat, seafood and milk. Some research has shown that it supports brain development and regulates mineral and water levels in the body. Taurine has also been linked to improved athletic performance (16,18). However, most western diets already contain a sufficient amount of Taurine and the effects of supplementation with an energy drink are not well established.

Ginseng is a highly valued herb found in North America and Asia. While it has been linked to improvements in athletic performance, increases in immune response and enhancements in mood, there is very little proof to back these claims. Ginseng might also have undesirable side effects if taken in high doses (16,9).

B vitamins are a group of water-soluble vitamins related to cell metabolism. They have been shown to improve mood and possibly fight disease and cancer. However, according to most dietitians, the amount in most energy drinks is likely not sufficient to illicit a measurable effect (16,19).

In a real-life tactical situation it is the combination of all of these substances, consumed in the form of an energy drink, that will effect the tactical professional.

The second major difference is in the absorption profile of the delivery method. Energy drinks are quicker acting and more potent than pills and gum. Drinks reach blood saturation in 39-42 minutes, gum takes approximately 44-80 minutes and pills take 84-120 minutes (14). Energy drinks also have a bioavailability of 99%, versus 90% from capsules and 77% for gums (14).

### 1.3 Energy Drink Selection

The energy drink used in this study was selected based on the results of an online survey conducted with tactical professionals: <https://www.surveymonkey.com/r/R2GNBBZ>.

This survey identified *Sugar Free Monster* as the most common energy drink used by tactical athletes (29.4% of all the votes). The second most common energy drink was *Monster* at 17.7%, followed by a tie between *Red Bull* and *RipIt* at 14.7%.

After experimenting with a few variations, *Monster Zero Ultra* (a sugar free Monster flavor), was selected for the study. This was due to fact that, during pre-study trials, it was the most difficult to differentiate from placebos.

## 2. METHODS

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### 2.1 Subjects

Fifteen healthy male subjects (29-43 years) who were all members of a full-time state law enforcement (LE) tactical unit participated in the study. Participants were all experienced marksman with at least 7 years of LE experience and a minimum of 1 year of full-time tactical experience.

Anthropomorphic measurements were collected prior to the study (age, height and weight). Unlike previous studies which required subjects to refrain from caffeine consumption 20-24 hours prior to testing, this study allowed subjects to conduct their daily routine without interruption. Instead of creating an artificial environment where regular caffeine consumers refrained from normal caffeine intake, the researchers allowed subjects to consume caffeine as they normally would. This was done to create a more realistic environment in which to examine supplemental energy drink effects. It was also believed that this structure would alleviate some of the negative side-effects subjects might experience if they deviated from their normal routines. Thus, before beginning the study subjects self-reported their average daily caffeine consumption and their previous 24-hour caffeine consumption (estimated amounts and times).

**TABLE 1: Subject Data**

	<b>Average</b>
<b>Age</b> (years)	36.3
<b>Height</b> (inches)	71.3
<b>Weight</b> (pounds)	206.9
<b>Tactical Team Experience</b> (years)	7.5
<b>LE Experience</b> (years)	12.7
<b>Military Experience</b> (years)	1.5
<b>Total Marksmanship Experience</b> (years)	15.5
<b>Average Daily Caffeine</b> (mg)	135.5*
<b>Caffeine Consumed in last 24 hours</b> (mg)	86.7*

\*8oz of brewed coffee is approximately 100mg of caffeine

### 2.3 Marksmanship Baseline Trials

After the initial data was collected, subjects completing a series of 24 marksmanship trials. Trials were divided into two categories: (1) Non-stressed and (2) Stressed. Each trial consisted of one magazine of 5 rounds (5.56mm). Subjects fired a total of 60 rounds during the non-stressed trials and 60 rounds during the stressed trials (120 total rounds).

Marksmanship category type:

1. Each Non-Stress drill required athletes to assume a kneeling position and fire 5 rounds at a MGM 10 inch Steel Challenge target. The target was located 80 yards from shooter. The drill was not timed. Two heart rate measures (HR average and HR max) were recorded during each trial. As was the total number of hits per 5 round magazine.  
Non-Stress Drill [Video Link](#)
2. Each Stress drill required athletes to complete two 15-yard shuttle runs, retrieve their weapon from a tabled location, assume a kneeling position and fire 5 rounds at a MGM 10 inch Steel Challenge target. The target was located 80 yards from shooter. The drill was completed with a 20 second time limit. Two heart rate measures (HR average and HR max) were recorded during each trial. As was the total number of hits per 5 round magazine  
Stress Drill [Video Link](#)

2.4 Energy Drink Treatments and Trials

Prior to the study, athletes were randomly divided into 3 groups. Each group received two treatments during the study. Treatments consisted of either a 16oz Energy Drink or a 16oz placebo. Group 1 received two placebo treatments (PP). Group 2 received one placebo treatment and one energy drink treatment (EP). Group 3 received two energy drink treatments (EE). Treatments were administered 5 minutes prior to the first recorded shooting trial and 60 minutes into the study.

**TABLE 2: Subject Data By Treatment Group**

	Group 1 (PP)	Group 2 (PE)	Group 3 (EE)
<b>Age (years)</b>	37.0	36.8	35.0
<b>Height (inches)</b>	71.4	71.2	71.2
<b>Weight (pounds)</b>	209.6	200.0	211.0
<b>Years on Team</b>	7.8	8.8	6.0
<b>Law Enforcement Experience (years)</b>	13.2	13.0	11.8
<b>Military Experience (years)</b>	1.0	1.0	2.6
<b>Total Marksmanship Experience (years)</b>	16	18.6	11.8
<b>Average Daily Caffeine Intake (mg)</b>	172	148	86
<b>Caffeine consumed in previous 24 hours (mg)</b>	80	68	112

Between 0-60 minutes each group completed 8 non-stressed trials and 8 stressed trials. Following the second treatment at minute 60 the athletes then completed another 8 non-stressed trials and 8 stressed trials (65-125 minutes).

**TABLE 3: Study Timeline**

		-5 min	0 min	15 min	30 min	45 min	60 min	65 min	80 min	95 min	110 min	125 min
<b>Group 1 (PP)</b>	<b>Stress #</b>	Treatment 1	1,2	3,4	5,6	7,8	Treatment 2	9,10	11,12	13,14	15,16	17,18
	<b>Non-Stress #</b>	(Placebo)	1,2	3,4	5,6	7,8	(Placebo)	9,10	11,12	13,14	15,16	17,18
<b>Group 2 (EP)</b>	<b>Stress #</b>	Treatment 1	1,2	3,4	5,6	7,8	Treatment 2	9,10	11,12	13,14	15,16	17,18
	<b>Non-Stress #</b>	(Energy)	1,2	3,4	5,6	7,8	(Placebo)	9,10	11,12	13,14	15,16	17,18
<b>Group 3 (EE)</b>	<b>Stress #</b>	Treatment 1	1,2	3,4	5,6	7,8	Treatment 2	9,10	11,12	13,14	15,16	17,18
	<b>Non-Stress #</b>	(Energy)	1,2	3,4	5,6	7,8	(Energy)	9,10	11,12	13,14	15,16	17,18

During each trial the athlete's marksmanship performance (hits per 5 rounds), HRavg and HRmax were recorded. Marksmanship performance was tracked by tactical team members who were not participating in the study. HR data was collected using the iOS Polar Team Training App® and Polar H7® bluetooth heart rate monitors.

**2.5 Dosing**

All treatment doses consisted of 16 fluid ounces. This dosage equated to approximately one regular sized can of the energy drink (*Monster Zero Ultra*). To create the placebo drink, approximately 16 ounces of flavored carbonated water and 6 milliliters of a sugar-free, colored, flavored liquid drink mix were mixed.

Athletes were blind to their treatment. Both drinks were emptied into identical 5-gallon beverage coolers. The drinks were served to subjects in identical 20 ounce cups (with markings for 16 ounces). A prior single-blind taste test conducted before the study demonstrated to the researchers that subjects would be unable to identify and differentiate the beverages. This was confirmed during the study when participants who, once surveyed, were unable to identify the beverages.

**Flavoring**

Ingredients: Water, Malic Acid, Propylene Glycol, Citric Acid, Contains Less Than 2% of Natural Flavor, Sucralose and Acesulfame Potassium (Sweeteners), Potassium Citrate, Red 40, Potassium Sorbet (Preservatives).

**Carbonated Water**

Ingredients: Filtered Carbonated Water, Citric Acid, Natural Flavor, Potassium Citrate, Potassium Benzoate (A Preservative), Aspartame, Acesulfame Potassium, Zinc Gluconate, Vitamin E Acetate, Vitamin A Palmitate.

**Energy Drink**

Ingredients: Carbonated Water, Citric Acid, Erythritol, Natural & Artificial Flavors, Taurine, Sodium Citrate, Panax Ginseng Extract, L-Carnitine L-Tartrate, Caffeine, Sorbic Acid (Preservative), Sucralose, Benzoic Acid (Preservative), Niacinamide (Vit. B3), Acesulfame Potassium, D-Calcium Pantothenate (Vit. B5), Salt, Guarana Extract, D-Glucuronolactone, Inositol, Pyridoxine Hydrochloride (Vit. B6), Blue #1, Red # 40, Cyanocobalamin (Vitamin B12).

**Flavoring (Placebo)**  
**Nutrition Facts**

Serving Size 2ml	
Servings Per Container 24	
<b>Amount Per Serving</b>	
Calories	0
Calories From Fat	0
<b>% Daily Value</b>	
Total Fat 0 G	0
Saturated Fat 0 G	0
Trans Fat 0 G	0
Cholesterol 0 Mg	0
Sodium 0 Mg	0
Total Carbohydrate 0 G	0
Dietary Fiber 0 G	0
Sugars 0 G	0
Protein 0 G	0
Vitamin A	0
Vitamin C	0
Calcium	0

**Carbonated Water (Placebo)**  
**Nutrition Facts**

Serving Size 8 Fl Oz	
Servings Per Container 51	
<b>Amount Per Serving</b>	
Calories	0
Calories From Fat	0
<b>% Daily Value</b>	
Total Fat 0 G	0
Sodium 0 Mg	0
Total Carbohydrate 0 G	0
Sugars 0 G	0
Protein 0 G	0

**Monster Zero Ultra**  
**Nutrition Facts**

Serving Size 240 ml	
Servings Per Container 2	
<b>Amount Per Serving</b>	
Calories	
Calories From Fat	
<b>% Daily Value</b>	
Total Fat 0 G	
Saturated Fat 0 G	
Trans Fat 0 G	
Cholesterol 0 Mg	
Sodium 180 Mg	
Total Carbohydrate 2 G	
Dietary Fiber 0 G	
Sugars 0 G	
Protein 0 G	
Vitamin A	
Vitamin C	
Calcium	
Niacin	
Vitamin B6	
Pantothenic Acid	

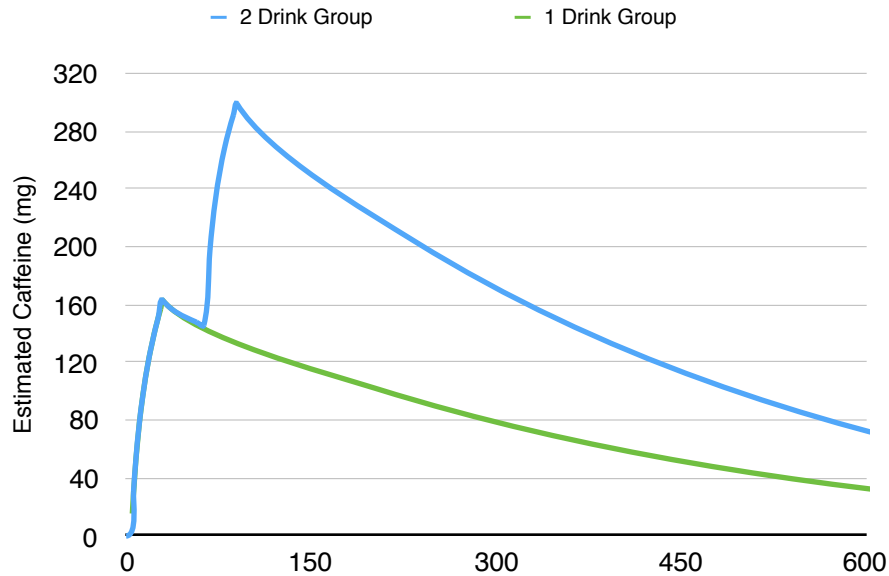
2.6 Analytical Method

All data analytics and statistical modeling were completed using Apple Numbers 2015 (3.5.3 - 2150), Microsoft Excel Online 2016 (15.14.0), released 15 September 2015 and IBM Watson Analytics Online Program 2015.

2.7 Modeling

An estimated caffeine model was created using Apple Numbers 2015 (3.5.3 - 2150) and Watson Analytics (2015). The model was based on previous research from Kamimori et. al. (20), The Committee on Military Nutrition Research Food and Nutrition Board (11), and information provided on the National Institute of Health (NIH) website.

**GRAPH 1: Estimated Caffeine Model**





### 3. RESULTS

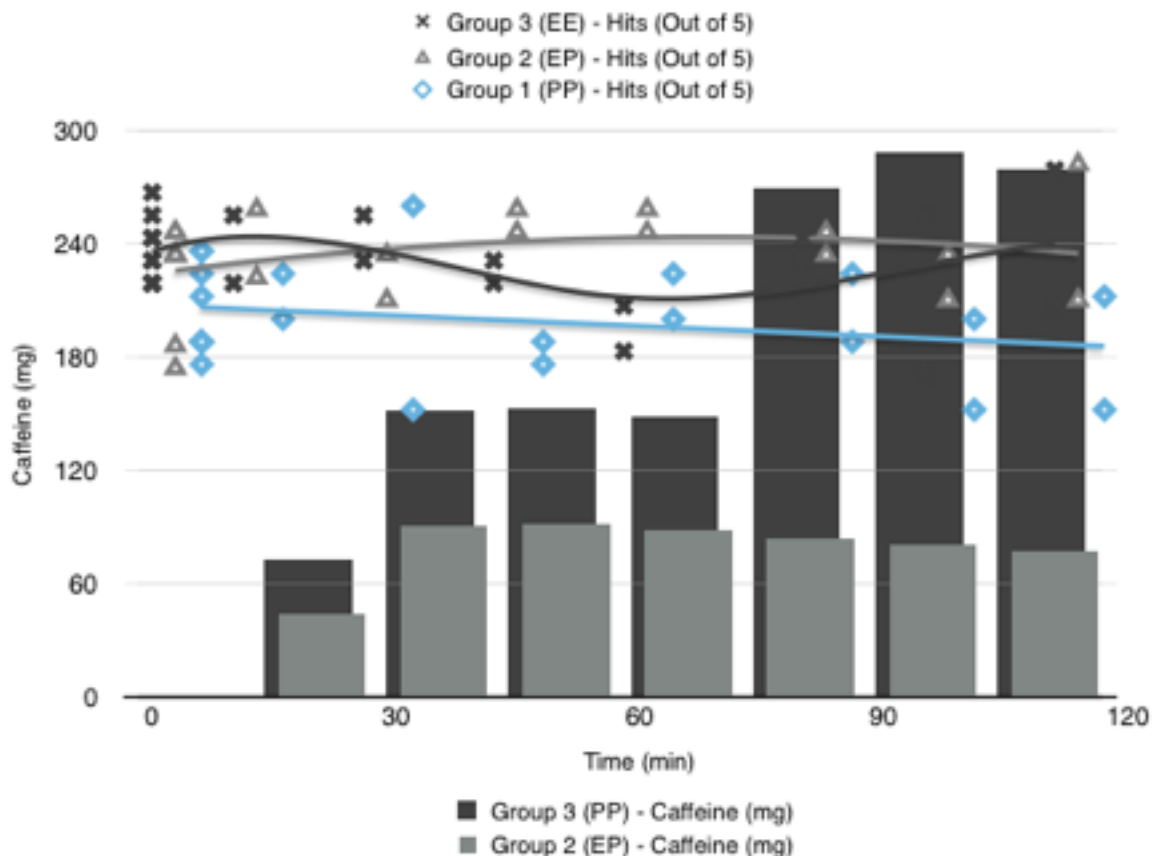
#### 3.2 Energy Drink (Treatment) Effects during Non-Stress Trials

The average performance change (from baseline to treatment) across all three groups over the 2-hour trial was -3.8%. Group 1 (PP) had an initial increase in performance from 0-30 minutes and a steady decrease during the remainder of the experiment (31-120 minutes). Group 2 (EP) saw performance increases at every 30-minute marker, with their highest performance occurring during the 31-60 minute window (4.1 hits, +12.5%). Group 3 (PP) had an initial increase in performance from 0-30 minutes, then a large decrease from 31-60 minutes and then a slight increase during the remaining two 30-minute time periods.

**TABLE 4: 30-Minute Average Non-Stressed Performance**

	Group 1 (PP)	Group 2 (EP)	Group 3 (EE)
<b>Baseline</b>	3.5	3.6	3.9
<b>0-30 min</b>	3.6 (+2.4%)	3.8 (+2.9%)	4.0 (+1.6%)
<b>31-60 min</b>	3.4 (-3.4%)	4.1 (+12.5%)	3.5 (-11.3%)
<b>61-90 min</b>	3.3 (-6.3%)	3.8 (+2.9%)	3.7 (-4.9%)
<b>91-120 min</b>	3.1 (-12.0%)	3.8 (+4.3%)	3.8 (-3.6%)

**GRAPH 2: Non-Stressed Performance, Caffeine and Time**



Between group comparisons using standard Two-Sample T-Tests revealed three significant differences during the treatment trials ( $p < .05$ ). The first difference occurred during the second assessed time period (31-60 minutes). During this period there was a significant difference between the placebo group (Group 1) and the single drink group (Group 2),  $t(19) = 2.36$ ,  $p < .05$ . The second and third significant differences occurred during the last time period (91-120 minutes). During this time period there were significant differences between Group 1 (PP) and Group 2 (EP),  $t(19) = 2.25$ ,  $p < .05$  and between Group 1 (PP) and Group 3 (EE)  $t(19) = 2.04$ ,  $p < .05$ .

**TABLE 5: Significant Differences During Non-Stressed Trials**

Time	Group	Group	Group Comparison (Change from Baseline)	TTest (p)
31-60 min	Group 1 (PP)	Group 2 (EP)	Group 1 = -3.4% Group 2 = +12.5%	0.02
91-120 min	Group 1 (PP)	Group 2 (EP)	Group 1 = -12.0% Group 2 = +4.3%	0.03
91-120 min	Group 1 (PP)	Group 3 (EE)	Group 1 = -12.0% Group 3 = -3.6%	0.05

### 3.3 Energy Drink (Treatment) Effects during Stress Trials

The average performance change (from baseline to treatment) across all three groups over the 2-hour trial was +19.0%. Group 1 (PP) had an initial decrease from 0-30 minutes and then increases over their baseline during the remaining three 30-minute intervals. Group 2 (EP) also had an initial decrease from 0-30 minutes and then increases over their baseline during the remaining three 30-minute intervals. Group 3 (EE) had increases over their baseline during each of the four 30-minute intervals.

**TABLE 6: 30-Minute Average Stressed Performance**

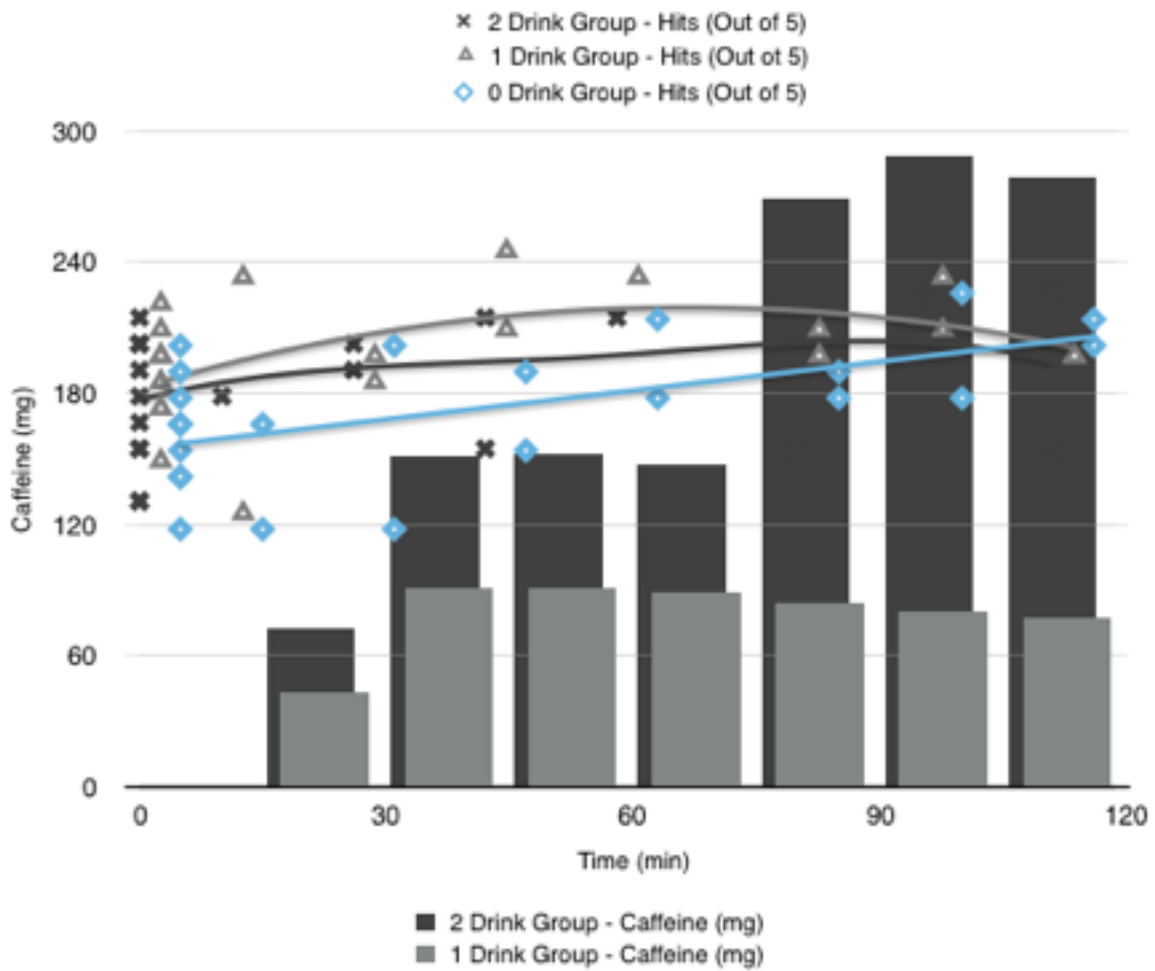
	Group 1 (PP)	Group 2 (EP)	Group 3 (EE)
<b>Baseline</b>	2.5	2.9	3.0
<b>0-30 min</b>	2.4 (-6.6%)	2.8 (-1.8%)	3.2 (+5.6%)
<b>31-60 min</b>	2.9 (+15.2%)	3.6 (+24.5%)	3.4 (+12.3%)
<b>61-90 min</b>	3.1 (+21.4%)	3.3 (+14.0%)	3.4 (+12.3%)
<b>91-120 min</b>	3.3 (+31.6%)	3.2 (+13.1%)	3.4 (+15.5%)

Despite these large changes, between group comparisons using standard Two-Sample T-Tests revealed only two significant difference during the treatment marksmanship trials ( $P < .05$ ). These differences were found during minute 0-30 between Group 1 (PP) and Group 3 (EE),  $t(19) = 2.10$ ,  $P < .05$ , and then between minute 31-60 between Group 1 (PP) and Group 2 (EP),  $t(19) = 2.45$ ,  $P < .05$ .

**TABLE 7: Significant Differences During Stressed Trials**

Time	Group	Group	Group Comparison (Change from Baseline)	TTest (p)
0-30 min	Group 1 (PP)	Group 3 (EE)	Group 1 = -6.6% Group 3 = +5.6%	0.04
31-60 min	Group 1 (PP)	Group 2 (PE)	Group 1 = +15.2% Group 2 = +24.5%	0.02

**GRAPH 3: Stressed Performance, Caffeine and Time**



## 4. DISCUSSION

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The overall objective of this study was to evaluate the effects of a popular energy drink (*Monster Zero Ultra*) on non-stressed marksmanship and stressed marksmanship.

### 4.1 *The effects of Energy Drinks on Non-Stressed Marksmanship*

The non-stressed results from this study suggest that 1-2 energy drinks can have a positive impact on non-stressed marksmanship performance. Over the course of this study (two hours and 16 non-stressed marksmanship trials) the no energy drink group (PP) saw their performance decrease by 12.0%. This was by far the largest decrease among the three groups.

Group 3 (EE), which received energy drinks twice during the study, also saw an overall decrease in performance, but significantly out-performed the control group. Group 3's decrease was significantly less than the control group (-3.6% vice -12.0%),  $t(19) = 2.04$ ,  $P < .05$ .

Group 2 (EP), who received an energy drink at the beginning of the study and then a placebo 60 minutes into the experiment, was by far the best performer. Group 2 was the only group whose performance increased over the course of the study (+4.3%). Group 2 also significantly out performed the control group (Group 1) from 31-60 minutes (+12.5% vice -3.4%),  $t(19) = 2.36$ ,  $P < .05$  and from 90-120 minutes (+4.3% vice -12.0%),  $t(19) = 2.25$ ,  $P < .05$ .

Previous research examining caffeine alone offered recommendations of approximately 200mg of caffeine consumption (12,13,14) for optimum performance. According to company documents and independent reports the energy drink used during this study had approximately 150-160mg of caffeine per 16 ounces (21). Thus, our finding that one energy drink (16 ounces and approximately 160mg of caffeine) was the optimum dosage is slightly lower than previously suggested caffeine levels. However, based on the additional ingredients found in energy drinks (16), and the possibly that the caffeine levels can be under-reported this study's findings seem to support some of the previous research concerning caffeine supplementation (16,19).

Another study, Published by the Committee on Military Research Food and Nutrition Board, found that between 200-250mg of caffeine was sufficient to restore sentry engagement times and did not negatively impact marksmanship (15). Again, this current study seems to support this recommendation given the variability in caffeine and additional substances in energy drinks.

### 4.2 *The effects of Energy Drinks on Stressed Marksmanship*

The results found during the stressed portion of this study suggest that stressed performance will improve regardless of treatment. During this portion of the study all three groups (PP, PE, EE) showed improved performances (over baseline) from 30 minutes to 120 minutes.

However, where energy drinks seemed to have an effect was during the first hour of testing. During this time period both Group 2 (EP) and Group 3 (EE) received a single energy drink treatment while Group 1 (PP) received only the placebo. From time 0-30 minutes Group 1 (PP) experienced a -6.6% change in performance while Group 3 (EE) experienced a +5.6% change in performance. This represented the first of two significant differences between the placebo group and a treatment group  $t(19) = 2.10$ ,  $P < .05$ .

The second significant difference measured between groups occurred during the 31-60 minute time period. During this time period Group 2 (EP) experienced a +24.5% increase in performance while Group 1 (PP) experienced a +15.2% increase,  $t(19) = 2.45$ ,  $P < .05$ .

Based on these two findings it would seem that a single energy drink, taken within 60 minutes of a stressed marksmanship trial would be optimal. However, for stressed marksmanship drills taking place longer than 2 hours after a treatment any treatment should be sufficient to illicit improvement. It should be pointed out that this finding could also be the result of subjects becoming increasingly practiced on a particular drill and thus improving based on familiarity.

Previous research examining caffeine's effect during stressful situation like US Navy BUD/S training

showed that candidates who took 200mg of caffeine every 2 hours were more vigilant, more alert and better at speed and accuracy tasks (12). Although this current study did not proceed beyond 2 hours, the improvements seen between the two treatment groups seem to show that energy drinks consumed at similar intervals would likely have comparable results.

Another study from the U.S. Army Research Institute found that 200mg of caffeine did not impair accuracy (14). This finding was also supported by the current study, which found that even 2 energy drinks (approximately 320mg of caffeine) did not negatively impact marksmanship.

## 5. PRACTICAL APPLICATIONS

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The findings from this study can be used to help tactical athletes better prepare, plan, and perform during marksmanship training. This, in turn, should allow them to be better prepared for the real-world tactical demands of their jobs.

Based on the results found while examining the effects of an energy drink during both non-stressed and stressed marksmanship drills, tactical athletes would likely want to experiment with energy drink supplementation prior to their training and performance. Although each athlete responded slightly differently to the energy drink treatments, overall this study found that a single energy drink (similar to *Monster Zero Ultra*), consumed approximately 30-60 minutes prior to a marksmanship trial can effectively be used to counter-act negative effects experienced during short (60 minutes) and long-term (>120 minutes) non-stressed and stressed drills.

The application of this information could help tactical athlete better prepare and perform during marksmanship training and real-world tactical situations.

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