THE EFFECTS OF SELECTED DOSES OF CAFFEINE FOLLOWING FASTING ON HAND STEADINESS, TRACING ABILITY, KINESTHETIC SENSE AND MANUAL DEXTERITY

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THE EFFECTS OF SELECTED DOSES OF CAFFEINE FOLLOWING FASTING ON HAND STEADINESS, TRACING ABILITY, KINESTHETIC SENSE AND MANUAL DEXTERITY

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CHAPTER I

INTRODUCTION

Current Status of Caffeine

Caffeine, a methylxanthine, can be found in virtually every individual's diet today. It is currently the most wide-spread and indiscriminately used drug available to consumers of all ages. This creates a need for more research regarding the potential health risks and deleterious effects encountered by consumers of caffeine.

The earliest study of the influence of caffeine in metabolism was carried out in 1850 (1). Few investigations of caffeine occurred prior to the 1970s, but a growth in scientific interest in the drug resulted from a draft issued by a special committee on drugs generally recognized as safe by the Food and Drug Administration (FDA) of the U.S. Public Health Service (2).

Caffeine can be found as an ingredient in coffee, soft drinks, tea, chocolate, gelatines, puddings, frozen dairy products, baked goods, and over the counter as well as prescription medications (1). According to the FDA, about 1000 prescription drug products and about 2000 OTC (nonprescription) drug products contain caffeine (3). Typical prescription drugs contain on the order of 30-100 mg.

caffeine per tablet or capsule. Caffeine levels in OTC drugs also vary widely (typically from 15 to 200 mg. per tablet or capsule) and depend not only on the type of product, but also on the brand involved (4)(Table I). Many Americans are aware that the majority of soft drinks on the market today contain caffeine (Table I). Consequently several companies have developed "caffeine-free" soft drinks. Unfortunately the products still lack popularity with the consumers. The caffeine-free products accounted for 4.1% of the total soft drink market in 1986, a decline from the 4.7% share it represented in 1985 (43).

As a result of the indiscriminate use of caffeine as an ingredient in many products, most Americans are not aware of the amount of caffeine they consume in their diet. According to the Market Research Corporation of America Survey the mean daily caffeine intake for adults (18 years of age and above) is 2.6 milligrams per kilogram of body weight (mg./-kg. bwt.). The mean estimated intake among the heaviest 10% of adult consumers has been calculated from the MRCA data to be 7.0 mg./kg. bwt. (5). According to another source the average daily consumption of caffeine in the U.S. is estimated to be 206 mg. per person (6).

A need exists for research regarding the effects of caffeine on hand steadiness, tracing ability, kinesthetic sense, and manual dexterity. Many occupations today demand precision and the performance of simple motor skills. If

caffeine should affect these demands employees as well as employers have the right to know this information.

TABLE I

CAFFEINE CONTENT OF SOFT DRINKS (MG. CAFFEINE IN 12 OZ.)

	Source*			
Brand	1	2	3	4
Sugar Free Mr. Pibb	58.8	58.0		
Mountain Dew	54.0	54.0	54.7	49.0
Mellow Yellow	52.8	52.0		
TAB	46.8	46.0	49.4	45.0
Coca-Cola (old and new)	45.6	46.0	64.7	42.0
Diet Coke	44.4	46.0		
Shasta Cola	44.4	44.0		
Shasta Cherry Cola	44.4	44.0		
Shasta Diet Cola	40.8	44.0		
Mr. Pibb	40.8	40.8		57.0
Dr. Pepper	39.6	40.8	60.9	61.0
Sugar Free Dr. Pepper	39.6	40.8	54.2	
Big Red	38.4	30.8		
Sugar Free Big Red	38.4			
Pepsi-Cola	38.4	38.4	43.1	35.0
Diet Pepsi	36.0	36.0		34.0
RC Cola	36.0	36.0	33.7	36.0
Diet Rite	36.0		31.7	
Diet RC			33.0	

*Source

1. Institute of Food Technologists (IFT), April 1983, based on data from National Soft Drink Association, Washington, D.C.

2. Soft Drink Companies

3. Bunker, L. and McWilliams, M. (1979). "Caffeine Content of Common Beverages." Journal of The American Dietetic Association, 74: 28-32.

4. Soft Drink Companies and the Journal of the American Dietetic Association.

TABLE I (Continued)

CAFFEINE CONTENT IN COFFEE (MG. IN 5 OZ.)

	Source*		
	1	2	3
Brewed, drip method	60-180	150	40-170
Brewed, percolator	40-170	110	
Instant	30-120	66	30-120
Decaffeinated, brewed	2-5	4.5	
Decaffeinated, instant	1-5	2	

*Source
1. FDA, Food Additive Chemistry Evaluation Branch.

2. Journal of the American Dietetic Association.

3. FDA, Food Additive Chemistry Branch, based on evaluations of existing literature on caffeine levels.

CAFFEINE CONTENT IN TEA (MG. IN 5 OZ.)

	*Source	
	1	2
Brewed	20-90	45
Iced (12 oz.)	67-76	
Instant	25-50	45

*Source
1. FDA, Food Additive Chemistry Evaluation Branch.

2. Journal of the American Dietetic Association.

CAFFEINE CONTENT IN NON-PRESCRIPTION DRUGS

	*Source
Weight-Control Aids (capsule/tablet)	Mg. Caffeine
Codexin	200
Dexatrim	200
Dietac	200
Prolamine	140

*Source
1. FDA's National Center for Drugs and Biologics.

TABLE I (Continued)

CAFFEINE CONTENT IN NON-PRESCRIPTION DRUGS CONT.

	*Source Mg. Caff.
Pain Relievers (capsule/tablet)	
Anacin	32.0
Excedrin	65.0
Midol	32.4
Vanquish	33.0
Dristan	16.2
Duradyne	15.0
Cold & Allergy Remedies (capsule/tablet)	**Mg. Caff.**
Coryban-D capsules	30
Triaminicin tablets	30
Diuretics	**Mg. Caff.**
Aqua-Ban	100
Aqua-Ban Plus	200

*Source
Physician's Desk Reference and Pharmaceutical Companies.

Alertness Tablets (tablet/capsule)	*Source Mg. Caff.
Nodoz	100
Vivarin	200
Caffedrine	200

*Source
FDA's National Center for Drugs and Biologics.

CAFFEINE CONTENT IN MISC. PRODUCTS

	*Source Mg. Caffeine
Cocoa (5 oz.)	2-20
Chocolate Milk (8 oz.)	2-7
Milk Chocolate (1 oz.)	1-15
Semi-sweet Choc. (1 oz.)	5-35
Choc. flavored syrup (1 oz.)	4

*Source
FDA, Food Additive Chemistry Evaluation Branch.

Properties of the Drug

In order for an individual to have an understanding of the effects of caffeine on hand steadiness, tracing ability, kinesthetic sense, and manual dexterity one must possess general knowledge of the chemical make-up of the drug and caffeine's effects on the various systems within the body. Caffeine is a xanthine derivative. Pure caffeine is a white, odorless powder with a bitter taste. Sublimed crystals are hexagonal prisms, and crystals from saturated aqueous solutions are long, silky white needles which mat together rapidly (7). Caffeine is structurally identified as 1,3,7-trimethylxanthine (Figure 1). Caffeine forms relatively stable combinations with sodium benzoate and sodium salicylate, which are used in oral and intramuscular medicinal applications, and is decomposed by hot alkalies and reacts with chlorine (7). The majority of neuropharmacological information on caffeine is limited to effects related to formation and release of neurotransmitters (8) specifically the catecholamines in the autonomic nervous system.

Caffeine empties rapidly from the stomach and is absorbed from the gastrointestinal tract (9). The drug readily passes the blood brain barrier (10) and directly acts on the vagal, medullary, and vasomotor centers. It is absorbed by all organs and tissues in proportion to the water content of the organelle (9). Peak blood concentration occurs approximately 45-60 minutes after ingestion (42). Half-life

of caffeine has been reported to extend from two to four hours (11) and may be affected by hormone interaction. For example, oral contraceptives taken in conjunction with caffeine increases the half-life threefold (12). However, tobacco use has been found to significantly decrease caffeine's plasma half-life (13)(Figure 2).

Caffeine serves to stimulate the central nervous system, cardiac muscles, kidneys, and certain glands (42). Additional reported physiological responses may include effects of the adenosine receptors by inhibition of enzyme activity (14).

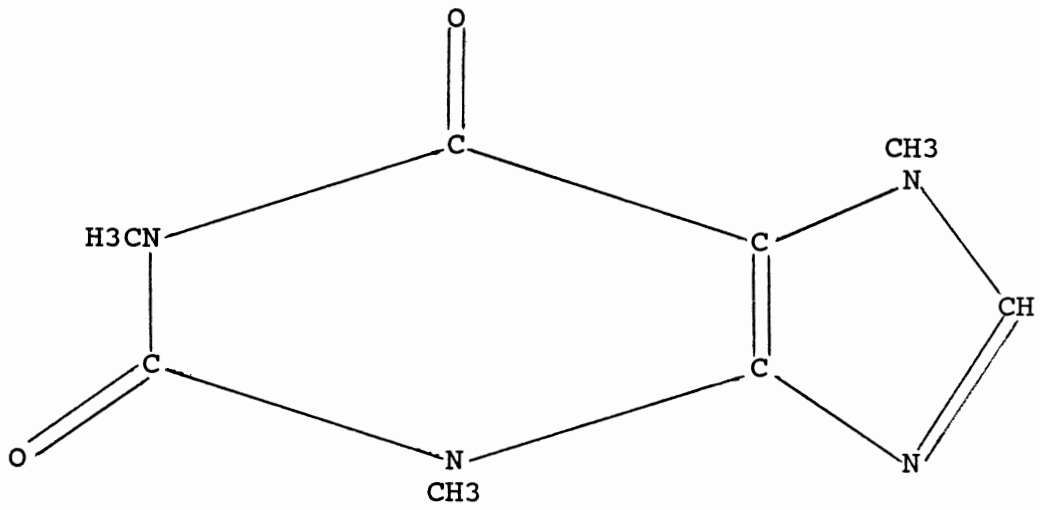

Figure 1. Chemical Structure of Caffeine

Individual	Hours
Adult	5-6
Child (6-10 yrs.)	2-3
Infant	
premature and newborn	98
7-9 months	4
Pregnant Woman	
1 to 3 months	6
4 to 9 months	10-18
one week after birth	6
Oral Contraceptive User	12
Smoker	3.5

Figure 2. Half-life of Plasma Caffeine Levels* (In Individuals)

*The amount of time caffeine stays in the blood stream.

Source: Sanford Miller and Jane Harris, FDA in "Don't Get Jittery Over Caffeine," Denise Grady. Discover. July, 1986.

Effects of Caffeine

Caffeine serves as a stimulant to the Central Nervous System (CNS). Although distribution of ingested caffeine is dependent on the water content of the tissue and the response is proportional to the concentration, tolerance to caffeine by habitual users may alter the response (15). Additionally, some subjects may inherently be more or less sensitive to caffeine. Even small amounts of caffeine may alter blood pressure, heart rate, respiration and metabolic rate (16). Caffeine also causes blood vessels in the brain to constrict, while those in the extremities and around the heart dialate (17). Loss of hand steadiness, trembling, tremors, and chronic muscle tension have been causually observed in some investigations as undesired physical side effects of caffeine consumption.

More research is being conducted in an effort to investigate the long-term effects of the use of caffeine. Presently long-term use is being scrutinized as the cause for peptic ulcers, painful (though benign) breast lumps, cancer, heart disease, and birth defects (17). However, the American Cancer Society denies any accusations linking caffeine to any form of cancer in human beings. This is difficult for researchers to study and prove as it requires a long-term investigation and must take many variables into account.

Research also suggests possible associations to coronary disease, arrhythmias, and elevated cholesterol (18).

Lethal doses of caffeine have been reported at 5,000 mg. to 10,000 mg. (17).

The relationship between caffeine and birth defects is of interest to every expectant mother. Such a correlation has been suggested. Jacobson (19) reported that 23.2 percent of mothers who gave birth to abnormal babies drank eight or more cups of coffee per day. Other studies are presently in progress or being planned and until more information is available the FDA recommends pregnant women avoid caffeine-containing products or use them sparingly. Nursing mothers should also use caffeine products sparingly. Concentrations in breast milk often rise above those in the mother's blood and may make a nursing infant wakeful and cranky (17).

One of the most noticeable effects of caffeine on humans is the stimulant effect. This effect was explained by a group led by Solomon Snyder (17) at Johns Hopkins School of Medicine in 1981. They concluded caffeine has similar molecular structure to that of adenosine which is a chemical in the body with many properties, including the ability to act as a sedative. Adenosine locks on to special receptor molecules on brain cells, thus reducing the cells' activity. Caffeine also has the capability of attaching to these molecules, preventing adenosine from doing so. Consequently the cells keep firing and a stimulant effect is experienced. Snyder and his colleagues (17) also found that the body has more than one kind of adenosine receptor, that

the receptors are distributed differently in various tissues, and that caffeine can combine with all types - hence its ability to affect so many systems. It has been suggested by many caffeine researchers the drug affects hand steadiness, simple motor skills, and reaction time. Caffeine has also been accused of inducing tremors. These findings have prompted other researchers to investigate caffeine's useful properties.

Purpose of the Study

The intent of this investigation was to examine the effects of two levels of caffeine (2.5 mg./kg. bwt, and 5.0 mg./kg. bwt.) and a placebo containing lactose powder on hand steadiness, tracing, kinesthetic sense, and manual dexterity.

Hypotheses

The following hypotheses were examined in this investigation:

HO1: There will be no difference between the placebo and two levels of caffeine post-tests on hand steadiness time (HST) after consumption of placebo, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine.

HO2: There will be no difference between the placebo and two levels of caffeine post-tests on hand steadiness count (HSC) after consumption of placebo, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine.

HO3: There will be no difference between the placebo and two levels of caffeine post-tests on tracing time (TT) after consumption of placebo, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine.

HO4: There will be no difference between the placebo and two levels of caffeine post-tests on tracing off time (TOF) after consumption of placebo, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine.

HO5: There will be no difference between the placebo and two levels of caffeine post-tests on tracing count after consumption of placebo, 2.5 mg./kg. bwt and 5.0 mg./kg. bwt. caffeine.

HO6: There will be no difference between the placebo and two levels of caffeine post-tests on the kinesthesiometer testing kinesthetic sense after consumption of placebo, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine.

HO7: There will be no difference between the placebo and two levels of caffeine post-tests on finger tip dexterity and speed capacity of simple but rapid coordinated movement after consumption of placebo, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine.

Delimitations

1. There were eight subjects used in this investigation.

2. All subjects were healthy female college students from Oklahoma State University.

3. There were two levels of caffeine administered, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt.

4. The subjects for this investigation were not randomly selected.

5. All subjects were below the national average in amount of caffeine consumed per day (206 mg.).

Limitation

1. There may be individual sensitivity to caffeine.

Assumptions

1. Subjects correctly followed all instructions.

2. Subjects consumed all caffeine with tap water.

3. Subjects were honest in their initial estimates of caffeine ingestion prior to the study.

CHAPTER II

LITERATURE REVIEW

Introduction

Caffeine has become a topic of current interest as an ergogenic agent, thus enhancing performance. Research regarding the drug's effect on endurance, movement and reaction time and muscular strength has resulted in equivocal conclusions. The speculative physical effect of caffeine has prompted the International Olympic Committee and the National Collegiate Athletic Association of the U.S. to adopt bans on the use of caffeine to aid sport performance. Doses equivalent to 500-600 mg. caffeine or five to six cups of coffee within a one to two hour period are currently prohibitive (1).

Biological Effects of Caffeine

Contemporary research suggests that caffeine may prolong endurance events lasting one hour or more (20) (21) but does not aid in short exhaustive bouts of exercise (22). Recent evidence by Jacobson and Edgley (23) also suggests that moderate doses of caffeine reduces movement time and reaction time but higher doses may attenuate these effects. Although caffeine is known to affect the membrane integrity

of the sarcoplasmic reticulum (24) and to influence calcium engineering in the muscle (11) no contemporary data exists indicating that caffeine may increase voluntary muscular strength in either isometric or isotonic activity (25). It has also been suggested that caffeine restores performance only when it has been impaired by fatigue, or otherwise degraded (26) (27).

Doses of caffeine representative of the amount found in servings of food have been found to have behavioral effects on humans (28). In the same study it was found that doses of caffeine equivalent to amounts present in a 12 oz. serving of many cola beverages, over-the-counter analgesics, and one or two cups of coffee or tea, significantly improve auditory and visual vigilance (28).

Effects of Caffeine on Movement Time and Reaction Time

Research on the effects of caffeine on movement time and reaction time date back to 1912. However, the results are inconsistent. Hollingsworth (29) reported 65-130 mg. caffeine improved typing speed, and that a dose of 390 mg. resulted in poor motor performance and tremor. Jacobson and Edgley (23) found a significant improvement in both reaction time and movement time after a dose of 300 mg. caffeine but no considerable change after 600 mg. They suggested the neuromuscular system may reach a saturation level of the drug agent which may serve to prohibit further positive

effects, thus a dose response curve may be in effect. A study by Wenzel and Rutledge (30) which investigated the effects of 100-300 mg. doses of caffeine found dose-related improvement on simple reaction time and inverse relationships on complex reaction time. Thornton (31) reported faster reaction times after a 300 mg. dose of caffeine.

Switzer (32) documented that moderately large doses of caffeine stimulated associative performance, reaction time, and mental activity. Carpenter (33) suggests that caffeine produces small reductions in reaction time when there is a high intensity stimulation and high alcohol dose. Cheney (34) in early investigations of caffeine found that a dose of 3-5 mg./kg. bwt. resulted in a varied reaction time effect and that a dose of 5 mg./kg. bwt. always decreased reaction time for up to a 3 hour period. In yet another study Cheney (35) found that 3.3-3.6 mg./kg. bwt. reduced discriminatory reaction time and reported no visible effect on color discrimination, mental decision, or precision reaction time unless the dose exceeded 3.0 mg./kg. bwt.

Effects of Caffeine on Hand Steadiness and Manual Dexterity

A possible correlation between hand steadiness and the consumption of caffeine has intrigued researchers for many years. However, the results of such studies have conflicting conclusions. Some researchers have suggested that caffeine impairs hand steadiness and causes tremor (36) (41).

However, Wharrad et. al. (37) indicated no finger tremor as a result of 150 mg. caffeine taken three times daily in conjunction with a normal diet. Furthermore, Goldstein, Kaizer, and Warren (38) found no impairment of coordination as a result of 150 mg. and 300 mg. caffeine. Koller, Cone, and Herbster (39) studied 50 subjects without neurologic disease and reported that caffeine does not induce tremor in most normal individuals. However, they also suggested fine motor performance may be worsened by caffeine.

Hollingsworth (40), who was commissioned by the Coca-Cola Company to study the influence of caffeine on mental and motor efficiency devised nine double-blind tests. He found beneficial motor and mental effects from 65 to 130 mg. caffeine, and tremor, poor motor performance, and insomnia caused by 390 mg. caffeine. Many investigations of hand steadiness involve the use of a hand held stylus which is placed in a hole for an allotted amount of time. Smith, Tong, and Leigh (41) used such an instrument after their subjects ingested 200 mg. of "wake up" pills dissolved overnight in orange juice. They concluded that hand steadiness was significantly impaired by caffeine.

Summary

Currently there is a lack of research regarding the dose response curve and its effect on hand steadiness. Any research in this area would be beneficial to all caffeine investigators. The results of investigations regarding the

effects of caffeine on reaction time, movement time, hand steadiness, and manual dexterity are inconsistent. The inconsistencies could be attributed to many variables including individual sensitivity to caffeine, differences in experimental protocol, and differences in dose administration.

CHAPTER III

METHODS

Subjects

This investigation consisted of eight healthy volunteer female subjects, all of whom were undergraduate students at Oklahoma State University, Stillwater, Oklahoma. The subjects were chosen on the basis of availability. They do not represent a sample of a stratified group within the population. They were not chosen from a particular class or organization. The mean age of the subjects was ±21.1 years old and the mean weight was ±58.0 kg. All subjects were informed of the nature and the procedures of the experiment, including any possible risks or side effects that might be encountered. Each subject voluntarily signed an informed consent document as stipulated and approved by the Institutional Review Board at Oklahoma State University (Appendix A). The subjects then completed a medical history questionnaire (Appendix B) which included questions pertaining to pregnancy, high blood pressure, intestinal disorders, cardiac or vascular disorders, and current medication. The subjects were also orally screened for any of these symptoms. If any of these symptoms were indicated by a subject

prior to testing, they were eliminated from the study. Following the medical history questionnaire, each subject completed a caffeine consumption questionnaire (Appendix B).

Preliminary Procedures

Prior to testing the subjects were asked to fast from food a minimum of 5 hours and fast from caffeine a minimum of 48 hours. Following an explanation of the experiment and the completion of the necessary documents the subjects' heart rate and blood pressure were taken. Next, the subjects' were randomly assigned either a placebo or a caffeine dosage; 2.5 mg./kg. bwt. or 5.0 mg./kg. bwt. The subjects' body weight, which was determined by oral inquiry, was used to ascertain the amount of caffeine that would be administered. Prior to each pre-test session each subject was orally screened to determine if they were experiencing a lack of sleep, high level of stress, or pre-menstrual syndrome. If a subject answered "yes" to any of the above questions they were given the opportunity to reschedule the test session.

Equipment and Testing Procedure

The study used a double-blind, placebo controlled format. Neither the subject nor the principal investigator had knowledge of which dose was ingested. Subjects were randomly assigned to dose administrations and testing stations. Prior to the ingestion of either the placebo or a

caffeine dose, each subject was pre-tested on the following testing apparatus: 1) Lafayette model 32001 Steadiness Tester (hole type) for hand steadiness, 2) tracing pattern interfaced with a timer for hand steadiness, 3) kinesthesiometer used in conjunction with opaque goggles which served as a blinder for kinesthetic sense, and 4) O'Connor Dexterity tweezer-pin placement apparatus test for finger-tip dexterity and speed capacity of simple but rapid coordinated movement. When subjects were tested for hand steadiness two variables were recorded. The first was hand steadiness time (HST) which was the amount of time during a 60 second test the subject was in contact with the plate, which was not desirable. The second variable was hand steadiness count (HSC), which was the number of times during the 60 second period the subject contacted or touched the plate with the stylus.

When the subjects were tested for tracing ability three variables were recorded. The first, total tracing time (TT) was the amount of time it took the subject to trace the pattern from start to finish. The second variable tested was tracing off time (TOF) which was the amount of time the subject was not in contact with the pattern. The third variable was tracing count (TC) which indicated the number of times the subject was not in contact with the pattern.

When subjects were tested for kinesthetic sense (K) the value recorded represents the difference between what the correct angular position previously placed by the

investigator and the angular placement by the subject in trying to duplicate the investigator's placement. The movement performed was shoulder rotation. The value which represents manual dexterity (D) was derived from the amount of time it took the subject to complete three rows of the tweezer-pin placement apparatus.

The testing order was established in a random design. Subjects were given verbal instructions for task completion by the investigator and two trials were recorded at each station (Appendix D).

Subsequent to each pre-test the subjects were given an oral dose of either a placebo or 2.5 mg./kg. bwt. or 5.0 mg./kg. bwt. caffeine. The placebo consisted of a capsule containing lactose powder. Both the placebo and caffeine doses were administered with approximately 100 ml. cold tap water. Immediately following the ingestion of caffeine, the time was recorded so re-testing could be performed no less than one hour after ingestion. During the one hour waiting period subjects were asked to relax and refrain from any strenuous activities.

Testing was performed in a quiet, isolated room in an attempt to avoid any outside visual or auditory interference. All testing was performed in the Exercise Physiology lab on the campus of Oklahoma State University. All caffeine and placebo products were prepared by a local pharmacist. Pre- and post-test measurements were recorded for each one of the three product administrations (Appendix E).

This figure was derived by calculating the average of the two pre-test scores and calculating the average of the two post-test scores. This process of averaging scores was performed on all pre-tests and post-tests on each testing apparatus (Appendix F). Testing sessions were scheduled one week apart at identical times for each subject.

Post-Procedure

Immediately following the post-test session each subject was asked to complete a perceived ingestion question to ascertain the amount of caffeine they believed they had consumed. The time for each session was approximately 1.5 hours. The total time for all sessions was approximately 4.5 hours. Subjects were encouraged to eat immediately after the testing but were asked to refrain from eating spicy foods. Any subject who encountered any ill feelings was asked to contact the principal investigator immediately.

CHAPTER IV

RESULTS AND DISCUSSION

Results

This investigation involved the testing of seven hypotheses for significance at the .05 level. A hypothesis for each of the following was tested: hand steadiness time, hand steadiness count, tracing time, tracing off time, tracing count, kinesthetic sense, and manual dexterity. The hypotheses were examined to see if a difference occurred between post-tests when 0 mg./kg. bwt., 2.5 mg./kg. bwt., and 5.0 mg./kg. bwt. caffeine was ingested.

Hypothesis 1

The first hypothesis stated there would be no difference between the placebo and two levels of caffeine post-tests on hand steadiness time after consumption of placebo, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine.

Hypothesis 2

The second hypothesis stated there would be no difference between the placebo and two levels of caffeine post-tests on hand steadiness count after consumption of placebo, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine.

Hypothesis 3

The third hypothesis stated there would be no difference between the placebo and two levels of caffeine posttests on tracing time after consumption of placebo, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine.

Hypothesis 4

The fourth hypothesis stated there would be no difference between the placebo and two levels of caffeine posttests on tracing off time after consumption of placebo, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine.

Hypothesis 5

The fifth hypothesis stated there would be no difference between the placebo and two levels of caffeine posttests on tracing count after consumption of placebo, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine.

Hypothesis 6

The sixth hypothesis stated there would be no difference between the placebo and two levels of caffeine posttests on the kinesthesiometer testing kinesthetic sense after consumption of placebo, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine.

Hypothesis 7

The seventh hypothesis stated there would be no difference between the placebo and two levels of caffeine post- tests on finger tip dexterity and speed capacity of simple but rapid coordinated movement after consumption of placebo, 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine.

The mean and standard deviation for each variable can be found in Table III. A repeated measures analysis of variance was used in analyzing the pre-test data. No significance ($p>0.05$) was found for any variable in the pre-test. A repeated measures analysis of variance was also used in analyzing post-test data and a significant difference ($p<0.05$) was detected on four occasions (Tables II and III). By administering the Newman-Kuels post-hoc procedure on all post-test data a significance ($p<0.05$) was found between post-tests on hand steadiness time after 5.0 mg./kg. bwt. caffeine was ingested. Therefore, the first hypothesis was rejected. A significant difference was also detected between the caffeine and placebo on hand steadiness count after 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine was ingested. This caused the second hypothesis to be rejected.

The third hypothesis was accepted when no significance was detected between post-tests on tracing time. Likewise, the fourth hypothesis was also accepted when no significance was found between post-tests on tracing off time. A significant difference was detected between post-tests on tracing

count after 5.0 mg./kg. bwt. was ingested. Therefore, the fifth hypothesis was rejected.

No significant difference was found between post-tests on the kinesthesiometer which was used to measure kinesthetic sense. As a result the sixth hypothesis was accepted.

Finally, a significance was found between post-tests on manual dexterity after 5.0 mg./kg. bwt. caffeine was ingested. Consequently, the seventh hypothesis was rejected.

When subjects were given the placebo the majority perceived to have ingested 0 mg./kg. bwt. caffeine. When the subjects ingested 2.5 mg./kg. bwt. caffeine (small dose) the majority perceived they had ingested a moderate amount. Finally, when the subjects received a moderate dose of 5.0 mg./kg. bwt. caffeine they perceived to have ingested a large dose. In conclusion, the author suggests when the subjects received a caffeine dose (not including placebo) they perceived it to be higher than what it actually was.

Discussion of Results

Based on the results of this experiment hand steadiness is impaired after 2.5 mg./kg. bwt. caffeine. Also 5.0 mg./kg. bwt. caffeine impairs hand steadiness, tracing ability, and finger tip dexterity and speed capacity of simple but rapid coordinated movement. For a 120 lb. person this would be equivalent to two to three cups of coffee. For a 180 lb. person this would be the equivalent of four to

six cups of coffee. This should be of particular concern to those individuals who maintain occupations requiring fine motor performance (surgeon, dentist, key punch operator, etc.)

The results of this experiment are consistent with the findings of many other studies. However, it is difficult to compare the results of this study to previous studies because the dosage of caffeine was given according to the subject's body weight (not a blanket dose which is often performed in caffeine research). Also all subjects were female and below the national average for caffeine consumption per day. Subjects were asked to fast from caffeine and food prior to testing. The author does not have knowledge if these variables were considered in previous studies, therefore making it difficult to make a comparison.

TABLE II

ANALYSIS OF VARIANCE

HAND STEADINESS TIME
Post Test

Source	Sum of Squares	D.F.	Mean of Squares	F Ratio	F Prob.
Between Groups*	1224.08128	1	1224.08128	100.90	0.0000
Within Groups	196.90070	2	98.45035	7.21	0.0070

HAND STEADINESS COUNT
Post Test

Source	Sum of Squares	D.F.	Mean of Squares	F Ratio	F Prob.
Between Groups	165668.16667	1	165668.16667	92.10	0.0000
Within Groups	12683.08333	2	6341.54167	7.59	0.0059

TRACING TIME
Post Test

Source	Sum of Squares	D.F.	Mean of Squares	F Ratio	F Prob.
Between Groups	18216.05484	1	18216.05484	30.55	0.0009
Within Groups	188.49270	2	94.24635	2.14	0.1545

*Groups refer to levels of dosage (0, 2.5 and 5.0 mg./kg. bwt. caffeine.

TABLE II (Continued)

TRACING OFF TIME
Post Test

Source	Sum of Squares	D.F.	Mean of Squares	F Ratio	F Prob.
Between Groups	502.33493	1	502.33493	33.19	0.0007
Within Groups	24.89251	2	12.44625	2.12	0.1547

TRACING COUNT
Post Test

Source	Sum of Squares	D.F.	Mean of Squares	F Ratio	F Prob.
Between Groups	15708.16667	1	15708.16667	70.95	0.0001
Within Groups	604.58333	2	320.29167	4.92	0.0241

KINESTHETIC SENSE
Post Test

Source	Sum of Squares	D.F.	Mean of Squares	F Ratio	F Prob.
Between Groups	3408.16667	1	3408.16667	81.94	0.0000
Within Groups	5.58333	2	2.79167	0.10	0.9055

TABLE II (Continued)

MANUAL DEXTERITY
Post Test

Source	Sum of Squares	D.F.	Mean of Squares	F Ratio	F Prob.
Between Groups	258690.34444	1	258690.34444	347.43	0.0000
Within Groups	2489.97405	2	1244.98703	5.46	0.0177

TABLE III

MEAN TIMES ± STANDARD DEVIATIONS
OF VARIABLES

HAND STEADINESS TIME

Group	Post Test	Standard Deviation
1. 0 mg./kg. bwt	3.70	±2.05
2. 2.5 mg./kg. bwt.	7.01	±3.06
3. 5.0 mg./kg. bwt.	10.71	±5.08*

HAND STEADINESS COUNT

Group	Post Test	Standard Deviation
1. 0 mg./kg. bwt.	52.00	±21.90
2. 2.5 mg./kg. bwt.	90.38	±32.47*
3. 5.0 mg./kg. bwt.	106.88	±44.01*

TRACING TIME

Group	Post Test	Standard Deviation
1. 0 mg./kg. bwt.	23.90	±12.90
2. 2.5 mg./kg. bwt.	28.04	±15.41
3. 5.0 mg./kg. bwt.	30.71	±16.75

*Denotes statistically significant difference.

TABLE III (Continued)

TRACING OFF TIME

Group	Post Test	Standard Deviation
1. 0 mg./kg. bwt.	3.63	±1.96
2. 2.5 mg./kg. bwt.	4.11	±1.66
3. 5.0 mg./kg. bwt.	5.99	±4.50

TRACING COUNT

Group	Post Test	Standard Deviation
1. 0 mg./kg. bwt.	20.38	±6.50
2. 2.5 mg./kg. bwt.	23.75	±7.94
3. 5.0 mg./kg. bwt.	32.63	±15.69*

KINESTHETIC SENSE

Group	Post Test	Standard Deviation
1. 0 mg./kg. bwt.	11.25	±5.70
2. 2.5 mg./kg. bwt.	12.38	±7.07
3. 5.0 mg./kg. bwt.	12.13	±3.87

TABLE III (Continued)

MANUAL DEXTERITY

Group	Post Test	Standard Deviation
1. 0 mg./kg. bwt.	92.49	±12.40
2. 2.5 mg./kg. bwt.	101.79	±13.93
3. 5.0 mg./kg. bwt.	117.19	±29.20*

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER STUDY

Summary

Eight female undergraduate students were tested for the effects selected doses of caffeine have on hand steadiness, tracing ability, kinesthetic sense, and manual dexterity. Each subject was tested three times and was given either 0 mg./kg. bwt., 2.5 mg./kg. bwt., or 5.0 mg./kg. bwt. caffeine randomly. A different dose was administered each time the subject was tested. Subjects were administered a pre-test before each ingestion. Approximately 60 minutes after the ingestion of either the placebo or caffeine dose a post-test was administered.

Conclusions

This study which tested the effects of selected doses of caffeine suggests four conclusions. The first conclusion is hand steadiness time is impaired at 5.0 mg./kg. bwt. caffeine but not at 2.5 mg./kg. bwt. The second conclusion suggests that hand steadiness count is impaired at the 2.5 and 5.0 mg./kg. bwt. caffeine levels. The third conclusion is tracing count is impaired at the 5.0 mg./kg. bwt.

caffeine levels. Finally, the fourth conclusion suggests manual dexterity becomes impaired at the 5.0 mg./kg. bwt. caffeine level but not at 2.5 mg./kg. bwt. These findings and conclusions should be of importance to the general public and in particular, people who maintain occupations that require and demand hand steadiness and fine motor performance. Some occupations which would be affected by the loss of hand steadiness or manual dexterity include microsurgeons, computer chip technicians, laser technologists, key punch operators, etc.

The long-term effect of caffeine on children is of interest to many researchers. When conducting research with children it is imperitive to be aware of their body weight. For example, for a 30 lb. (13.6 kg.) child it would only take approximately 1.5 cokes before hand steadiness and fine motor coordination would be impaired. Parents should be aware of the amount of caffeine their children are consuming on both a short and long term basis.

Recommendations for Further Study

In an attempt to further study the effects of selected doses of caffeine the author suggests using more subjects and adding at least one more dosage of caffeine (higher than 5.0 mg./kg. bwt.) in an attempt to identify a dose response curve and/or the saturation level in the subjects. Another investigation which would be of benefit to the realm of caffeine research would involve the testing of subjects on a

full stomach after the ingestion of coffee. This investigation would attempt to determine if the deleterious effects of caffeine are avoided, decreased, or delayed as a result of a full stomach.

REFERENCES

(1) Jacobson, B.H. and Kulling, F.A. (1989). "Health and Ergogenic Effects of Caffeine." British Journal of Sports Medicine, 23:34-39.

(2) Dews, P.D. (1984). "Caffeine: Perspectives from Recent Research." Springer-Verlag, Berlin.

(3) Food and Drug Administration. (1980). "Caffeine content of various products." FDA, Washington (FDA Talk Paper, T80-45).

(4) Barone, J.J. (1981). "Consumption and the Food and Drug Administration's proposal to remove caffeine in cola beverages from the list of substances generally recognized as safe." (Docket No. 80N-0418). Coca-Cola, Atlanta.

(5) Little, A.D. (1977). "Comments on the health aspects of caffeine, especially the contribution of soft drinks with particular reference to the report of the Select Committee on GRAS sbustances." Little, Cambridge, MA.

(6) Burg, A.W. (1975). "How Much Coffee in a Cup." Tea and Coffee Trade Journal, 147:40-42.

(7) Sivetz, M. and Desrosier, N.W. (1979). Coffee Technology. AVI Publishing Company, Westport, CN.

(8) Jacobson, B.H. and Edwards, S.W. (1990). "Effects of Ingested Doses of Caffeine on Neuromuscular Reflex Response Time in Man." International Journal of Sports Medicine, 11.

(9) Axelrod, J. and Reichenthal J. (1953). "The Fate of Caffeine in Man and a Method for its Estimation in Biological Material." Journal of Pharmacology and Experimental Therapeutics, 107:519-523.

(10) Weber, A. (1968). "The Mechanism of the Action of Caffeine on Sarcoplasmic Reticulum." Journal of General Physiology, 68:760772.

(11) Fabiato, A. and Fabiato, F. (1975). "Dependence of the Contractile Activation of Skinned Cardiac Cells on the Sarcomere Length." Nature, London 256:54-56.

(12) Syed, I.B. (1976). "The Effects of Caffeine." Journal of American Pharmaceutical Association, 16:568-572.

(13) Arnaud, M.J. (1984). "Products of Metabolism of Caffeine." In: Dews P (ed) Caffeine, Springer, Berlin, pp. 3-38.

(14) Beavo, J.A. et. al. (1970). "Effects of Xanthine Derivatives on Lipolysis and on Adenosine 3'5'-Monophosphate Phosphodiesterase Activity." Molecular Pharmacology, 6:597-603.

(15) Oldendorf, W.H. (1971). "Brain Uptake of Matabolites and Drugs Following Carotid Arterial Injections." Transactions of the American Neurological Association. 96:46-50.

(16) Van Handle, P. (1986). "Effects of Caffeine on Physical Performance." Journal of Physical Education and Recreation, Feb., 56-57.

(17) Grady, D. (1986). "Don't Get Jittery Over Caffeine." Discover, July, 73-79.

(18) Prineas, R.J., Jacobs, D.R., Crews, R.S., and Blackburn, H. (1980). "Coffee, tea, and VPB." Journal of Chronic Disease, 33:73-76.

(19) Jacobson, M. (1978). "Caffeine's role in birth defects." Family Health, 3:20-22.

(20) Costill, D.L., Dalsky, G., and Fink, W. (1978). "Effects of Caffeine Ingestion on Metabolism and Exercise Performance." Medicine and Science in Sports and Exercise, 1:81-86.

(21) Ivy, J.L., Costill, D.L., Fink, W.J. and Lower, R.W. (1979). "Influence of Caffeine and Carbohydrated Feedings on Endurance Performance." Medicine and Science in Sports and Exercise, 11:6-11.

(22) Butts, N., and Crowell, O. (1985). "Effects of Caffeine Ingestion on Cardiorespiratory Endurance in Men and Women." Research Of Exercise and Sport, 56:301-305.

(23) Jacobson, B.H. and Edgley B.M. (1987). "Effects of Caffeine on Simple Reaction Time and Movement Time." Aviation, Space, and Environmental Medicine, 58:1153-1157.

(24) Kavaler, F., Anderson, T.W., and Fisher, V.J. (1978). "Sarcolemmal Site of Caffeine's Inotropic Action on Ventricular Muscle of the Frog." Circulation Research, 42:285-290.

(25) Bond, V., Gresham, K., McRae, J., and Tearney, R.J. (1986). "Caffeine Ingestion and Isokinetic Strength." British Journal of Sports Medicine, 20:3.

(26) Goldstein, A., Warren, R., and Kaizer, S. (1965). "Psychotropic Effects of Caffeine in Man, I. Interindividual Differences in Sensitivity to Caffeine - Induced Wakefulness." Journal of Pharmacology and Experimental Therapeutics, 149:156-159.

(27) Dews, P.D. (1982). "Caffeine." Annual Review of Nutrition, 2:323-341.

(28) Lieberman, H.R., Wurtman, R.J., Emde, G.G., Roberts, C., and Coviella I.L.G. (1987). "The Effects of Low Doses of Caffeine on Human Performance and Mood." Psychopharmacology, 92:308-312.

(29) Hollingsworth, H. (1912). "The Influence of Caffeine on Mental and Motor Efficiency." Archives of Psychology, 3:1-16.

(30) Wenzel, D., Rutledge, C. (1962). "Effects of Centrally Acting Drugs on Human Motor and Psychomotor Performance." Journal of Pharmaceutical Sciences, 51:631-644.

(31) Thornton, G. (1939). "The Effects of Benzedrine and Caffeine Upon Performance in Certain Psychomotor Tasks." Journal of Abnormal Social Psychology, 34:96-113.

(32) Switzer, St. C.A. (1935). "The Influence of Caffeine Upon 'Inhibition of Delay.'" Journal of Comparative Psychology, 22:150-163.

(33) Carpenter, J.A. (1959). "The Effect of Caffeine and Alcohol on Simple Visual Reaction Time." Journal of Comparative Physiological Psychology, 52:491-496.

(34) Cheney, R.H. (1935). "Comparative Effect of Caffeine Per Se and Caffeine Beverage Upon the Reaction Time in Normal Young Adults." Journal of Pharmacology and Experimental Therapeutics, 53:72-79.

(35) Cheney, R.H. (1936). "Reaction Time After Caffeine and Coffee Consumption." Journal of Experimental Psychology, 18:357-369.

(36) Stephenson, P.E. (1977). "Physiologic and Psychotropic Effects of Caffeine on Man." Journal of American Dietary Association, 71:240-247.

(37) Wharrad, H.J., Birmingham, A.T., MacDonald, I.A., Inch, P.J., and Mead, J.L. (1985). "The Influence of Fasting and of Caffeine Intake on Finger Tremor." European Journal of Clinical Pharmacology, 29:1,37-43.

(38) Goldstein, A., Kaizer, S., and Warren R. (1965). "Psychotropic Effects of Caffeine in Man, II. Alertness, Psychomotor Coordination, and Mood." Journal of Pharmacology and Experimental Therapeutics, 150:1,146-151.

(39) Koller, W., Cone, S., and Herbster, G. (1987). "Caffeine and Tremor." Neurology, 37:169-172.

(40) Hollingsworth, H.L. (1912). "The Influence of Caffeine on Mental and Motor Efficiency." Archives of Psychology, 22:1.

(41) Smith, D.L., Tong, J.E., and Leigh, G. (1977). "Combined Effects of Tobacco and Caffeine on the Components of Choice Reaction Time, Heart Rate, and Hand Steadiness." Journal of Perceptual and Motor Skills, 45:635-639.

(42) Robertson, D., Wade, D., Workman, R., Woolsey, R.L., and Oates, A. (1981). "Tolerance to the Humoral and Hemodynamic Effects of Caffeine in Man." Journal of Clinical Investigation, 67:1111-1117.

(43) Hemphill, G. (1987,88). Beverage Industry Annual Manual. Harcourt, Brace, Jovanovich Inc. Duluth, MN, 1987, p. 30.

APPENDIXES

APPENDIX A

INDIVIDUAL'S CONSENT FOR PARTICIPATION IN A RESEARCH PROJECT

Individual's Consent for Participation in a Research Project

OKLAHOMA STATE UNIVERSITY

I, _____, voluntarily agree to participate in this study entitled: The Effects of Selected Doses of Caffeine on Hand Steadiness, Manual Dexterity, Fine Motor Coordination, Kinesthetic Sense, and Perceived Ingestion.

1. PURPOSE: This study involves research that will be carried out under the supervision of Bert H. Jacobson, Ed.D. and Krista Winter. The purpose of this study will be to ascertain the effects of 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine on hand steadiness, manual dexterity, fine motor coordination, kinesthetic sense, and perceived ingestion. Such qualities are often necessary and/or vital for occupations today. Given that one cup of coffee contains 100 mg. caffeine, it is safe to assume that many professionals consume up to 400 mg. caffeine prior to or during work time. However, casual consumption is not all in one dose. This study will attempt to find if deleterious effects follow a single dose of 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine consumption.

2. STATUS OF INVESTIGATIONAL DRUG PROCEDURES: Caffeine may alter blood pressure, heart rate, respiration and metabolic rate. Caffeine may also induce tremors, nervousness, and anxiety.

3. DESCRIPTION OF STUDY: This study will involve a pre-screening consisting of blood pressure and heart rate. Additionally a medical history questionnaire containing the following items will be administered: oral contraceptive use, medication use, current illnesses, pregnancy, hang over and history of heart disease. Further, a caffeine consumption questionnaire will be administered to ascertain the average amount of caffeine consumed per day and week. Any subject indicating a blood pressure reading above 140 mm. Hg. systolic pressure and/or 60 mm. Hg. diastolic pressure and/or tachycardia will be eliminated from the study. Also, any positive response on the medical history questionnaire will result in elimination.

Subjects will be asked to fast from food for 5 hours and fast from caffeine for 48 hours prior to testing.

Subjects will be pre-tested for hand steadiness, manual dexterity, fine motor coordination, and kinesthetic sense. Following the pre-test, each subject will be given one of three solutions containing 1) 0 mg. caffeine, 2) 2.5 mg./kg. bwt. or 3) 5.0 mg./kg. bwt. caffeine on a double blind format. Following a one (1) hour waiting period, all subjects will be post-tested using the pre-test protocol. The full duration of this study will take approximately one and a half (1.5) hours.

I understand that I will be given 0 mg., 2.5 mg./kg. bwt. and 5.0 mg./kg. bwt. caffeine. Neither I nor the investigator will know which dosage I have been administered during each test but that information can be obtained if necessary.

4. BENEFITS: No direct benefit in the consumption of caffeine may be expected. However, observable physical changes may lead to a change in attitude toward caffeine consumption and a greater awareness of products containing caffeine may ensue.

5. POSSIBLE RISKS: Caffeine ingestion in the quantities described in this study may increase nervousness, irritability and anxiety. Respiration, blood pressure and heart rate may also be magnified. Additionally, nausea may appear if the meal following caffeine consumption includes spicy and/or greasy food. STAY AWAY FROM PIZZA. If you become nauseous or feel ill, you will be retained for observation and transported to the University Health Center.

I recognize that the primary risk is the possibility of experiencing some side effects. Those that have been observed in the past for caffeine consumption include:

Hyperactivity
Upset stomach after eating pizza

If I have any side-effects, I will report them immediately to the investigator, my physician or his/her associates. If side-effects are severe, I may be removed from the study.

6. ALTERNATE PROCEDURES: None

7. SUBJECT ASSURANCES: Whereas no assurance can be made concerning results that may be obtained (because results from investigational studies cannot be predicted with certainty), the principal investigator will take every precaution consistent with best scientific practice.

By signing this consent form, I acknowledge that my participation in this study is voluntary. I also acknowledge that I have not waived any of my legal rights or released this institution from liability for negligence.

I may revoke my consent and withdraw from this study at any time without penalty or loss of benefits. My treatment by, and relations with the investigators and staff at Oklahoma State University, now and in the future, will not be affected in any way if I refuse to participate, or if I enter the program and later withdraw.

Records of this study will be kept confidential with respect to any written or verbal reports making it impossible to identify me individually. All records will be held in a locked file belonging to the PI.

If I have any questions about my rights as a research subject, I may take them to the Office of University Research Services, 001 Life Sciences East. Phone: 744-9991.

8. SIGNATURES:

_____	_____
Date	Research Subject
_____	_____
Date	Witness
_____	_____
Date	Principal Investigator

Any questions regarding the research may be addressed to Bert Jacobson, 102 Colvin Center. Phone: 744-5493. Subjects will receive a copy of this consent form following the study.

APPENDIX B

CAFFEINE RESEARCH QUESTIONNAIRE

CAFFEINE RESEARCH QUESTIONNAIRE

Caffeine Consumption History
Vital Statistics
Medical History

Name_____ Age_____ Weight_____ Height_____

Pre HR:_____ Pre BP:_____

Caffeine Consumption History

Coffee: Cups/day_____avg.

Soft Drinks (Coke, Pepsi, Diet Coke, etc.)/day_____ avg.

Tea: Cups/day_____. Glasses/day_____.

Other: explain_____

How does caffeine affect you?_____

_____

Medical History

Have you ever experienced or know of:

Heart trouble	_____	Stomach disorders	_____
Intestinal disorders	_____	High Blood Press.	_____
High heart rate	_____	Mental/Emotion.dis.	_____

Are you presently on medication?_____. If so explain _____.

Are you suffering from a hangover?_____.

Do you think you are pregnant?_____.

Are you currently taking oral contraceptives?_____.

Are you currently suffering from lack of sleep?_____.

Have you fasted for five hours?_____.

Last meal was _____ hrs. ago.

Last caffeine was consumed _____hrs. ago in the form of _____ _____.

Time of ingestion_____

Time of testing _____

Group _____

APPENDIX C

CAFFEINE RESEARCH QUESTIONNAIRE UPDATE

CAFFEINE RESEARCH QUESTIONNAIRE UPDATE

Caffeine Consumption Update
Vital Statistics
Medical Update

Name_____ Session_____

Pre HR_____ Pre BP _____

Post HR_____ Post HR_____

1. Are you presently on medication? If so, what?_____
2. Are you suffering from a hangover?_____
3. Do you think you are pregnant?_____
4. Are you taking oral contraceptives?_____
5. Are you suffering from lack of sleep?_____
6. Are you currently experiencing a high level of stress?___
   If so, would you prefer to reschedule this session?_____
7. Are you currently experiencing PMS?_____ If so, would you like to reschedule this session?_____
8. Have you suffered an illness since your previous test session?(flu, cold, etc.)If so, what?_____
9. Has your average caffeine consumption per day changed since your previous test session?_____If so, what is it?_____

Have you fasted from food for five hours?_____

Your last meal was _____ hours ago?

Your last caffeine was consumed _____ hrs. ago in the form of _____

Time of ingestion_____

Time of testing_____

Group_____

APPENDIX D

INSTRUCTIONS FOR TESTING

INSTRUCTIONS FOR TESTING

INSTRUCTIONS FOR HAND STEADINESS

1. Hold stylus like you would a pencil.
2. Do not rest fingers or arm on table or brace arm against your body in any way.
3. Hold tip of stylus in hole which has two black stripes above it.
4. You will perform this test for 60 seconds.

INSTRUCTIONS FOR TRACING

1. Hold stylus as you would a pencil.
2. Do not rest or brace fingers or arm on table.
3. Trace the pattern on the board, working from the bottom of the pattern to the top.

INSTRUCTIONS FOR KINESTHESIOMETER

1. Place right arm in the tray.
2. Grasp knob with little finger.
3. Close your eyes.
4. The tester will move your arm to a designated spot and back to the point of origin.
5. With your eyes closed you will attempt to move your arm to the exact the tester did and stop at that position.

INSTRUCTIONS FOR MANUAL DEXTERITY

1. Hold tweezer in a comfortable position.
2. Using the tweezer, pick up a pin from the bowl and place it in the first row, first hole on the left side.
3. Work left to right. When you complete the first row move to the second and complete it as you did the first.
4. Complete the designated number of rows as quickly as possible.

APPENDIX E

RAW DATA RECORD SHEET

RAW DATA RECORD SHEET

Name_____ Session_____

PRE

Hand Steadiness (60 sec)

	Time	Count
1.	_____	_____
2.	_____	_____

Tracing

	Total Time	Off Time	Count
1.	_____	_____	_____
2.	_____	_____	_____

Kinesthesiometer

1. (45) _____
2. (30) _____
3. (60) _____

O'Connor Dexterity

1. _____
2. _____

POST

Hand Steadiness (60 sec)

	Time	Count
1.	_____	_____
2.	_____	_____

Tracing

	Total Time	Off Time	Count
1.	_____	_____	_____
2.	_____	_____	_____

Kinesthesiometer

1. (45) _____
2. (30) _____
3. (60) _____

O'Connor Dexterity

1. _____
2. _____

Perceived Ingestion

None Small Moderate Large

0 10

Place an "x" at the point you feel most indicates your perception of caffeine ingestion.

APPENDIX F

POST-TEST RAW DATA

POST-TEST RAW DATA

0.0 mg./kg. bwt. caffeine

Subject	HST	HSC	TT	TOF	TC	K	D
01	01.5	023	07.7	00.9	13	15	079.9
02	02.5	056	19.8	01.3	13	17	092.5
03	03.6	049	22.9	03.1	26	13	088.5
04	07.2	093	08.9	05.8	19	06	111.1
05	02.0	033	30.7	04.6	25	12	100.9
06	05.6	064	21.1	02.7	20	11	081.8
08	05.1	061	33.6	06.2	31	16	079.0
10	02.1	037	46.5	04.4	16	00	106.2

2.5 mg./kg. bwt. caffeine

01	05.8	080	05.9	01.9	12	25	092.9
02	04.1	053	22.1	01.9	14	12	108.2
03	07.6	114	23.9	04.6	29	11	095.3
04	09.7	118	10.4	03.6	21	01	117.3
05	05.5	075	36.1	05.4	31	07	110.8
06	12.9	146	36.0	06.4	33	17	085.8
08	06.8	080	52.3	05.5	29	15	084.4
10	03.7	057	37.6	03.6	21	11	119.6

POST-TEST DATA CONT.

5.0 mg./kg. bwt. caffeine

Subject	HST	HSC	TT	TOF	TC	K	D
01	13.1	141	08.3	01.4	22	15	118.5
02	16.6	133	23.0	04.5	35	07	111.5
03	06.7	091	44.7	09.0	44	13	159.0
04	12.3	179	11.0	04.2	21	19	119.2
05	17.1	083	40.5	14.6	63	10	151.7
06	05.9	073	23.5	03.0	22	13	075.5
08	10.9	115	55.0	09.0	38	12	081.9
10	03.1	040	39.7	02.2	16	08	120.2

VITA[2]

Krista A. Winter

Candidate for the Degree of

Master of Science

Thesis: THE EFFECTS OF SELECTED DOSES OF CAFFEINE FOLLOWING FASTING ON HAND STEADINESS, TRACING ABILITY, KINESTHETIC SENSE, AND MANUAL DEXTERITY

Major Field: Health, Physical Education and Recreation

Biographical:

Personal Data: Born in Ponca City, Oklahoma, November 30, 1965, the daughter of Dallas and Mary Lou Winter.

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Professional Experience: Substitute teacher, Putnam City, Stillwater, and Waukomis Public School Systems, and Pioneer Area Vocational Technical School in Ponca City, January 1989 to June 1990.