RELATIONSHIPS BETWEEN CAFFEINE INTAKE AND SELF REPORTED ANXIETY

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ABSTRACT

A survey and an experiment were conducted to investigate relationships between caffeine intake and self-reported anxiety. Previous investigations have documented correlations between anxiety levels and levels of caffeine intake, but there has been negligible experimental work in and detailed study of the area.

The experimental results showed that four hundred milligrams of caffeine in coffee, drunk by subjects subjected to a stressful situation, significantly increased self-reported anxiety levels. On the other hand, the same quantity of caffeine in coffee drunk under relatively stress-free conditions, had no significant impact on self-reported anxiety levels.

The survey showed that a third of the respondents reported that a"fairly important" reason for drinking coffee was the belief that coffee has a calming effect. 25% of males and 16% of females reported an increase in coffee consumption when under stress and 62% of males and 56% of females reported increasing their coffee intake during exam times and when they have a heavy workload; presumably times of significant stress.

Contrary to previous findings, there was no significant relationship between high anxiety levels and high caffeine intake, among the survey respondents.

It is concluded from the results that although a significant proportion of people tend to increase their consumption of coffee during times of stress, and believe that coffee will calm them down, it is actually unwise to consume large amounts of caffeine (in any form) when under stress, because this only intensifies the experience of anxiety.

CHAPTER I

INTRODUCTION

Along with alcohol and nicotine, caffeine is one of the most widely consumed psychoactive substances in the world. It is found naturally in coffee seeds ('beans'), tea leaves, kola nuts, cocoa trees and ilex plants (the source of maté). Some common sources of caffeine include cocoa, Coca-Cola, chocolate and many over-the-counter medications and prescription drugs, as well as coffee and tea.

Table I shows the approximate amounts of caffeine found in various common substances. An extremely wide range of caffeine content in coffee and tea has been reported. This reflects:

(1) Different (or unreported) testing methods (Gilbert, 1976).

(2) Different (or unreported) cup sizes.

(3) Different (or unreported) beverage strengths.

(4) Caffeine levels being inferred from beverage consumption rather than precise measurement of the quantities of caffeine consumed.

(5) Method of beverage preparation. Grossier (1978) found that a tea bag or a porous metal container tends to retard some of the caffeine leakage into the cup.

(6) Actual variations in the caffeine concentrations of tea leaves and coffee (Gilbert et. al., 1976).

TABLE 1 Milligrams of Caffeine Found in Some Common Substances.

Unless otherwise specified:

N.B. For beverages, the quantities show the number of milligrams (mgs) per 5 ounce cup.
For drugs and over-the-counter preparations, the number of mgs. per tablet.

Beverages	Mgs. Caffeine
Brewed coffee	100 - 150
Instant coffee	70 - 110
Decaffeinated coffee	1.3 - 5
Tea	60 - 100
Cocoa	36 - 72
Coca-Cola	35 - 55 (12 ounce) (bottle)
Over-the-Counter Medications	
Stimulants (e.g. No-Doz)	100
Analgesics (e.g. Midal)	30 - 66
Cold preparations	30
Prescription Drugs	
APC's (aspirin, phenacetin, caffeine)	32
Cafergot	100
Darvon compound	32
Fiorinal	40
Migral	50
Chocolate	Up to 25 mg/ounce

Figures from Hart & Fisher, 1971, Harvey & Marsh, 1978, Lute, 1978, Greden, 1979.

Americans import and ingest more coffee than inhabitants of any other country, although the Swedes have greater per capita consumption. The majority of caffeine intake for high consumers is from coffee, but up to a quarter of daily quantities is from other sources. (Greden et. al., 1978).

During the twelve months ended 30th of June, 1982, New Zealand imported the quantities of caffeine - containing substances, shown in Table 2.

TABLE 2 New Zealand Imports of Caffeine-Containing Substances.

Substance	Quantity (kilograms)
Coffee	7,336,500
Tea	6,377,234
Maté	1,910
Cocoa beans (and derivatives)	5,647,388
Chocolate (and other food preparations containing cocoa)	88,087

(Figures from the New Zealand Government Department of Statistics).

The per capita consumption of common caffeine-containing substances in New Zealand, is not very high. New Zealanders, over the age of fifteen, consumed only 90 mg. of coffee per day (equivalent to a weak cup), 80 mg. of tea per day (also equivalent to one weak cup) and 70 mg. of cocoa per day, during the twelve months ended 30th of June, 1982. This would amount to an average per capita consumpt-

ion of two to three caffeine-containing drinks daily.

More than 250 mg. of caffeine is considered by pharmacologists to be a 'large dose,' (Truitt, 1971), but this amount is easily exceeded. For example, three cups of coffee, two over-the-counter headache tablets and a chocolate bar, in one morning, equal approximately 450 mg. of caffeine. The available evidence suggests that there may be considerable risk to the health of an adult of average weight, who consumes upward of 600 mg. per day (Gilbert, 1976), yet there is a wide range of combinations of substances that could be equivalent to that amount of caffeine.

Few reliable figures are available, but a conservative estimate (Greden et. al., 1978) is that twenty to thirty percent of adult Americans function with a daily caffeine intake of greater than 500 mg. per day. Ten percent may consume more than 1,000 mg. per day! Men, on average, consume more caffeine per day than women (Svensson et. al., 1980).

Historically, coffee has been described both as 'the devil's brew' and 'the nectar of the gods.' (Greden, 1979). Virtually wherever coffee has been introduced, at some time or another, governmental or religious leaders have attempted to ban it; in 1732, Bach was so stirred by Frederick the Great's suggested ban, that he composed his 'Coffee Cantata'! On the other hand, among Moslem Turks and Arabs, coffee has for centuries, been a popular substitute for alcohol, which is forbidden them by their religion.

Coffee is thought to have come to Europe via the baggage of the Turkish army, which was besieging Vienna in the seventeenth century. The story goes that it was first noticed by a Polish officer looting the camp left by the fleeing Turks, and he subsequently set up the first coffee shop in Vienna. From there the habit spread rapidly across Europe; first the French and then the Dutch producing coffee in their colonies for the export trade.

The history of tea drinking has been an equally controversial one. One Chinese mystic of the Tang dynasty wrote that:

> 'The first cup of tea moistens my lips and throat. The second shatters my loneliness. The third causes the wrongs of life to fade gently from my recollection. The fourth purifies my soul. The fifth lifts me to the realms of the unwinking gods.'

In the American colonies, tea became a symbol of British political dominance. To support a boycott against British tea, Benjamin Rush, a signer of the Declaration of Independence, claimed that tea, when taken too strong, was a slow poison, caused sterility, nervousness, irritability, weakness and effeminate characteristics for men, and was 'hurtful ... to the female constitution.' Following the Boston Tea Party (January 27th, 1774), the London Public Advertiser reported that ... 'four or five hundred chests of tea

have so contaminated the water in Boston harbour, that the fish may have contracted a disorder not unlike the nervous complaints of the body.'

Despite the numerous historical reports that coffee and tea can have negative effects on consumers, it is only very recently that a more systematic approach to studying these alleged effects has been adopted. Because coffee is the most commonly consumed caffeine-containing substance among high caffeine users (Greden et. al., 1978), most of the research into the effects of caffeine has concentrated on coffee rather than on tea.

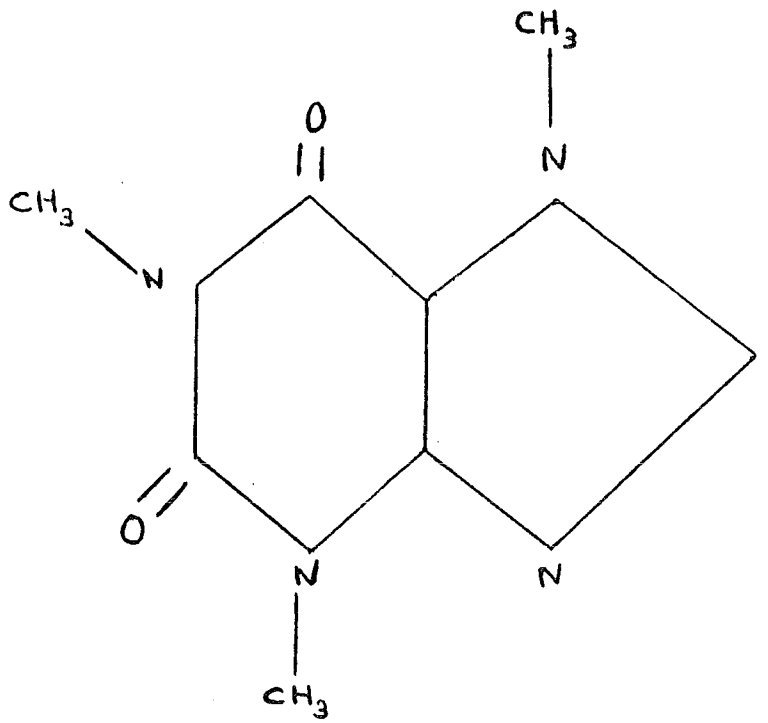
CHAPTER II

REVIEW OF THE LITERATURE

A) THE EFFECTS OF CAFFEINE

Caffeine is an alkaloid with a xanthine nucleus; pharmacologically, it is known as 1-, 3-, 7- trimethyl-xanthine. The molecular structure of caffeine is illustrated in Figure 1.

FIGURE 1: The Molecular Structure of Caffeine.



Some substances contain other xanthines as well as caffeine. For example, tea and chocolate contain theobramine (2 mgs. per cup and 25 mgs. per ounce, respectively). Tea also contains theophylline (1 mg. per cup) (Burg, 1975; Martinek, 1955). The xanthine family of substances all have stimulant properties.

Caffeine is freely and equally distributed throughout the total body water and is found in almost equal concentrations in all parts of the body, including the brain. (Goldstein et. al., 1974). Peak levels of caffeine in blood plasma occur approximately 30 to 45 minutes after oral ingestion and pharmacological actions can usually be noticed by this time. After intake, the plasma half-life of caffeine (the amount of time it takes to metabolize half of the caffeine in the bloodstream) is slightly greater than two and a half hours (Greden, 1979).

(a) Effects on the Central Nervous System

Caffeine is a powerful central nervous system stimulant, mainly affecting the cerebral cortex, the thalamus, the vasomotor and respiratory centres and the thermal regulatory mechanism (Reimann, 1967). The cerebral cortex and medullary centres are affected first, followed by the brainstem. The spinal cord becomes stimulated only after extremely high doses (2 - 5 grams) (Goldstein et. al., 1965; Ritchie, 1970; Truitt, 1971). With very high doses of caffeine (greater than 10 gms), convulsions and death may occur, however the convulsive dose is so high (approximately equal to 100 cups of coffee) that death from caffeine is highly unlikely.

The predominant and earliest effects on the cerebral cortex occur with doses of caffeine as little as 100-150 mg. (Martinek, 1955; Burg, 1975) and include rapid, clear thinking, enhanced intellectual alertness, wakefulness and increased memory span. Greden (1974) notes that these are

all valued commodities in an achievement-oriented society.

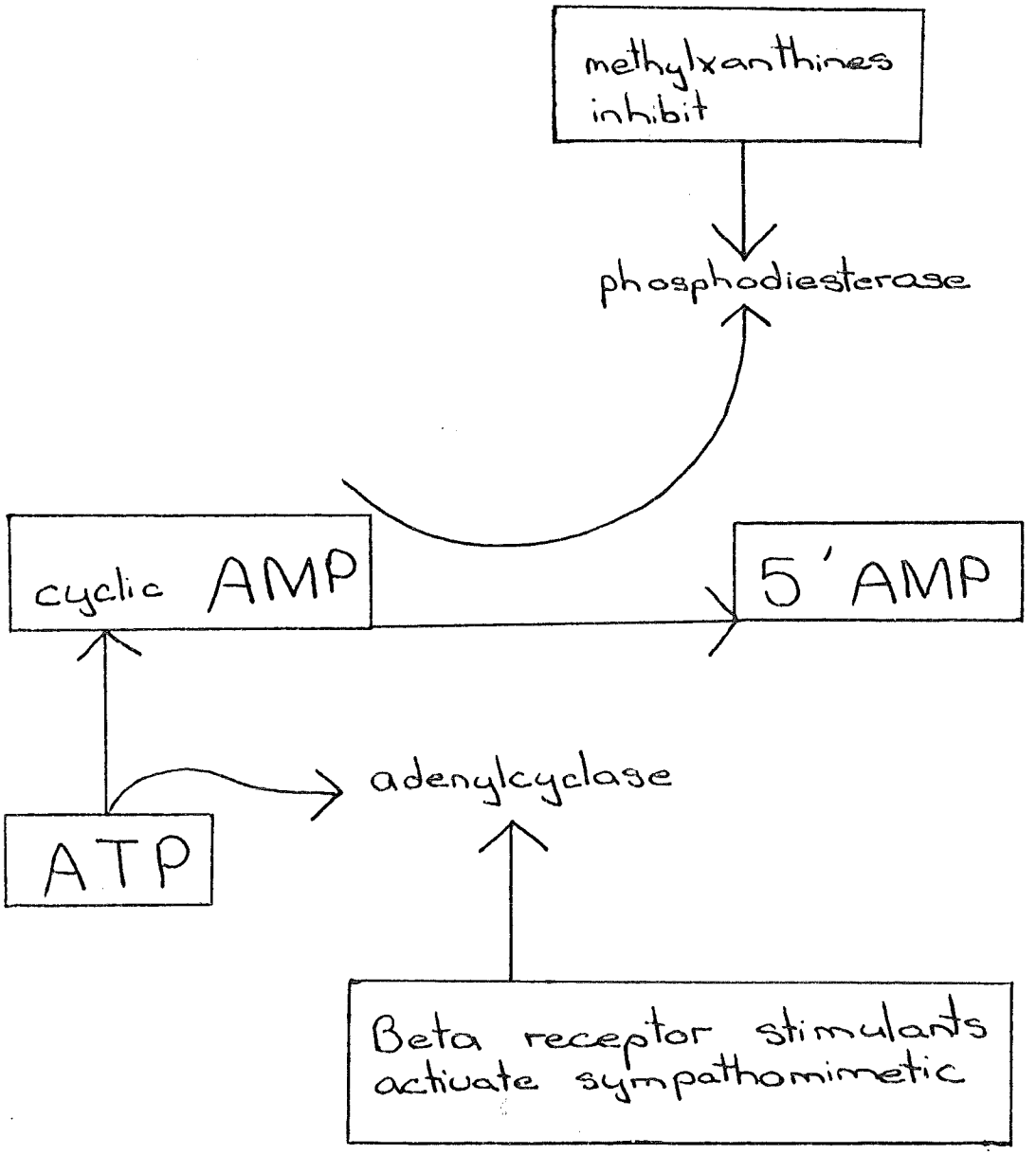
So it can be seen that small doses of caffeine could be interpreted as having BENEFICIAL effects.

Although caffeine is a stimulant, it has a paradoxical depressive effect on some functions. For example, caffeine directly suppresses the activity of the thalamic synchronizing elements (Eysenck, 1963), consequently, increased intellectual alertness for prolonged periods may be sustained without the disruption of co-ordinated intellectual or motor activity, that usually follows alteration of the medulla. Also, caffeine, paradoxically may reduce hyperactive behaviour in some children. (Harvey and Marsh, 1978; Arnold et. al., 1978). It also depresses mouse locomotion at very low concentrations, but stimulates it at higher ones. (Snyder et. al., 1981). Such mixed effects are not an unusual occurrence with psychoactive drugs.

(b) Pharmacological Effects of Caffeine

Caffeine inhibits phosphodiesterase, which ordinarily breaks down cyclic adenosine -3', 5'- monophosphate (cyclic AMP) to its inactive end-product, 5-AMP, thus increasing the levels of cyclic AMP (Vernikos-Danellis and Harris, 1968; Sattin, 1971; Kebabian et. al., 1972; Takenoshita et. al., 1973; Waldeck, 1975). (See Fig. 2).

FIGURE 2 Pharmacological Actions of Methylxanthines



This process has been used to explain caffeine's stimulatory effect on the central nervous system; the resultant increase in cyclic AMP leads to increased glucose production within cells and thus makes available more energy to allow higher rates of cellular activity. So, arousal effects probably result mainly from caffeine-induced augmentation of cellular metabolism rates (Butcher and Sutherland, 1962; Breckenridge and Bray, 1970; Greengard and Costa, 1970; Hoffer et. al., 1970; Waldeck, 1973; Ritchie, 1975, Julien, 1981).

Nevertheless, Snyder (1981) has criticized the theory that the inhibition of phosphodiesterase, by caffeine, is a reasonable explanation for caffeine's arousing effects, in the following ways:

a) Caffeine concentrations needed to inhibit phosphodiesterase are much higher than those that produce stimulation.

b) Concentrations of caffeine which elicit behavioural and therapeutic effects produce little or no phosphodiesterase inhibition in the brain.

c) Other compounds that block phosphodiesterase activity are not stimulants.

It is therefore possible that this theory may only explain arousal when high doses of caffeine are consumed.

Snyder (1981) has presented new evidence indicating that caffeine affects behaviour by countering the effects of

adenosine. Adenosine normally depresses nerve cell firing in many areas of the brain. It apparently does this by inhibiting the release of neurotransmitters (Sattin, 1971).

Like many other agents that affect nerve firing, adenosine must first bind to specific receptors on neuronal membranes. Bruns et. al. (1981) have shown that caffeine shows selective affinity for adenosine receptors in the brain, and the affinity of various caffeine analogues for these receptors parallels behavioural effects in animals. Snyder et. al. (1981) propose that caffeine, which is structurally related to adenosine, is able to bind to these receptors, preventing adenosine from attaching there and allowing the neurons to fire more readily than they otherwise would. Evidence is provided that the concentration of caffeine demonstrated to block adenosine receptors is closer to the 'physiological' range than the concentration demonstrated to inhibit phosphodiesterase.

Snyder et. al. (1981) found apparent exceptions to the general correlation between adenosine receptor binding and stimulation, with other xanthines, however. One of these was a compound called 3 - isobutyl - 1 - methylxanthine (IBMX) which bound very well but depressed the social interaction of mice. However Snyder et. al. found that the stimulant capabilities of IBMX were revealed by an interaction with the adenosine mimic. Likewise, Berkowitz (1970, 1971) found that while caffeine alone was unable to produce hyperthermia, it did so in combination with a monoamine oxidase inhibitor. The above findings point to the

importance of considering interactions between pharmacological systems when looking into the effects of psychoactive substances.

(c) Physiological and Sensorimotor Effects

Caffeine has a direct, peripheral, contractile effect on the striated muscle (Lutz, 1978). It is conceivable (Lutz, 1978) that the increase in striated muscle contractility interferes with the microcirculation to sensory nerve endings, leading to increased irritability of these structures, responsible for the dysphoric sensation of muscular restlessness. Masland (1947) showed that a high level of acetylcholine at the nerve ending, or increased irritability of this structure, could be causative.

On the other hand, caffeine also has physiologically depressive effects, which include the constriction of cerebral blood vessels (Reimann, 1967) and the direct depression and relaxation of the smooth muscles, including the bronchiales, blood vessels and intestines (Ritchie, 1970; Truitt, 1970).

The findings of research looking into the sensorimotor effects of up to 300 mg. of caffeine, are summarized in Table 3.

TABLE 3 Effects of 100-300 mg. of Caffeine on Sensorimotor Functions.

Effects of Caffeine	Researchers
Improved stimulus discrimination	Craig et. al. (1979)
Increased attentional performance ('vigilance')	Clubley et. al. (1979) Elkins et. al. (1981)
Improved reaction time	Clubley et. al. (1979)
Beneficial effect on hand steadiness	Strongin & Winsor (1935)
Increased tapping speed	Weiss and Laties (1962) Clubley et. al. (1979)
Increased typing speed and decreased number of errors.	Hollingworth (1912)
Decreased reaction time	Gilliland and Nelson (1939), Nash (1962) Franks et. al. (1975), Elkins et. al. (1981).
Increased motor activity and 'jumpiness'	Lienert and Huber (1966), Ritchie (1970), Elkins et. al. (1981)
Impairment of hand steadiness	Hollingworth (1912), Gilliland and Nelson (1939), Thornton (1939), Barmack (1940), Adler et. al. (1950), Nash (1962).
Significant decrease in standing steadiness	Franks et. al. (1975).

As can be seen from the summary, there is considerable variability of effects and caffeine is not uniformly beneficial in 'therapeutic' doses. We cannot assume, either, that the predominant effects of caffeine are exerted uniformly over the course of its action.

With doses increasing beyond 300 mg., side effects occur, which are extensions of caffeine's primary effects. These effects are easily explained by caffeine's known, stimulative, central nervous system pharmacological effects and peripheral pharmacological actions and include delayed sleep onset (Colton et. al., 1968), more frequent night-time awakenings (Greden et. al., 1980), psychomotor agitation (Elkins et. al., 1981), increased heart rate with occasional arrhythmias and minor increases or decreases in blood pressure. (Gilliland and Nelson, 1939). Once any stimulant is metabolized, there follows a period of behavioural and central nervous system depression, which must be considered when caffeine is ingested to maintain wakefulness or performance for prolonged periods.

(d) Subjective Effects of Caffeine

In small doses, caffeine has been reported to have beneficial effects on arousal and mood. Delayed experience of tiredness and drowiness (Ritchie, 1970; Lienert and Huber, 1966) and subjective arousal (Barmack, 1940; Goldstein et. al., 1965) have been reported after the ingestion of 150-300 mg. of caffeine. Clubley et. al. (1979) reported subjective arousal with as little as 75 mg. of caffeine; a dose where effects on performance tests were not significant. The

intake of 65-100 mg. of caffeine results in slight mood improvement (Cameron et. al., 1967), including increased extraversion and calmness (Svensson et. al., 1980). On the other hand caffeine doses of 300-600 mg. have been reported to cause anxiety, nervousness, irritability and agitation (Julien, 1981). Some of the earliest reports of caffeine's effects have therefore been substantiated.

(e) Toxic Effects of Caffeine

There exists a threshold beyond which the effects of methylxanthines on the central nervous system become 'toxic.' This threshold varies widely in different individuals, according to their level of tolerance to this class of drugs (McManamy and Schube, 1936; Goldstein et. al., 1965; Ritchie, 1970), but is usually greater than 700 mg. The symptoms of acute intoxication by caffeine include sensory disturbances, such as ringing in the ears, visual flashes of light and hyperesthesias (Ritchie, 1970), as well as protracted delirium in some cases (Erhardt, 1929; McManamy and Schube, 1936; Reimann, 1967; Ritchie, 1970). McManamy and Schube published the first reported case of psychosis precipitated by caffeine in 1936.

More recently, Stillner (1978) described the effects of 1070 mg. of caffeine, consumed by a competitor in the 1977 Iditarod Trail International Sled Dog Race; these included tremor, impaired memory, altered levels of consciousness, vertigo, pronounced anxiety and sensory disturbances, including visual illusions and hallucinations.

Excessive coffee and tea drinking have also been blamed for a huge list of medical disorders, including diarrhoea, epigastric pain, peptic ulcer, edema, coronary heart disease, diabetes, stroke, cancers of the urinary tract and gout (Paul et. al., 1963; Reimann, 1967; Flynn, 1970; Silver, 1971; Ross, 1971; Heyden et. al., 1978).

(f) Summary of the Acute Effects of Caffeine

In summary, caffeine is a stimulant which pharmacologically affects most physiological systems directly. In small doses (up to 300 mg.) it usually has beneficial effects on intellectual functions, sensorimotor abilities, arousal and mood. In doses of 300 mg. or more, however, caffeine may have excessive stimulant effects on the cardiovascular and gastro-intestinal systems and on mood and behaviour. The intake of 700 mg. or more of caffeine may cause toxic symptoms which include major sensory, behavioural and mood disturbances.

These effects are not uniformly experienced and vary according to each individual's history of caffeine intake. Long term, heavy coffee and tea drinking leads to the development of tolerance to some of the effects of caffeine.

B/ CAFFEINISM

Prolonged ingestion of large amounts of caffeine has been found to produce a condition of chronic toxicity, with a remarkably consistent symptomatology, known as 'caffeinism.' Such a condition has long been recognized as can be seen from these early descriptions:

> (The typical coffee drinker)... 'is tremulous, loses his self-command, is subject to fits of agitation and depression, and has a haggard appearance ... As with other agents, a renewed dose of the poison gives temporary relief, but at the cost of future misery.'
>
> (Siegerist, 1943).

> 'Every mother and father should forbid their children to take any coffee, unless they wish to see them shrivelled up, bony and withered little things, before they are twenty years old.'
>
> (Dr. John Harvey Kellog, 1800s).

Symptoms of caffeinism are best understood as dose-related extensions of caffeine's expected pharmacological actions. There are five main diagnostic areas: The development of tolerance, withdrawal symptoms, chronic anxiety, depression and the 'Restless Legs Syndrome.'

(a) Development of Tolerance

As little as 500 mg. of caffeine daily (five cups of coffee) results in the development of tolerance and of habituation, with an accompanying, gradual escalation of daily intake levels. (Goldstein, 1964; Colton et. al., 1968; Goldstein and Kaizer, 1969; Greden, 1980). Eventually, for chronic users, a daily dose like 900 mg. may seem routine, but if a non-coffee user ingested this same amount in one day, the clinical and pharmacological consequences would be marked and readily apparent.

An acquired tolerance to two actions of caffeine has been demonstrated unequivocally and these are to diuresis (Eddy and Downs, 1928) and parotid gland secretion i.e. enhanced salivary flow (Winsor and Strongin, 1933). Although acquired tolerance to the control nervous system effects of caffeine has not been demonstrated convincingly in humans (Goldstein et. al., 1965), the sleep-disturbing properties are clearly more marked among non users than among habitual coffee-drinkers (Goldstein, 1964). Colton et. al. (1968) found that, when given 150 mg. of caffeine in coffee at bedtime, only non coffee drinkers reported disturbances in sleep patterns.

It has been suggested that tolerance may develop to the mood-altering properties of caffeine, such as nervousness and anxiety. However, there is no real evidence for such a suggestion. On the contrary, the evidence is that individuals with caffeinism can be recognised by their chronic anxiety.

(b) Withdrawal Symptoms

Abstinence from coffee or tea produces withdrawal symptoms among individuals suffering from caffeinism. The major symptom is a generalized and throbbing headache, which has been clinically observed (Greden, 1974), experimentally induced (Driesbach and Pfeiffer, 1943) and epidemiologically documented to occur in natural settings (Goldstein et. al., 1969). Caffeine-withdrawal headache occurs in approximately 25% of high consumers, if they forgo their daily caffeine intake (Greden et. al., 1980) and its onset occurs within 18-24 hours. Caffeine-withdrawal headaches may occur with

only a reduction of intake. Greden et. al. (1980) found that three people, who normally drank 15 cups a day, experienced these headaches when drinking less during week-ends.

Other caffeine-withdrawal symptoms include drowsiness, lethargy, yawning, irritability (Goldstein et. al., 1969), nervousness, depression (Greden et. al., 1980) and anxiety (White et. al., 1980). Laboratory and clinical studies show that withdrawal symptoms can be relieved by the administration of caffeine (Driesbach and Pfeiffer, 1943; Goldstein, 1964; Goldstein et. al., 1969, Greden, 1974; Greden et. al., 1980) and that headaches can be relieved by preparations containing caffeine, but not by analgesics, such as aspirin, alone. Greden (1979) has hypothesized that many individuals who are plagued with recurrent 'tension headaches' might actually be suffering from repetitive episodes of caffeine withdrawal. The short half-life of caffeine and the development of tolerance to many of its effects might be expected to lead, during chronic, heavy usage, to a mixture of those symptoms produced by its direct action with those that are characteristic of its withdrawal syndrome (Ritchie, 1970).

(c) Chronic Anxiety

Frequent, high caffeine consumption has effects on mood that closely resemble a condition of chronic anxiety. (Greden, 1974; Molde, 1975; Greden, 1979; Eysenck and Folkard, 1980). The somatic manifestations are shown in Table 4 and they include agitation, irritability, diuresis, tremulousness, light-headedness, rapid heart beat, upset

stomach, muscle twitchings, rapid breathing and cardiac palpitations; seldom do all of these occur together, however.

In a thorough and extensive study, Greden et. al. (1980) obtained total caffeine intake amounts for 205 survey respondents and divided the respondents into two groups. Those who reported having experienced signs of caffeinism, specifically, caffeine-withdrawal headache, had:

1. significantly higher state and trait anxiety scores on the State-Trait Anxiety Inventory,
2. a greater than 50% higher total caffeine intake,
3. a mean caffeine intake of 616 mg. per day,
4. and significantly greater use of anti-anxiety agents.

It is quite possible, however, that coffee does not increase anxiety but that high consumers were anxious before beginning high caffeine consumption, and that anxious people tend to drink more coffee. Another possibility is that coffee intensifies an existing anxiety state.

TABLE 4: Physiological Correlates of Anxiety

Effects of Caffeine.

Effects of Caffeine	Researchers
Increased heart rate	Ritchie (1970), Truitt (1970).
Increased blood pressure	Gilliland and Nelson (1939), Ritchie (1970), Truitt (1970)
Faster and greater galvonomic skin response to conditioned stimulus.	Switzer (1935).
10% increase in basal metabolic rate.	Ritchie (1970), Truitt (1970).
Respiratory acceleration	Ritchie (1970), Truitt (1970).
Strengthens contraction of skeletal muscles.	Truitt (1970)
Diuretic effect on the kidney.	Ritchie (1970)

(d) Depression

There is some evidence to suggest that chronic, high caffeine intake also results in significantly more depression. Greden et. al. (1977) found that when eighty-three patients were subdivided, on the basis of their total caffeine consumption (determined by a computer summation from all sources of caffeine intake), a significantly greater proportion of high caffeine consumers reported elevated scores on the Beck Self-Rating Depression Scale. Only 17% of the 'low' sub group (less than 250 mg. per day) had a Beck Depression score of greater than 23 (indicating significant depression), compared with 34% of the 'moderate' group (250-749 mg. per day) and 50% of the 'high' consumers (greater than 750 mg. per day). Furthermore, the depression scores increased proportionately with caffeine intake. Further evidence is provided by Greden et. al. (1980) who found that those who had experienced caffeine-withdrawal headache had elevated Beck Depression Scores.

Just as an increase in the consumption of caffeine-containing substances may be a response to anxiety, high caffeine usage may be a response to depression. Neil et. al. (1978) point out several studies which provide indirect evidence that Unipolar II Depressives may be more prone to use caffeine in high doses as they become depressed. Also, Kupfer et. al. (1975) found that depressed people used more caffeine as they became depressed.

Individuals may 'self-medicate' themselves with caffeine when depressed, with caffeine producing its own physiological stimulation, or secondarily, modifying

affective states by increasing circulating catecholamine levels (Levi, 1967). Greden (1979) provides evidence for this possibility, from his finding that 22% of high caffeine consumers reported that caffeine made them feel 'less depressed.'

(e) The Restless Legs Syndrome

'Wherefore to some, when being abed they betake themselves to sleep, presently in the Arms and Leggs, Leapings and Contractions of the Tendons, and so great a Restlessness and Tossings of their Members ensue, that the diseased are no more able to sleep, than if they were in a place of the greatest Torture.'

(Thomas Willis, neurologist, 1685)

The above clinical description of, what is now known as the 'Restless Legs Syndrome,' was written during the time period when coffee and tea were introduced to the British Isles. The syndrome involves the experience of unpleasant 'creeping' sensations in the lower legs and sometimes in the arms, shoulders and thighs. The discomfort occurs mainly at rest and elicits an irresistible need to move the limbs. The Restless Legs Syndrome is closely associated with severe insomnia and affects 5% of the normal population (Ekbom, 1945), occuring particularly during periods of stress.

Lutz (1978) claims that there is enough evidence to suggest that caffeine is the major etiological factor in the Restless Legs Syndrome, and that anxiety, while modifying the subjective experience of the dysphoric sensation of restless

legs, is not a causative factor.

C/ METHODOLOGICAL PROBLEMS OF RESEARCH INTO THE EFFECTS OF CAFFEINE.

The major methodological problems with research investigating the acute and chronic effects of caffeine, result from the fact that most of the reported effects have been observed clinically or inferred from survey data, and there has been very little experimental research. As a result, there is little evidence for a causal link between the huge range of reported effects and caffeine intake.

The deficit in experimental work is particularly noticeable with regard to the acute effects of caffeine. This is especially true of two areas of research. Firstly, the claims that high, prolonged caffeine intake can cause a range of medical disorders including serious conditions such as cancer, are highly dubious. There is no satisfactory evidence that any of these disorders is causally associated with caffeine intake. Secondly, the claims that caffeine can make people anxious result mainly from inferences from survey data and clinical reports of a causal link in a particular direction, but it is equally likely that there is a causal link in the opposite direction and that anxious people drink more coffee. Where a causal relationship between caffeine intake and anxiety has been demonstrated experimentally (Svensson, et. al., 1980), the findings are not significant and there tend to be substantial individual differences of effects.

The small subject samples evident in the experimental, survey and clinical data, also tend to reduce the reliability of the reports of caffeine effects. There are often single case-studies presented as evidence of effects which are then generalized. Many of the subjects were psychiatric inpatients again limiting the generalizability of reported caffeine effects because of possible caffeine interactions with other drugs. Another problem is the failure of researchers to distinguish between caffeine intake spread out over the day, and intake within a short period of time, when looking at daily levels of caffeine intake and their effects.

Many researchers have failed to note and take account of their subjects' histories of caffeine intake. This is crucial when looking into the acute effects of caffeine and may explain the variety of findings with subjects given up to 300 mg. of caffeine; possibly these amounts had no effect on some people who had developed tolerance to caffeine effects. Also, people develop tolerance to some effects of caffeine, but not others.

Little information is provided about other important characteristics of subjects, such as their intake of other psychoactive substances. Any findings of caffeine effects resulting from chronic intake, are complicated by the fact that those who are high caffeine consumers also use significantly more anti-anxiety agents, smoke more, and drink more alcohol.

D/ AREAS FOR FURTHER RESEARCH

Further research looking into the effects of caffeine is necessary, as many of the current claims of caffeine effects are of dubious reliability. This is particularly true of reported acute effects. More experimental replication of existing findings with larger subject samples is important, along with more information regarding subjects' ingestion of a variety of psychoactive substances and their histories of caffeine intake. As studies have generally been 'one offs' and have looked at varying amounts of caffeine, it is important that experimental replications use the same levels of caffeine and assess the same effects using the same testing and measurement methods.

The evidence for chronic caffeine effects, or 'caffeinism' is more convincing, despite its clinical nature. This is because it is relatively easy to discern the presence of withdrawal symptoms when high caffeine consumers are asked to forgo their caffeine intake and it is relatively easy to discern their disappearance with a subsequent return to caffeine intake.

The poverty of data available to support the claims of caffeine effects on mood, is particularly evident. One of the aims of the present investigation was to look at the effects of caffeine on mood. Of particular interest were its effects on anxiety, which have often been reported, but with little or no experimental evidence.

CHAPTER III

NATURE AND SCOPE OF THE INVESTIGATION

Reports that high coffee drinkers are significantly more anxious than moderate to low coffee drinkers have frequently ignored the possibility that anxious people drink more coffee than relatively non-anxious people. Goldstein and Kaizer (1969) found that ten percent of high caffeine users believed that coffee 'makes you relax' and seven percent believed that coffee 'calms the nerves.'

Another possibility is that caffeine intensifies existing anxiety but has little or no effect on relatively non-anxious people. Two well-designed and executed studies have come to this conclusion from their findings that there is an interaction between stress and caffeine intake.

Henry and Stephens (1970) undertook an animal study in which there were four groups of mice, as follows:

1. isolated mice.
2. mice living peacefully together.
3. 'stressed' mice, living together, who fought and were hypertensive.
4. 'stressed' mice given water instead of coffee.

The mice in the first three groups were given 4 cc of coffee per 30 gm. weight per day; a caffeine dose estimated to be three times the amount a heavy coffee-drinking human would consume.

The results showed that isolated mice had no significant increase in blood pressure and a moderate incidence of myocardial fibrosis (scar tissue formation over a wound in the outer layer of the heart). On the other hand, the mice which were previously living peacefully together started fighting aggressively with one another, and demonstrated a sharp increase in blood pressure along with modest development of fibrosis. 'Stressed' mice, which were living together, demonstrated an even further blood pressure increase and a higher incidence of fibrosis than all the groups, including the control group.

The authors concluded that coffee, of itself, does not affect blood pressure or contribute significantly to coronary disease, but, in addition to the stimulus of community life, it does. Coffee increases the intensity of reactions, including excitability.

Cobb (1974) carried out a long-term study of automobile factory workers from two factories which closed and from four factories where there was no threat of closure. A standardized set of physiological, psychological, social and economic data was obtained during the time of anticipation of job termination, shortly after the closing, and six, twelve and twenty-four months later. With respect to 43 variables the two groups of 100 terminees and 74 controls were virtually homogenous.

Cobb found that the mean rate of norepinephrine excretion was significantly elevated for those whose jobs

ended, before termination and for twelve months afterwards (see Figure 3). Of particular interest, however, was the finding that when automobile workers consumed coffee during the time of anticipation and of termination, their increase in norepinephrine output was significantly greater ($p < 0.01$) than that of non-coffee-drinking workers who lost their jobs. There was no coffee effect at all among those who were in no danger of losing their jobs and for all of the terminees at twenty-four months, but for the stressful period of anticipation plus termination there was a highly significant difference and for six and twelve months later, there was a modest, non-significant difference. Figure 4 shows quite clearly the interaction effect between environmental stress and coffee on norepinephrine excretion.

Cobb's research demonstrates the importance of considering interactions with the environment when looking at physiological processes. It has previously been shown (De Schraepdryver, 1959; Leanderson and Levi, 1967; Levi, 1967; Bellet et. al., 1969; Berkowitz et. al., 1970; Corrodi et. al., 1972) that caffeine-containing beverages increase the excretion of catecholamines. Cobb explains his findings by putting forward the possibility that caffeine intake at stressful times, could accentuate, perhaps to a critical point, a neurotransmitter response cycle that enhances already-developing clinical symptoms.

The present investigation consisted of a controlled, laboratory experiment and a survey designed to examine relationships between self-reported anxiety and caffeine-intake.

FIGURE 3: Norepinephrine excretion rate in y/min. of the study. (Cobb, 1956).

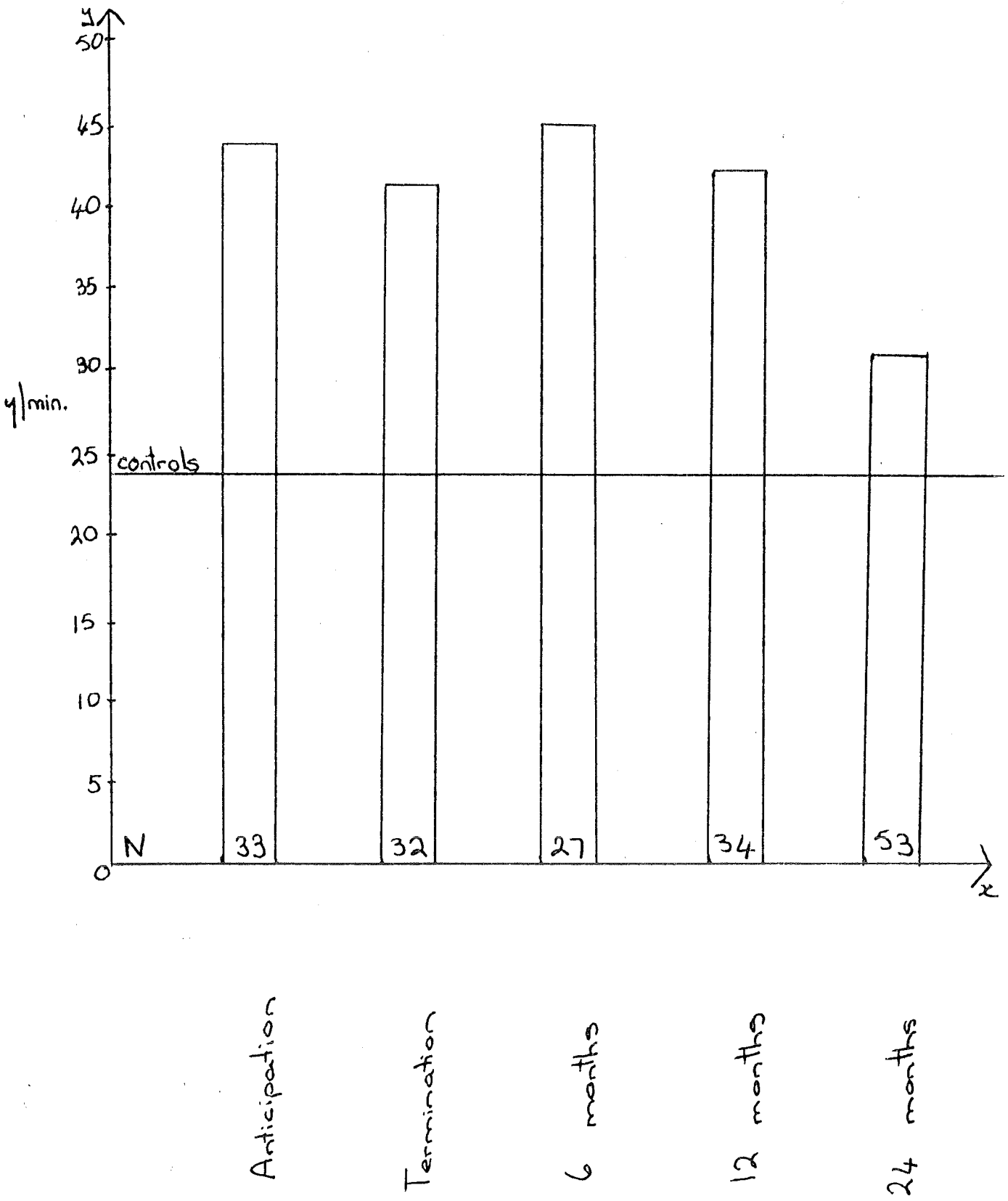
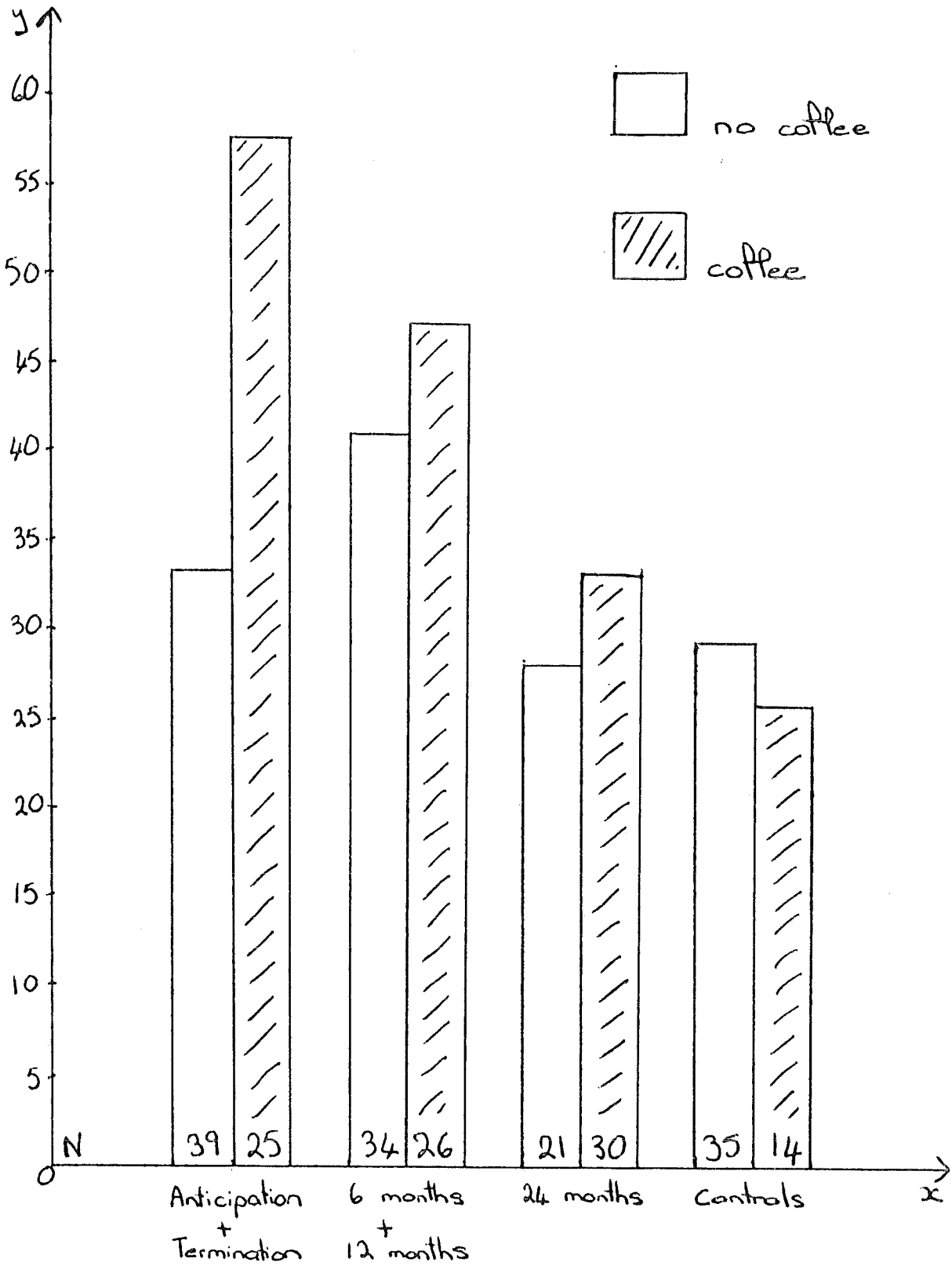


FIGURE 4: Physiological Changes in Men Whose Jobs were Terminated.



CHAPTER IV

THE EXPERIMENT

A/ AIMS, SUBJECTS AND PROCEDURES

(a) Aims of the Experiment

The major aim of the experiment was to test the hypothesis that caffeine increases self-reported anxiety levels in stressed, but not in non-stressed, subjects. A secondary aim was to identify any other effects of caffeine on mood.

(b) The Subjects

The subjects were 47 first and second year psychology students, at the University of Canterbury. There were nineteen males ranging between the ages of 18 and 35 (mean age was 20), and 28 females, ranging in age from 18 to 46 (mean age was 22). The overall mean age was 21.

This sample was obviously quite different from that of Cobb's study, as his sample population consisted of married, blue collar, American, factory workers, who had on average completed tenth grade (fourth form) in school and ranged in age from 35 to 62 (mean age was 49).

(c) Assignment to Groups

The subjects were randomly assigned to each of four groups, which were:

1. high caffeine and stressed conditions.
2. high caffeine and non-stressed conditions.
3. low caffeine and stressed conditions.
4. low caffeine and non-stressed conditions.

The four experimental conditions, combining to form each group, are described below:

i) High Caffeine Condition. Four hundred milligrams was chosen as the high caffeine dose, because this level is generally agreed to be greater than the 'therapeutic' level, and a dose where negative mood effects have been reported.

To Greggs Instant Decaffeinated coffee (containing 5 mgs. of caffeine per 100 gms. of coffee) was added 400 mgs. of caffeine per gram of instant coffee. To control for differences in subjects' weights, these were rounded to the nearest kilogram and grouped, as shown in Table 5.

TABLE 5: Weights of Coffee Powder For Subjects' Weight Groupings.

Weight of Subject (to nearest kilogram)	Weight of coffee powder (grams)
50 - 54	0.85
55 - 59	0.93
60 - 64	1.01
65 - 69	1.09
70 - 74	1.17
75 - 79	1.25
80 - 84	1.33
85 - 90	1.41
90 - 94	1.50

The appropriate weight of the coffee powder was then measured out for each individual, using a Mettler H30 Electric Balance. The dose equalled 6.5 milligrams per kilogram, which is equivalent to four cups of strong instant coffee, for an average 64 kg. person.

To reduce the highly unpleasant taste of the high caffeine beverage, all of the subjects in the high caffeine condition received a teaspoon of sugar added to the coffee mixture. The sugar also served to disguise the presence of the caffeine (which appeared as white flecks when mixed with the coffee powder). Subjects were able to add milk to their coffee if they wished.

ii) Low Caffeine Condition. The subjects in the low caffeine condition each received Greggs Instant Decaffeinated coffee only, with no caffeine added. They received 22-23 mg. of caffeine each. To control for the still-unpleasant, taste of the highly caffeinated coffee, the subjects in the low caffeine condition each received three 5.6 ml. teaspoons of coffee, and they were not allowed to add sugar or milk. It was presumed that very strong coffee, without the usual addition of milk and/or sugar according to individual preference, would taste unpleasant.

The subjects in both of the conditions drank their coffee from identical, 305 ml., heavy, plastic mugs.

iii) Stressed Condition Those in the stressed condition were given the Canterbury Reasoning Test (Shouksmith 1964); a test, designed and developed within New Zealand, to assess high level reasoning ability. The Canterbury Reasoning Test

is shown in Appendix 1, (page 97). The subjects were given the following instructions:

'This form is an I.Q. test which should be completed within twenty-five minutes. I want you to do as well as you can. Before you leave, you will swap forms with each other and score cards will be issued so the tests can be marked. One of the things that is of interest is the extent to which people can cope with any possible impairing effects upon performance. People with higher I.Q.s tend to be less likely to be affected by any potential effects of coffee drinking.'

The twenty-five minute time limit for completing the test meant that the subjects were experiencing the peak effects of the caffeine immediately following test completion. Caffeine has its maximum effect thirty to forty-five minutes after ingestion (Greden, 1979). Also with the marking of the test at the end of the experiment, it was expected that any apprehension regarding test performance would carry through following the completion of the test.

Anxiety over impending failure is considered to be a very strong, acquired drive in achievement-oriented cultures (Kardiner, 1950) and this would be expected to be particularly true for university students, who, it can reasonably be assumed, have a strong competitive drive. Many studies support the validity of using performance tests to induce anxiety in experimental situations. (for example, O. Neil, Spielberger and Hansen, 1969).

The Canterbury Reasoning Test, along with the accompanying instructional set, was expected to be particularly anxiety-inducing, because of the:

a) Difficulty of the test itself

b) Shortened time in which to complete the test (the proper time for completion was 35 minutes and not 25 minutes as the subjects were told).

c) Anticipation of having the test marked by one of the other subjects.

d) Strong message that intelligence was being evaluated.

e) Introductory statement implying that experiencing any effects of the coffee drinking might affect test performance and so may mean that one has a low I.Q.

iv) Non Stressed The subjects in this condition were asked to complete the Canterbury Student Personality Scale (Shouksmith 1964) which was designed to study certain aspects of personality considered to be important for adjustment as a student. The subjects were not told of this purpose however, but were given other instructions which were designed to minimise any anxiety they might feel about completing the scale; these were, as follows:

"I want to emphasise that this is a written task with no right or wrong answers; your opinions are what counts. There is no individual scoring of this (scale); I am interested in total numbers of responses from all of you. Your forms will be collected up when twenty-five minutes have passed and so your answers will remain anonymous."

The Canterbury Personality Scale is shown in Appendix 2 (page 100)

(d) The Dependent Variables

The independent variables are thus, the levels of caffeine and the tasks, along with their sets of instructions. The dependent variables of interest were anxiety, as assessed by the State-Trait Anxiety Inventory, and seven different mood states, as assessed by the State Response Scale. These states were "I feel ... irritable, cheerful and happy, fatigued and tired, relaxed, depressed and unhappy, energetic and active, tense and anxious."

i) The State-Trait Anxiety Inventory (STAI)

(i) Description The State-Trait Anxiety Inventory, developed by Spielberger et.at. (1970), consists of two self-report scales used to provide a measure of state anxiety and trait anxiety. State anxiety is conceptualized as a transitory emotional state, characterized by subjective, consciously perceived feelings of tension and apprehension, and heightened autonomic nervous system activity. State anxiety varies in intensity and fluctuates over time. Trait anxiety refers to relatively stable individual differences in anxiety proneness i.e. to differences between people in the frequency that anxiety states are manifested over time.

As well as distinguishing between state and trait anxiety, the STAI has the other advantage of being quickly and easily self-administered in a group situation. The state and trait scales of the STAI are shown in Appendices 3 and 4 (pages 103 and 104) respectively.

ii) Administration Both before and after the experimental interventions, the subjects were asked to respond

to the twenty self-report items of the State Anxiety Scale according to how they "feel right now ... at this moment". All of the subjects were also asked to respond to the twenty items of the Trait Anxiety Scale, before experimental intervention; this scale asks subjects to report "how you generally feel".

A measure of trait anxiety was obtained in order to compare the pre- and post- intervention STAI scores of subjects with high trait anxiety scores and those with low trait anxiety scores, in each of the four groups. Those with high trait anxiety are more easily threatened by experimentally-induced stress, and are thus more likely to respond anxiously to a stressful situation. (Schwab and Iverson, 1964). Circumstances in which an individual's personal adequacy is evaluated are particularly threatening to persons with high trait anxiety. (Spence and Spence, 1966; Spielberger, 1966; Spielberger and Smith, 1966).

The State Anxiety Scale was given to the subjects before the Trait Anxiety Scale. Since the State Anxiety Scale was designed to be sensitive to the conditions under which the test is administered, scores on this scale can be influenced by the emotional atmosphere created if the Trait Anxiety Scale is given first. On the other hand, trait anxiety scales are relatively impervious to the conditions under which they are given. (Johnson, 1968; Johnson & Spielberger, 1968; Lamb, 1969). Also, in the standardization of the STAI the State Anxiety Scale was given first.

The subjects were given eight minutes to complete the scales at each administration; students generally require six to eight minutes to complete the scales (Spielberger et. al. 1970). The STAI was consistently referred to as the Self Evaluation Questionnaire even though many of the items have face validity as measures of anxiety; this is in accordance with standardization procedures.

ii) The State Response Scale

(page 105)

The State Response Scale, reprinted in Appendix 5, is a modification of the Visual Analogue Scale used by Sanders (1982). It consists of seven statements, against each of which subjects indicated their level of agreement by:

(a) Circling one of the five forced choice responses and

(b) indicating by a cross on a line their degree of agreement.

The State Response Scale was given to each subject twice; both before and after the experimental intervention either preceding or following the administration of the STAI (test ordering was randomized). The subjects were given eight minutes to complete the scale at each administration.

The advantages of using such a scale were that it was quickly and easily administered in a group situation while covering a range of items. It also contained a built-in check; the accepted response of the two, for each statement, depended on the placement of the cross. If this agreed with the closest circled response, then that circled response was accepted. If the cross was nearer to a non-circled response, then that was accepted as being a more accurate indicator of the subject's intention; the under-

lying assumption was that points on a continuum provide a more accurate indicator of intended response than do forced choice responses.

The second assessments of mood and anxiety took place at the time of maximum central nervous system caffeine impact; that is, thirty to forty minutes after caffeine's ingestion. Peak levels of caffeine in blood plasma occur at this time (Greden, 1979).

(d) Controls in the Experiment

Each of the four possible combinations of test order was presented randomly to the subjects. All of the experimental sessions were as similar as possible, apart from the experimental manipulations themselves. The sessions took place on five consecutive mornings and were all conducted in the same room (except for one session which took place in another room, almost identical in appearance and size). The same experimenter used a set of standardized instructions.

To control for time-of-day effects of caffeine (Humphreys, Revelle, Simon and Gilliland, 1980), all of the sessions took place between 9.30 a.m. and 11 a.m. The subjects were asked to eat a light breakfast and to drink no tea or coffee in the morning prior to the experiment, in order to ensure that the presence of food or caffeine in the body would not confound the effects of the experimental interventions. To ensure that different levels of tolerance to caffeine's effects did not constitute a further source of confounding, information regarding usual coffee intake was obtained from a random sample of 19 subjects; this showed that habitual and non-coffee drinkers were spread evenly, over the four groups.

The following table summarizes how the events that took place during each experimental session were ordered.

TABLE 6 The Ordering of Events During the Experiment

Introduction/Data Form		
STAI (state)	OR	State Response Scale
STAI (trait)		STAI (state)
State Response Scale		STAI (trait)
Coffee Drinking		
Canterbury Reasoning Test	OR	
Canterbury Personality Scale		
STAI (state)	OR	State Response Scale
State Response Scale		STAI (state)
Debriefing		

B. RESULTS OF THE EXPERIMENT

The within-groups changes in the pre- and post-intervention measures were analyzed for their statistical significance, using t-tests. What were of interest with regard to the aims of the experiment, were the within-groups changes in pre - and post-intervention measures, and not between-groups comparisons. T-tests were used to assess the statistical significance of the within-group changes, for each of the four groups. The relevant question was 'under what experimental conditions did statistically significant changes occur in anxiety and the mood states

assessed by the State Response Scale?'

(a) State Anxiety

Table 7 shows that the state anxiety scores of three of the four groups increased following the experimental interventions. There was a non-significant trend towards increased anxiety for the low caffeine-stressed group and a near significant increase ($p < .10$) in the anxiety of those in the high caffeine-non stressed group. Of particular interest was the finding that there was a highly significant ($p < .001$) predicted increase with the high caffeine-stressed group.

There was a negligible decrease in the anxiety of the subjects in the low caffeine-non stressed group.

TABLE 7: Table of Mean State Anxiety Scores.

		PRE-INTERVENTION	POST-INTERVENTION
NOT STRESSED	low caffeine intake (n=10)	34.4	33.6
	high caffeine intake (n=9)	35.22	40.11
STRESSED	low caffeine intake (n=12)	38.08	41.17
	high caffeine intake (n=16)	38.25	51.63

(b) The State Response Scale

The scores for each scale of the State Response Scale were coded and combined together in order to assess 'positivity' or 'negativity' of mood on a scale from 7 (negative) to 35 (positive). There was no significant change in the overall scores for any of the four groups, after the experimental phase. An interesting finding was that the greatest increase in the negativity of mood occurred with the high caffeine-stressed group, whereas the high caffeine-non stressed group was the only group to show a slight increase in mood positivity (Table 8). Therefore, the stressful situation appeared to have a negative mood-related modifying effect on the high level of arousal induced by the caffeine.

TABLE 8: Table of Mean Mood Positivity Scores.

		PRE-INTERVENTION	POST-INTERVENTION
NOT STRESSED	low caffeine intake (n=10)	27.7	26.8
	high caffeine intake (n=9)	26.11	26.44
STRESSED	low caffeine intake (n=12)	24.25	22.92
	high caffeine intake (n=16)	22.67	21.07

Each of the seven measures of the State Response Scale was analyzed separately, using t-tests. On the scale itself, the following numbers represent the categories of

strongly agree (1), agree (2), uncertain (3), disagree (4) and strongly disagree (5). Therefore, in response to the statement, 'I feel irritable,' for example, a post-intervention score changing from 4 to 2 indicates an increase in irritability.

There were significant changes in pre - and post-intervention scores on three of the measures from the State Response Scale: irritability, fatigue and tiredness, and, energy and activity.

(i) Irritability. The mean pre - and post-intervention irritability scores for each group are summarized in Table 9.

TABLE 9: Table of Mean Irritability Scores.

		PRE-INTERVENTION	POST-INTERVENTION
NOT STRESSED	low caffeine intake (n=10)	4.50	4.60
	high caffeine intake (n=9)	4.44	4.00
STRESSED	low caffeine intake (n=12)	3.92	3.67
	high caffeine intake (n=16)	3.67	2.8

For three of the four groups there is an increase in irritability, whereas there is a decrease for the low caffeine-non stressed group. The high caffeine-stressed group showed a significant increase in irritability ($p < 0.02$) following

the experimental intervention and the increase in the irritability of those in the high caffeine-non stressed group approaches significance ($p < 0.10$).

(ii) Fatigue and Tiredness. Table 10 summarizes the mean pre - and post-intervention 'fatigue and tiredness' scores. Subjects in the high caffeine-non stressed group were significantly less tired ($p < 0.02$) following the experimental intervention, whereas there were no significant differences for any other groups.

TABLE 10: Table of Mean 'Fatigue and Tiredness' Scores.

	PRE-INTERVENTION	POST INTERVENTION
NOT STRESSED low caffeine intake (n=10)	3.70	3.10
high caffeine intake (n=9)	3.33	4.22
STRESSED low caffeine intake (n=12)	2.83	3.17
high caffeine intake (n=16)	2.87	2.93

(iii) Energetic and Active. Subjects in the high caffeine-non stressed group were significantly more energetic and active ($p < 0.05$) following the experimental intervention. The increase in the energy and activity of subjects in the high caffeine-stressed group approaches significance ($p < 0.10$). There were slight non-significant decreases in the energy and activity scores of the low caffeine groups. The mean pre - and post-intervention energetic and active

scores are summarized in Table 11.

TABLE 11: Table of Mean Energetic and Active Scores.

		PRE-INTERVENTION	POST-INTERVENTION
NOT STRESSED	low caffeine intake (n=10)	2.90	2.80
	high caffeine intake (n=9)	3.00	3.67
STRESSED	low caffeine intake (n=12)	2.67	2.42
	high caffeine intake (n=16)	2.20	2.73

(c) High and Low Trait Anxiety Subgroups.

The subjects were divided into high and low trait anxiety subgroups on the basis of their trait anxiety scores; those individuals with scores exceeding the median (38) were categorized into the high trait anxiety subgroup and those scoring equal to or less than the median were categorized into the low trait anxiety subgroup.

The pre - and post-intervention state anxiety scores were compared, using t-tests, for each of the trait anxiety subgroups, within each of the four experimental groupings.

Of the subjects in the low trait anxiety subgroup there was a significant increase in the state anxiety of those in the high caffeine-stressed group ($p < 0.05$). For subjects in the low caffeine-non stressed group there was a significant

decrease in state anxiety ($p < 0.05$). The mean pre - and post-intervention scores are summarized in Table 12.

TABLE 12: The Mean State Anxiety Scores of Low Trait Anxiety Subjects (n=24)

		PRE-INTERVENTION	POST-INTERVENTION
NOT STRESSED	low caffeine intake (n=8)	31.25	28.63
	high caffeine intake (n=5)	35.20	34.20
STRESSED	low caffeine intake (n=4)	36.00	41.00
	high caffeine intake (n=7)	31.71	37.71

There were no significant increases in the state anxiety of subjects in the high trait anxiety subgroup for any of the experimental groups. The mean pre - and post-intervention scores are summarized in Table 13.

TABLE 13: The Mean State Anxiety Scores of High Trait Anxiety Subjects (n=23)

		PRE-INTERVENTION	POST-INTERVENTION
NOT STRESSED	low caffeine intake (n=2)	47.00	53.50
	high caffeine intake (n=4)	35.25	47.50
STRESSED	low caffeine intake (n=8)	39.13	41.25
	high caffeine intake (n=9)	43.67	51.33

C/ DISCUSSION

The results of the experiment support the hypothesis that caffeine increases self-reported anxiety levels in stressed subjects, but not in non-stressed subjects given an equivalent amount of caffeine. A combination of the stressful condition and high caffeine intake also caused a significant increase in irritability, not evident in the high caffeine-non stressed and low caffeine-stressed groups.

In contrast those subjects who received a high caffeine dose, but were not subjected to the stressful situation, reported feeling significantly more energetic and active and significantly less tired following the intervention. Also, the State Response Scale showed that this group was the only group to show a slight (though insignificant) increase in mood positivity.

The experiment showed that four hundred milligrams of caffeine alone did not induce significant levels of anxiety. It has often been assumed that caffeine is the causal factor when there is a high correlation between high caffeine intake and high anxiety, however, correlational procedures are not appropriate methods for identifying causal factors. In this case they leave open the possibility that caffeine may intensify but not induce anxiety resulting from a stressful situation.

The findings,that caffeine significantly increased reported feelings of energy and activity while significantly decreasing feelings of tiredness and fatigue among non-

stressed subjects, are well supported by previous research showing that caffeine doses of 150-300 mg. increase arousal (Barmack, 1940; Goldstein et. al., 1965, Craig et. al., 1979), promote wakefulness (Julien, 1981), increase activity and delay the experience of tiredness and drowsiness (Lienert and Huber, 1966; Ritchie, 1970). Little research has been directed at the effects of 400 mgs. of caffeine; a dose which has traditionally been reported to induce a superoptimal level of arousal.

When the subject sample is divided into high and low trait anxiety subgroups, the finding of a significant increase in the state anxiety of low trait anxiety subjects in the high caffeine-stressed group replicates that of the overall subject population. It seems surprising, however, that there were no significant changes in the state anxiety of the high trait anxiety subjects in either of the experimental groups. Previous findings have clearly shown that individuals with high trait anxiety are more likely to respond anxiously to a stressful situation (Schwab and Iverson, 1964), especially one in which personal adequacy is being evaluated (Spence and Spence, 1966; Spielberger, 1966; Spielberger and Smith, 1966).

The lack of any significant increase in the state anxiety of the high trait anxiety subjects may be explained by ceiling effects. The mean pre-intervention state anxiety score of the high trait anxiety subjects (41) was considerably higher than that of the low trait anxiety subjects (33). High trait anxiety people are more likely to respond anxiously to a wider range of situations and with a greater intensity of anxiety to commonly stressful situations

(Spielberger, Lushene and McAdoo, 1971). It is therefore reasonable to conclude that the high trait anxiety subjects experienced a very high level of pre-intervention experimental anxiety and that the experimental stress condition was not significantly more stressful for them. On the other hand, the low trait anxiety subjects did not experience significant experimental anxiety but anxiety was significantly induced by the experimental interventions.

(a) The Relationship Between Anxiety and Arousal.

Researchers have previously concluded that caffeine induces anxiety. Eysenck and Folkard (1980) found that symptoms indistinguishable from anxiety can be produced by high doses of caffeine. Greden (1979) pointed out that 'anxiety' findings are quite predictable; most are simple, dose-related extensions of known and expected stimulant actions of caffeine on the sympathetic nervous system so that anxiety and arousal look the same physiologically regardless of etiology (Greden , 1974). The symptoms clearly indicate the presence of arousal, but do they indicate the presence of anxiety?

Anxiety has been defined in two different ways in terms of its relationship to arousal and each definition changes the interpretation of an interaction between anxiety and caffeine intake. The two different definitions are each discussed below.

i) Anxiety is an unpleasantly high level of arousal. The Yerkes-Dodson Law states that there is an 'inverted U' relationship between arousal level and performance. At

very low levels of arousal performance is poor, however, with increasing arousal performance improves until the arousal reaches a level where performance is optimal. Any further increases in arousal are then accompanied by a decline in performance.

In the same way Revelle et. al. (1980) argued that it is theoretically fruitful to subsume the effects of caffeine and anxiety under a common construct of arousal. Viewing anxiety as an extreme of arousal can explain the finding that caffeine increases existing anxiety in the following way: High levels of anxiety may simply accentuate the arousing effects of a high dose of caffeine to the extent that the level of arousal is perceived as unpleasant; the arousal comes first and is followed by the subjectively dysphoric experience.

Viewing anxiety as an unpleasantly high level of arousal has the following implications. Had the caffeine dose been high enough it alone would have induced anxiety in the high caffeine-non stressed group, without the presence of the stressful situation. Mood improvement occurred because arousal was increased to an optimal level, whereas for the high caffeine-stressed group, arousal was increased beyond the optimal level.

The finding that there was also a significant increase in irritability in the high caffeine-stressed group can be explained in the same way. An unpleasantly high level of arousal may be characterized by a generally dysphoric mood which includes irritability as well as anxiety. In the

experiment there was no significant increase in depression, however, this is an unpleasant mood state characterized by a very low level of arousal, whereas caffeine and stressful situations increase arousal. Arousal greater than that of an optimal level then, produces a negative mood state.

Cobb explained his findings by putting forward the possibility that caffeine intake at stressful times could accentuate, perhaps to a critical point, a neurotransmitter response cycle that enhances already-developing anxiety. Caffeine increases, or potentiates, brain norepinephrine, thus inducing central nervous system stimulation (Schildkraut and Kety, 1967). Also, Thierry et. al. (1968) found that mild and severe stress induced the synthesis and use of norepinephrine in the brain. These effects of norepinephrine are general, that is, they are not associated with specific emotional states. We have already seen how caffeine induces arousal, pharmacologically; it is conceivable that there is a critical point beyond which the arousal level becomes unpleasant.

There is increasing evidence that the Yerkes-Dodson Law is an oversimplification, however. Russell and Mehrabian (1977) conducted a thorough investigation of self-reported emotional states, which indicated the existence of the two independent factors of degree of arousal and degree of pleasure-displeasure. They concluded that anxiety can't be regarded merely as a state of high arousal, since it actually consists of a combination of high arousal and displeasure. In usual everyday circumstances cognitions

and arousal are highly inter-related, one leading to the other and vice versa; sometimes, however, they are independent. (Maranon, 1924).

Secondly, although there are many examples of the inverted U relationship in the literature (for example, Easterbrook, 1959; Eysenck, 1964), they lack clarity, and there is no known study which demonstrates the inverted U relationship to exist within one subject. There are also doubts regarding the relevance of the Yerkes-Dodson Law when investigating emotional states, for the following reasons:

(a) The Yerkes-Dodson Law receives support from studies looking into the effects of varying levels of arousal on performance, but it does not distinguish between emotional states which are very similar in terms of arousal level, but are very different behaviourally, for example, anxiety and elation. Also, drugs which promote or inhibit norepinephrine also promote or inhibit rage (Reis and Fuxe, 1969). How can rage and anxiety be distinguished?

(b) The main source of data has come from disturbed individuals, in whom negative emotion is so predominant that it seems undifferentiated. Thus anxiety has been treated as a global, undifferentiated concept (Izard, 1972).

(c) A large degree of support for the Yerkes-Dodson Law comes from sensory deprivation and sensory overload studies, which involve extreme situations.

Finally, it is not evident that there is such a simple relationship between increased norepinephrine and central nervous system stimulation, as has been reported. Berkowitz (1970, 1971) found no correlation between the release of norepinephrine in the brain and central nervous system stimulation. Also, animal research demonstrates that catecholaminergic drugs may increase activity at low doses but decrease it at higher ones (e.g. Hughes and Greig, 1976).

ii) Anxiety consists of an arousal element plus an independent displeasure element. Schachter (1964, 1965, 1970, 1972) has produced extensive evidence that for an emotion to occur, there must be a state of arousal and a way of interpreting that state in emotional terms. The interpretation comes from the situation and not from the state of arousal (Schachter and Singer, 1962) and the cognitive interpretation may precede the physiological arousal or vice versa.

Using Schachter's findings, the interaction between caffeine intake and stress may be explained in the following way: the stressful situation enabled the high level of arousal to be labelled, emotionally, as anxiety. This was because the stressful situation consisted of a difficult intelligence test, to be completed within a prescribed period of time, with the message in the instructions that each subject's intelligence was being evaluated.

Kardiner (1950) theorized that competitive success is the dominant cultural value in Western Society and is therefore the dominant criterion of self-valuation; it is accepted as the means of validating the self in one's own

eyes as well as in the eyes of others.

> "Whatever threatens this goal is therefore the occasion for profound anxiety for the individual in our culture, because the threat is to values held essential to his existence as a personality, that is, essential to his worth and prestige as a personality."

There is considerable evidence that anxiety is conditioned to situations of evaluation and validation of self, leading to 'evaluation apprehension' (Rosenberg, 1965).

The results of the experiment also showed an interaction between caffeine intake and irritability. Irritability may be defined as a high frequency of responding with a combination of annoyance and anger.

According to Schachter's theory, the combination of high arousal and a context for this, would have led to the emotional experience, whereas the nature of the stressful situation rather than the high level of arousal, led to the labelling of the emotional experience as 'irritability.' For a significant proportion of the subjects, there may have been irritability with the knowledge that they were being evaluated, when they had not expected to be, prior to the event.

Schachter has been critized by Leventhal (1980) on the basis that he has not proved that emotion is dependent on sympathetic arousal and cognition, only that it is influenced by these. This could be so whilst emotion

remains independent of them. If cognitions label arousal, and by so doing create subjective feelings, then feelings must be learned. However, Leventhal argues against this viewpoint by questioning how a young child can be capable of feeling anything before he knows the label for the feeling, if it is the label which promotes the feeling. The only way in which this is possible is if the situations are similar in meaning to those for which the child already has labels.

Leventhal turns the argument around and suggests that situations become construed as similar because they generate similar feelings.

Leventhal (1980) has also produced considerable evidence to suggest that arousal is not a necessary part of subjective emotional experience (Wynne and Solomon, 1955; Valins, 1966; Scherwitz, 1973; Van Toller and Tarpy, 1974). He concludes that arousal is a conditioned stimulus or an unconditioned stimulus for emotion; the experience of autonomic arousal appears to be conditioned to images and feelings to become part of emotion (Hohman, 1966). Autonomic arousal facilitates the acquisition of emotional behaviour, but if this behaviour is acquired beforehand, autonomic arousal is not necessary for its maintenance.

b) An Interpretation of the Results

The interaction between caffeine intake and stress and their combined effect on anxiety, may be explained most adequately using the theory and research produced by Leventhal (1980) and Schachter (1970, 1972). The caffeine induced a significant level of arousal. For those in the

high caffeine-stressed group, the stressful experience of completing the Canterbury Reasoning Test resulted in a further increase in arousal and enabled the overall arousal to be interpreted, emotionally, as anxiety, which is an appropriate learned response in a stressful situation. In the experiment, the subjects recognised a familiar situation to which the experience of anxiety had previously been conditioned through direct or vicarious experiences of failure or anticipation of poor performance.

The experiment showed that there was no significant increase in the anxiety of the low caffeine -stressed group. This implies that a higher level of arousal was a necessary concomitant of the cognitive interpretation for producing the experience of anxiety. Research shows that people do not seem to notice their arousal unless it reaches high levels, nor do they usually make clear, conscious, attributions of arousal to one of a series of sequential events (Johnson and Day, 1974; Cantor, Zillman and Bryant, 1975; Zillman, 1978).

There was no significant increase in the anxiety of those in the high caffeine - non stressed group, however there was a significant decrease in fatigue and tiredness and a significant increase in subjective 'energy and activity'. The caffeine induced significant arousal, but there was no labelling of this arousal in negative emotional terms (specifically as anxiety), as there was no clearly defined anxiety-producing context to which this high arousal could be attributed.

It is reasonable to conclude that the subjects may have attributed the high arousal to the coffee drinking, and it is therefore unlikely that the arousal would be labelled, emotionally. Whether the arousal would be labelled emotionally with increasing caffeine dosages, is indeterminate.

For the high caffeine-stressed group, then, it seems that the significant increase in reported anxiety resulted for the following reasons:

(i) The caffeine-induced arousal intensified the experience of anxiety significantly, and thus increased the subjective awareness of a dysphoric state. Arousal becomes conditioned to emotion to become part of it (Leventhal, 1980), so may more clearly define an emotion for a person.

(ii) The stressful experience of completing the Canterbury Reasoning Test enabled the overall arousal to be interpreted, emotionally, as anxiety.

(c) The Influence of Biochemical Changes

The experiment showed that four hundred milligrams of caffeine had no significant effect on measures of anxiety and depression of the subjects in the high caffeine-non stressed group, however this finding cannot legitimately be generalized to the intake of larger quantities of caffeine or to heavy, long-term, caffeine intake. It is quite possible that caffeine may induce depressive symptoms, since caffeine alters several central nervous system neuro-transmitter functions associated with mood regulation;

xanthine derivatives, like caffeine, can modify the activity of the catecholamines.

Caffeine increases the release and synthesis of norepinephrine (De Schaepdryver, 1959; Levi, 1967; Bellet et. al., 1969; Leanderson and Levi, 1967; Corrodi et. al., 1972; Berkowitz et. al., 1970), decreases dopamine turnover (Waldeck, 1975; Corrodi et. al., 1972) and increases the concentration of brainstem serotonin (Berkowitz, 1970, 1971). Caffeine also sensitizes central catecholamine receptors (Waldeck, 1975), particularly those for dopamine. These findings are of particular interest considering the substantial amount of evidence for a dopamine-acetylcholine balance required for the normal functioning of both motor and cognitive processes in humans. Alterations in relative dopamine and acetylcholine activity are reflected in motor disorders such as Parkinson's Disease, and in psychiatric disorders such as schizophrenia and affective disorders.

Bellet et. al. (1969) found that the ingestion of only moderate quantities of coffee results in a significant increase in catecholamine release. Levi (1967) reported that the magnitude of increase of the release of catecholamines in the plasma is similar to that induced by stress situations. Chronic or acute ingestion of high doses of caffeine might therefore result in central nervous system mood disturbances like anxiety and depression.

Further evidence has been reported to show that caffeine can exacerbate certain depressive conditions,

notably the unipolar II subgroup (Neil et. al., 1978). Also, caffeine-induced exacerbation of schizophrenic symptoms has been reported (Hansell, 1975). It is quite conceivable that caffeine may supersensitize an already vulnerable system, as the neurotransmitter system is known to be abnormal in clinically depressed and schizophrenic individuals (Mikkelsen, 1978).

There is considerable evidence to suggest that caffeine intake is unusually high amongst psychiatric inpatients (Greden, 1974), especially those with mixed affective states (Kupfer et. al., 1975). Also, Winstead et. al.,(1976) found in two studies of psychiatric inpatient populations that high caffeine consumers reported statistically significant elevations in their anxiety scores, compared with other subgroups. Of particular interest, in view of the caffeine-anxiety interaction, is Mikkelson's (1978) finding that increased caffeine consumption among psychiatric inpatients occurred during periods of increased anxiety.

Despite the obvious importance of caffeine intake among psychiatric patients, there is little or no mention of coffee - or tea.-drinking patterns in hospital records. Greden's (1974) review of the literature failed to reveal any significant mention of caffeinism and a random review of one hundred outpatient psychological records failed to reveal a single listing of coffee -or tea-drinking patterns, even though 42 of these records referred to anxiety symptoms. Also, compared with others, high caffeine users

have been found to consume more anti-anxiety agents and minor tranquillizers, such as Valium and Librium (Winstead et. al., 1976).

(d) Methodological Issues

There are four major areas within the experimental procedure, which warrant consideration with regard to methodological issues. These are; subjects' expectations, the effectiveness of the 'stressed' and the 'non-stressed' conditions, the reliability and validity of the subjective measures and the control of extraneous variables. Of additional importance is the generalizability of the experimental results.

(i) Subjects' Expectations Subjects' expectations regarding the purpose of the experiment and the results of the experiment are very important in determining their responses (Orne, 1962). In the introduction, the subjects were told that the purpose of the experiment was to 'look into the effects of coffee-drinking'. Such a description left considerable room for speculation on the part of the subjects for the following reasons:

(a) The dependent variables of interest were unknown. They could have included any one or combination of medical, behavioural, subjective, social or performance effects.

(b) The subjects were given no reason to believe that the coffee would be different, in any way, from that which they normally drink.

(c) At no stage was the word 'caffeine' mentioned, in order to minimize associations with stimulant effects.

The only information that came from the introduction was the implication that coffee-drinking has effects. Aside from this the subjects were told nothing about the independent and dependent variables of interest. With the administration of the State - Trait Anxiety Index and the State Response Scale, however, subjects may have developed expectations that the purpose of the experiment was to look at mood states, as both the State - Trait Anxiety Index and the State Response Scale have face validity as measures of anxiety and mood, respectively.

In order to control for subjects' expectations regarding the effects of the coffee, it was important that subjects in both the high and the low caffeine conditions did not come to different conclusions regarding the coffee. Because of the unpleasant taste of the highly caffeinated coffee (many of the subjects found it difficult to finish the drink), it was highly unlikely that the subjects believed that they were drinking a normal mug of coffee, thus raising indeterminate expectations regarding its effects. One may speculate, however, that the strong, unpleasant taste of the coffee is likely to lead to the conclusion that the coffee will have effects. In an attempt to control for the unpleasant taste of the highly caffeinated coffee, those drinking the low caffeinated beverage received strong, black, unsweetened coffee (which many of the subjects also reported having trouble consuming).

Had those drinking the highly caffeinated beverage guessed that their coffee contained more caffeine than usual, then this belief would have been controlled for by subjects in the low caffeine condition drinking strong-tasting, black, unsweetened coffee, which is suggestive of a high caffeine level and of effect.

It is highly unlikely that subjects in either condition would have discerned that they were receiving more or less quantities of caffeine because few, if any, of them would be familiar with the distinctive taste of caffeine.

(ii) The Effectiveness of the 'Stressed' and the 'Non-Stressed' Conditions A second methodological issue concerns the effectiveness of the 'stressed' and the 'non-stressed' conditions in controlling subjects' anxiety levels.

a) The 'Stressed' Conditions A major problem with experimentally induced anxiety is that of finding a technique that has a reasonable probability of stressing the subjects appropriately and uniformly.

> "I saw that all the things I feared and which feared me had nothing good or bad in them save in so far as the mind was affected by them."
>
> (Spinoza, 1950)

Artificial methods of inducing anxiety fail to produce reactions of the scope and intensity found in naturally-occurring situations. (Levitt, 1968).

For the reasons outlined on page 38 the use of a performance test was shown to be a proven method of inducing significant anxiety. It is also a 'natural' rather than an 'artificial' method of inducing anxiety, especially for university students. Of interest, however, was the experimental finding that there was no significant increase in anxiety between pre - and post-intervention measures for the low caffeine-stressed group. This is surprising, given the difficulty of the test and the instructional set suggestive of evaluation of personal competence. The following possibilities seem reasonable explanations:

a) Anxiety was present cognitively, but the level of physiological arousal was not great enough to be subjectively perceived. People do not seem to notice their arousal unless it reaches high levels. (Zillman, 1978).

b) The task demands may have required full concentration, thus diverting attention away from subjective experiences.

c) There may be a relief factor, following the task demands.

d) The Canterbury Reasoning Test may not have been stressful to subjects who perceived that the experimenter's intent was to stress them. This is a possibility, considering that the subjects had already been assessed as to their moods.

b) The 'Non-Stressed' Conditions A potential danger in using The Canterbury Personality Scale along with the instructions for the 'non-stressed' conditions, was that subjects' uncertainty regarding its purpose may have resulted in anxiety about their responses; it would have been difficult for subjects to see the Scale's relevance to the effects of coffee-drinking. On the other hand, there were no significant pre - and post-intervention changes in the anxiety measures of the low caffeine - non-stressed group, so the Scale proved to be effective for its purpose.

(iii) Reliability and Validity The third area of methodological importance is that of the reliability and validity of the subjective measures. Self-report measures of mood were used in order to overcome the difficulty in distinguishing between arousal and anxiety. Also, the validity of physiological indicators of mood is questionable and arousal levels may not accurately reflect anxiety levels. Physiological indicators (such as temperature) may provide a valid index of within-subjects arousal, but not necessarily a valid between-subjects index and often various physiological indices of arousal do not agree with one another. For these reasons, self-report measures are more accurate than behavioural or physiological measures, when the variable of interest is subjective anxiety.

The State-Trait Anxiety Inventory (STAI) is one of the most carefully developed instruments from both theoretical and methodological standpoints (Speilberger and Gorsuch, 1966). It has been well validated (Speilberger

and Gorsuch, 1966) and its reliability is greater than that of physiological measures and projective tests, as it is less affected by extraneous factors in the experimental situation. The STAI was especially appropriate for use with a student population, because its standardization, validity and reliability procedures were conducted entirely with college students.

The State Response Scale is a modification of the visual analogue scale used by Sanders (1982), and it hasn't been validated, neither have reliability checks been made. It was interesting that the State Response Scale showed no significant increase in 'tension and anxiety' whereas the STAI showed a highly significant increase for the high caffeine-stressed group. The Scale may not have been a sensitive enough instrument to use for detecting changes in mood.

The repeated administration of the subjective measures possibly lowered the reliability of the post-intervention measures; repetition may be associated with boredom and lack of motivation. On the other hand, it has been found that repeated administrations of personality tests either lead to greater reliability in differentiating among subjects (Howard and Diesenhaus, 1965) or have no significant influence on test scores (Bendig and Bruder, 1962).

iv) Control of Extraneous Variables Lack of sleep, general health, motivation, intake of tea, and food intake prior to the experiment, were controlled for by the randomized subject assignment to groups. 19 of the subjects (a

random sample) were asked about their usual coffee intake, to further ensure that varying tolerance levels to caffeine would not confound the experimental effects; high coffee drinkers (greater than 5 cups a day) were evenly distributed over the four groups.

The unpleasantness of the highly caffeinated coffee possibly induced more anxiety in the affected groups than in the groups receiving low caffeinated coffee, thus confounding the experimental variables. The coffee may have tasted more pleasant if the high caffeine dose had been spread over two cups, however, the practicalities of the situation, in particular the time restrictions and the precise measurements involved, meant that all subjects received their high or low caffeine doses in a single, prepared, mug of coffee. It is unlikely that the unpleasant taste of the highly caffeinated coffee represents a serious threat to the experiment, however, because the strong, unsweetened, low caffeinated coffee also tasted unpleasant, and the post-intervention mood assessments took place half an hour after the coffee-drinking.

v) Generalizability of the Results The experimental finding that caffeine increases the anxiety of stressed student subjects but not of non-stressed subjects may be legitimately generalized to other subject populations, even though the subjects were all students, within a limited age range. This is because it is unlikely that caffeine would affect non-students or older people significantly differently with regard to arousal. What may differ, however, are the situations that are stressful; these may vary across

individuals, age-groups, cultures and subcultures.

It is not legitimate to generalize the experimental finding of significantly increased anxiety, to the effects of doses of caffeine that are higher or lower than 400 mg. The experimental finding tells us that anxiety is significantly increased when a person, under stress, drinks coffee containing 400 mg. of caffeine. A lower dose of caffeine may not induce enough arousal to facilitate the labelling of an emotional state and a higher dose of caffeine may result in a labelled emotional state without the presence of any concurrent stressful situation. The experiment showed increases in the anxiety and irritability of the subjects in the high caffeine - non stressed group, which were approaching significance.

Since there was no significant increase in anxiety for the control group, the experimental situation itself did not appear to induce significant anxiety, hence this suggests that the results may be generalizable to everyday situations, outside of the laboratory.

The explanation provided for the self-reported increase in the anxiety of the high caffeine-stressed group, may not be relevant to anxiety among chronic, high caffeine users. Chronic, high usage can modify catecholamine levels and alter balances affecting mood. In the same way, there was no significant change in self-reported depression in the experiment but, although acute caffeine intake may not induce depression, chronic caffeine ingestion, pharmacolog-

ically, has the potential to produce depressive symptoms, by modifying the catecholamine levels (Levi, 1967) inhibiting the phosphodiesterase breakdown of cyclic AMP in the central nervous system (Waldeck. 1975), or by sensitizing central catecholamine receptors, particularly those for dopamine (Waldeck, 1975).

CHAPTER V

THE SURVEY

If caffeine intensifies existing anxiety during periods of stress, then it is important to investigate the beliefs people have regarding the effects of caffeine. Goldstein and Kaizer (1969) found that ten per cent of their survey respondents believed that coffee 'makes you relax' and seven per cent, that it 'calms the nerves'. Such beliefs may lead to an increase in the intake of caffeine during times of stress.

Also important are the situations in which people increase their consumption of caffeine-containing substances. If people tend to increase their consumption during periods of stress, then they may actually be intensifying their anxiety. A survey was designed to investigate these areas of interest. The full questionnaire is reprinted in Appendix 6, (page 106).

A/ AIMS OF THE SURVEY

The main aim of the survey was to investigate the following questions:

(a) Is there a relationship between high caffeine intake and high levels of anxiety?

(b) Why do people drink tea and coffee?

(c) Does coffee and tea intake increase during times of stress?

B/ THE SAMPLE POPULATION

Three hundred and ninety four students from the University of Canterbury responded to the survey (186 males and 208 females). The age groupings of the survey respondents are shown in Table 14; the average age was nineteen years.

TABLE 14 Proportions of Male and Female Survey Respondents in Each Age Group (June 1st, 1982).

	Males	Females
16 - 19	37%	62%
20 - 23	48%	21%
⩾ 24	12%	14%
No answer	3%	3%

Table 15 shows the categories of degrees being studied for; most of the males were studying for professional degress, such as engineering and commerce, whereas most of the females were studying arts degress, such as psychology and education.

TABLE 15 Categories of Degrees Being Studied for by Male and Female Survey Respondents

	Males	Females
Arts	22%	60%
Sciences	26%	22%
Professions	34%	10%
No Answer	18%	8%

Table 16 shows that among the students sampled coffee is the most commonly consumed caffeine-containing substance. Tea is the second most common caffeine-containing substance. Most people who drink coffee also drink tea, whereas only a third of the sample drink one or the other of these. Only seven per cent abstain from both beverages.

TABLE 16 Proportions of Respondents Consuming Coffee and/or Tea

	Males	Females	Total
Coffee Drinkers	87%	82%	84%
Tea Drinkers	71%	72%	72%
Consumers of Coffee and Tea	63%	60%	61%
Consumers of Coffee OR Tea	32%	32%	32%
Abstainers from Coffee and Tea	5%	8%	7%

Table 17 shows the daily levels of intake of coffee and tea among survey respondents.

TABLE 17 Daily Intake of Coffee and Tea Among Survey Respondents.

	COFFEE		TEA	
	Males	Females	Males	Females
Less than 4 cups per day	67%	68%	88%	86%
4 or more cups per day	33%	32%	12%	14%

Most students (68%) drink less than four cups of coffee a day, however, a significant proportion (32%) drink four or more cups a day. Considerably fewer students drink more than four cups of tea a day.

TABLE 18 Daily Intake of Cocoa and Chocolate Among Survey Respondents.

	COCOA		CHOCOLATE	
	Males	Females	Males	Females
Less than 1 drink/bar per day	92%	88%	97%	94%
1 or more per day	8%	12%	3%	6%

Survey respondents receive negligible amounts of caffeine from cocoa and chocolate, in terms of daily intake, (Table 18) and only 4% of males and females reported ever taking No-Doz tablets.

There were no apparent sex differences.

C/ RESULTS

(a) Caffeine Intake and Anxiety Levels

The anxiety levels of the survey respondents were assessed using the Trait Anxiety Scale of the State-Trait Anxiety Inventory (Spielberger, 1970). A median-split procedure was followed, in which anxiety scores greater than the median score (38) were referred to as 'high', and scores less than and equal to the median were referred to as 'low'.

Because coffee was found to be the most commonly consumed caffeine-containing substance, and also the substance most likely to be consumed in high quantities, the analysis was restricted to high and low coffee intake rather than overall caffeine intake. 'High' coffee intake was defined as a usual daily intake of four or more cups per day, and 'low' coffee intake as less than four cups per day.

A Chi Square analysis (corrected for continuity) showed that there was no significant relationship between high anxiety levels and high caffeine intake, among the survey respondents. ($X^2 = 2.36$, df = 3)

(b) Reasons Why Respondents Drink Coffee and Tea.

Section B of the survey investigated the reasons why people drink tea. Respondents were asked to indicate by circling the appropriate number whether each of ten statements was a 'very, very important' (1), 'fairly important' (2) or 'not important' (3) reason for coffee and tea drinking. These statements were divided into four main categories; those concerning the physical properties of the substance, the social situation, activity type and level and believed calming effects.

(i) Physical Properties of Coffee and Tea. The physical properties of coffee and tea include their taste and thirst - quenching capacities. Most coffee and tea drinkers stated that the physical properties are a 'fairly important' reason for drinking them. A slightly lower proportion of tea drinkers than coffee drinkers found physical properties a 'very, very, important' reason. Only about a fifth of the respondents found physical properties 'not important.'

TABLE 19: The Importance of the Physical Properties of Coffee and Tea for Male and Female Survey Respondents.

	very, very important	fairly important	not important
COFFEE			
Males (n=161)	27%	47%	26%
Females (n=171)	32%	43%	25%
TEA			
Males (n=132)	33%	47%	20%
Females (n=150)	44%	43%	13%

(ii) Social Situation. The social situation includes circumstances such as being with people who are drinking coffee and tea or being offered a cup of coffee or tea. Most coffee and tea drinkers reported that the social situation was 'not important' in determining coffee and tea intake although about a quarter stated that it was 'fairly important.'

TABLE 20: The Importance of the Social Situation for the Consumption of Coffee and Tea Among Male and Female Survey Respondents.

	very, very important	fairly important	not important
COFFEE			
Males (n=161)	6%	26%	68%
Females (n=171)	6%	26%	68%
TEA			
Males (n=132)	9%	25%	66%
Females (n=150)	6%	26%	68%

(iii) Activity Type and Level. Activity type and level is potentially an important determinant of coffee and tea drinking as it is relevant to the stimulant properties of caffeine. Most coffee and tea drinkers, however, stated that activity type and level was 'not important' in determining coffee and tea intake although about a third stated that activity type and level were 'fairly important.' Very few respondents stated that it was 'very, very important.'

TABLE 21: The Importance of the Activities of Male and Female Survey Respondents for the Consumption of Coffee and Tea

	very, very important	fairly important	not important
COFFEE			
Male (n=161)	13%	30%	57%
Females (n=171)	16%	36%	48%
TEA			
Males (n=132)	6%	18%	76%
Females (n=150)	8%	27%	65%

Interestingly, those respondents who reported using No-Doz tablets (only four percent of the sample) did so only when they studied late at night during examination time or when completing an assignment.

(iv) Belief that Coffee and Tea Have Calming Effects. Table 22 shows that for most coffee and tea drinkers the idea that these substances have a calming effect on mood is not an important reason for coffee and tea intake. However, for a substantial proportion (a third) of these respondents it is a 'fairly important' reason. Only a tenth of the respondents find it a 'very, very important' reason. More coffee than tea drinkers find the calming effect on mood a 'fairly important' reason.

TABLE 22: The Importance of the Belief that Coffee and Tea have Calming Effects on their Consumption by Male and Female Survey Respondents.

	very, very important	fairly important	not important
COFFEE			
Males (n=161)	10%	31%	59%
Females (n=171)	11%	34%	55%
TEA			
Males (n=132)	7%	27%	66%
Females (n=150)	10%	30%	60%

In summary, for coffee and tea drinkers, the physical properties of these substances are the most important reason for their consumption. The social situation is the least important reason for coffee and tea consumption except for tea-drinking males for whom activity type and level is the least important reason. Overall, the differences are very slight, and are of little significance.

(c) Situations in Which Tea and Coffee Consumption Fluctuate.

The survey respondents were asked the following two questions regarding situations in which their coffee intake fluctuates; the same two questions were asked regarding fluctuations in their tea intake.

(a) Does your coffee/tea drinking fluctuate according to your mood?

(b) If so, when do you drink more coffee/tea?

Half of the coffee-drinking males (48%) and females (51%) reported fluctuations in their intake of coffee according to their mood whereas only 17% of the tea-drinking

males and 26% of the females reported fluctuations in their intake of tea, according to their mood.

Table 23 shows that, of coffee drinkers, 25% of males and 16% of females increase their consumption when under stress. Of tea drinkers, 19% of males and of females increase their consumption when under stress. Only 3% of males and 2% of females increase their coffee consumption when relaxed; 9% of males and 6% of females increase their tea consumption when relaxed.

TABLE 23 Increases in the Coffee and Tea Intake When When Under Stress and When Relaxed.

	COFFEE		TEA	
	Males (n = 161)	Females (n = 171)	Males (n = 132)	Females (n = 150)
Under Stress	25%	16%	19%	19%
Relaxed	3%	2%	9%	6%

Of coffee drinkers, 62% of males and 56% of females reported increasing their coffee intake during examination times and when they have a heavy workload. Also, 19% of tea drinking males and females increase their tea intake at these times.

TABLE 24 Increases in the Coffee and Tea Intake of Respondents During Examination Time and When Under a Heavy Workload.

	COFFEE	TEA
MALES	62%	19%
FEMALES	56%	19%

Some further findings from the survey are discussed in Appendices 7, 8 and 9.

D/ DISCUSSION

The survey showed that, contrary to previous findings (Cobb, 1974), there was no significant relationship between high anxiety levels and high caffeine intake among the survey respondents. This finding is possibly a result of methodological and conceptual problems relating to the use of a median-split procedure. This procedure does not compare the more extreme high coffee consumers with the low caffeine consumers. Also, the figures for coffee consumption are estimates and may not reflect actual coffee consumption, nor can we assume that these figures accurately reflect overall caffeine intake.

There is evidence from the survey that people do increase their consumption of coffee and tea when they are anxious. The survey showed that most people drink coffee and tea because of their physical properties. However, the

belief that coffee and tea have calming effects is a 'fairly important' or a 'very, very important' reason for consumption for two fifths of the sampled coffee and tea drinkers.

Also important, in view of the finding that caffeine exacerbates anxiety, is the situations when people drink tea and coffee. Ideally, during times of stress, coffee and tea consumption should decrease, however, the survey showed that, of coffee drinkers, a quarter of the males and a fifth of the females increase their coffee intake when under stress. Tea intake increases when under stress for a fifth of those sampled. In addition, about three fifths of the sample report increases in coffee consumption during examination times and during times of a heavy workload. Whatever the reason for increased consumption, whether it be a belief that coffee and tea 'calm the nerves' or a knowledge of their stimulant properties, this increased consumption is, presumably, occurring during a time of considerable stress.

Some of the survey findings are supported by previous research and may reflect actual trends in the general population. However, the survey was intended to be a limited, descriptive study only, and as such, the findings are limited in terms of generalization to a larger population.

CHAPTER VI

CONCLUSION

From the results of the experiment and the survey it may be concluded that there is no simple causal relationship between caffeine intake and anxiety. Caffeine effects cannot be isolated from other variables such as environmental stresses, mood and cognitive interpretations of events. All of these effects may be of greater or lesser importance depending upon the quantities of caffeine consumed.

Caffeine intake and stress may lead to anxiety and irritability in two ways: firstly, the high arousal from both sources may lead the individual to search out an interpretation in order to explain and label the subjective experience. Secondly, the high arousal may enable an already labelled emotional state to be more intensely experienced.

The survey supports previous findings that a substantial proportion of people drink coffee when under stress and that a smaller proportion use coffee as a relaxant. The finding that caffeine intake actually increases the subjective anxiety of those under stress has major implications, and is of particular importance for people with certain psychiatric conditions.

It is suggested that further research into the following areas would be of value:

1. Replication of the experiment, using physiological measures of anxiety, as well as

subjective measures.

2. Replicating the experiment using a range of caffeine doses.

3. Looking at relationships between caffeine intake and mood states other than anxiety such as anger and elation, in the context of Schachter's Theory of emotion.

4. Caffeine use in psychiatric hospitals.

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APPENDIX 1

THE CANTERBURY REASONING TEST

PREPARED BY G. SHOUKSMITH

Name..... Today's date.....

Age.....yrs.....mths. Date of Birth.....

.....

.....

Instructions

There are 50 questions in this test and for each one there is a line at the right hand side of the page. Wherever you see a line, there are letters, words or numbers missing. Your job is to write the correct letters, words or numbers just over the line, in order to answer the questions. Here is an example to show how it is done:—

Ex. 1. A B C D E F G

In this example the letters on the left are in alphabetical order. The next two letters in the alphabet after E, are 'F' and 'G'. Therefore 'F' and 'G' have been filled in above the lines on the right.

Here are two more examples:

Ex. 2. 1 3 5 7 9 11

Here, the rule is to add 2 to each number to get the next.

Ex. 3. SMALL BIG UP DOWN IN OUT

Each second word is the opposite of the one before it.

Now try this one for yourself:—

Ex. 4. ABC DEF GHI ———

Note that the lengths of the lines on the right *do not* correspond to the lengths of the missing piece or pieces. If there is only one line on the right only one answer is required. If there are two lines, then two answers must be given in order to get a mark.

Work as quickly as you can. You are not expected to answer every question but if you do finish before time is called, go back and check your work.

Are there any questions?

You will have 25 minutes exactly for this test.

DO NOT TURN OVER UNTIL YOU ARE TOLD

CANTERBURY REASONING TEST

Question No.				*Question No.*
1	A Z B Y	——	——	1
2	1 100 2 50 4	——	——	2
3	M N A B O	——	——	3
4	81 9 64 8 49 7	——	——	4
5	SMALL BLACK LARGE WHITE MEDIUM	——		5
6	RATED RATE	——		6
7	2 4 4 16 8 64	——		7
8	SPATE PATE ATE	——		8
9	GATE AT TONE	——		9
10	3OZS. 15OZS. 4LBS. 11OZS.	——		10
11	CHARTER ART MISS	——		11
12	2d. 6d. 1s. 6d. 4s. 6d.	——	——	12
13	A C B D C	——	——	13
14	N Q O R P	——	——	14
15	3150 450 90	——	——	15
16	D F C E B	——	——	16
17	600 120 30 10	——	——	17
18	1 2 4 7	——	——	18
19	2 5 9 14	——	——	19
20	2 2 4 12	——		20
21	FHK DFI	——		21
22	1 3 7 13	——	——	22
23	1 1 3 15	——		23
24	GKM FIJ EGG	——		24
25	0.3 0.6 0.9	——	——	25

GO ON TO THE NEXT PAGE

CANTERBURY REASONING TEST

Question No.			*Question No.*
26	0.25 1 5 30	——	26
27	0.2 0.4 0.6 0.8	—— ——	27
28	$\frac{1}{2}$ 1 3 12	—— ——	28
29	192 24 4	—— ——	29
30	7 CONFUSE 5 ABUSE 3 USE 1	——	30
31	7-1 ALARMED 7-2 DEMRALA 3-1 ALA 3-2	——	31
32	1 6 30 120	—— ——	32
33	1 8 32 64	——	33
34	64 32 8 1	——	34
35	1 2 1 3 2 5 4 8 7	—— ——	35
36	E D L K E D D C L	—— ——	36
37	10 9 11 8 14 7	—— ——	37
38	The sum of the of 11 and 6 exceeds twice the sum of their by 25.	—— ——	38
39	The difference between 8 and is equal to twice the sum of their minus 141.	—— ——	39
40	TORPEDO 654X1 DEPOT 6X1	——	40
41	$\frac{3}{4}$ 3 9 18	—— ——	41
42	56 1 28 3 14 9	—— ——	42
43	CHARMED 74635 DREAM 467	——	43
44	6 10 4 24 20	—— ——	44
45	1 16 4 8 16 4	—— ——	45
46	20 40 30 90 70	—— ——	46
47	2F 6I 18L 54	——	47
48	M3 O6 R18 T	——	48
49	169 121 49 25	—— —— ——	49
50	A B C E G	—— ——	50

THE CANTERBURY STUDENT PERSONALITY SCALE

Prepared by G. A. Shouksmith

TEST BOOKLET

Directions

The following test contains a number of statements about which there is no general agreement. People differ in the ways in which they feel about the statements and there are no right or wrong answers. [redacted] Try to say what you really believe rather than say what you *think* we want you to say!

Part I contains certain statements which are comments or opinions about various aspects of life. In Part I, your job is to study each statement and then to indicate on the answer sheet your feelings about the statement in terms of one of the following categories:

Strongly Agree (S.A.)		Disagree (D)
Agree (A)	Undecided (U)	Strongly Disagree (S.D.)

Look at the example:

A "All milk sold to the public should be pasturised."

Now look at the answer sheet. Alongside 'A' under examples you will see the letters:

S.A. A. U. D. S.D.

Place a cross over the letter or pair of letters which best indicate what you feel about the statement. You should do this for every statement in Part I. Try to express strong feelings as often as you can and only use the middle 'U' category very occasionally, when you just cannot make up your mind.

Parts II and 111 contain questions relating to your health, personality and general life. In Parts II and III you are to answer whether the questions are true for you;

Almost Always (A.A.)		Rarely (R.)
Frequently (F.)	Occasionally (O.)	Almost Never (A.N.)

Look at the example:

B "Do you fall asleep easily?"

Now look at the answer sheet under examples. Opposite 'B' you will find the letters:

A.A. F. O. R. A.N.

Place a cross over the letters which express best how easily you do fall asleep.

Again you are asked to use the middle category (O.) only when no other seems at all suitable.

ARE THERE ANY QUESTIONS?

Turn to Part I and begin.

PART I

Item No.

1 There is an equal opportunity for all to pursue University and Training College studies.

2 You can learn more by going to work than by contining your studies after the age of fifteen.

3 There is such a lack of competition that many of the top positions in the country are occupied by people of mediocre standing.

4 Almost anything can be fixed up in the courts if you have enough money.

5 Education should be pursued for its own sake and not for what one can get out of it.

6 A hungry man has the right to steal.

7 Modern education over-emphasises the importance of the child.

8 There is too much disparity between sentences for the same crime.

9 Success is more dependent on luck than real ability.

10 Education makes a person discontented.

11 The British legal system is without doubt, the best possible.

12 Lawyers are shrewd but usually honest.

13 There is no racial discrimination in this country.

14 Education enables one to advance more quickly, than does real ability.

15 This country does not have enough to say to make its voice heard in international circles.

16 Juries and Judges can be bribed.

17 The police force always handle things in the best possible manner.

18 Our legal system needs greatly improving.

19 Borstals only further corrupt their inmates.

20 The law protects properties and groups to the detriment of the individual.

PART II

21 As a rule do you feel self conscious when speaking before a class?

22 If you had a problem concerned with your work, would you approach a staff member about it?

23 Do you often feel inferior in social situations?

24 Do you take an active part in group discussions?

25 Do you enjoy yourself at parties?

26 As a general rule, do you make the most of the opportunities you get to make new friends?

27 Have you a large circle of acquaintances?

28 Do you find difficulty in talking for any length of time to people whom you know only slightly?
29 Do you hesitate to ask questions on anything you don't understand?
30 Do you feel shy at a party, early on in the evening?
31 Do you make friendly contacts with members of the opposite sex?
32 Do you usually feel at ease when approaching staff members?
33 Do you speak to people you have met if you see them again?
34 Do you enjoy most social affairs?
35 Do you usually have difficulty in saying the right thing at the right time?
36 Do you attend social functions for purposes other than enjoyment?
37 Are you ever embarrassed by lack of experience in social situations?
38 Do you find it easy to express your ideas?
39 Do you envy people who attend social functions often and regularly?
40 Do you ever refrain from expressing your ideas because of self-conscious feelings?

PART III

41 Does criticism usually disturb you?
42 Are you often miserable?
43 Are you troubled by useless thoughts?
44 Do you need to visit your Doctor frequently?
45 Are you depressed by low marks?
46 Do you feel lonesome even when in company?
47 Do you get up feeling tired?
48 Do you suffer from indigestion?
49 Are you often offended by others?
50 Are you afraid of being alone?
51 Do humiliating experiences stay a long time on your mind?
52 Do senseless ideas keep disturbing you?
53 Are you troubled with feelings of inferiority?
54 Do you feel self-conscious?
55 Do you brood too long over discouragements?
56 Do you worry over trifling matters?
57 Do you feel that your friends are disappointed in you?
58 Do you get excited easily?
59 Do you catch the 'flu easily?
60 Are you a moody person at times?

SELF-EVALUATION QUESTIONNAIRE

STAI FORM X-1

NAME _____ DATE _____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you *feel right now*, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	①	②	③	④
2. I feel secure	①	②	③	④
3. I am tense	①	②	③	④
4. I am regretful	①	②	③	④
5. I feel at ease	①	②	③	④
6. I feel upset	①	②	③	④
7. I am presently worrying over possible misfortunes	①	②	③	④
8. I feel rested	①	②	③	④
9. I feel anxious	①	②	③	④
10. I feel comfortable	①	②	③	④
11. I feel self-confident	①	②	③	④
12. I feel nervous	①	②	③	④
13. I am jittery	①	②	③	④
14. I feel "high strung"	①	②	③	④
15. I am relaxed	①	②	③	④
16. I feel content	①	②	③	④
17. I am worried	①	②	③	④
18. I feel over-excited and "rattled"	①	②	③	④
19. I feel joyful	①	②	③	④
20. I feel pleasant	①	②	③	④

SELF-EVALUATION QUESTIONNAIRE

STAI FORM X-2

NAME _____ DATE _____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
21. I feel pleasant	①	②	③	④
22. I tire quickly	①	②	③	④
23. I feel like crying	①	②	③	④
24. I wish I could be as happy as others seem to be	①	②	③	④
25. I am losing out on things because I can't make up my mind soon enough	①	②	③	④
26. I feel rested	①	②	③	④
27. I am "calm, cool, and collected"	①	②	③	④
28. I feel that difficulties are piling up so that I cannot overcome them	①	②	③	④
29. I worry too much over something that really doesn't matter	①	②	③	④
30. I am happy	①	②	③	④
31. I am inclined to take things hard	①	②	③	④
32. I lack self-confidence	①	②	③	④
33. I feel secure	①	②	③	④
34. I try to avoid facing a crisis or difficulty	①	②	③	④
35. I feel blue	①	②	③	④
36. I am content	①	②	③	④
37. Some unimportant thought runs through my mind and bothers me	①	②	③	④
38. I take disappointments so keenly that I can't put them out of my mind	①	②	③	④
39. I am a steady person	①	②	③	④
40. I get in a state of tension or turmoil as I think over my recent concerns and interests	①	②	③	④

A STATE RESPONSE SCALE.

For each of the following statements,

a. circle each letter or pair of letters which best indicates how you feel RIGHT NOW.

b. Mark along each continuum, with an 'X', the point which best indicates how you feel RIGHT NOW.

Try to express strong feelings either way, as much as possible and only use the middle 'U' category very occasionally, when you just cannot make up your mind.

SD = Strongly Disagree
D = Disagree
U = Uncertain
A = Agree
SA = Strongly Agree

eg. 'I feel sad.' SD D U (A) SA

1. I feel irritable.	SD	D	U	A	SA
2. I feel cheerful and happy.	SD	D	U	A	SA
3. I feel fatigued and tired.	SD	D	U	A	SA
4. I feel relaxed.	SD	D	U	A	SA
5. I feel depressed and unhappy.	SD	D	U	A	SA
6. I feel energetic and active.	SD	D	U	A	SA
7. I feel tense and anxious.	SD	D	U	A	SA

APPENDIX 6

UNIVERSITY OF CANTERBURY DEPARTMENT OF PSYCHOLOGY

A SURVEY OF CAFFEINE INTAKE (AND SMOKING) AMONG STUDENTS

Date of Birth: .....

Sex: Male ( )
Female ( )

Degree studying for .....

SECTION A.

Coffee Drinking

If you drink coffee answer the following questions and tick the appropriate response categories. If you don't drink coffee then go on to Section B.

N.B. 1 cup refers to one standard-sized breakfast cup.

1. What is your typical daily intake of coffee?

Irregular (less than daily) ( )
1 - 3 cups a day ( )
4 - 7 cups a day ( )
More than 7 cups a day ( )
(Please specify) .....

2. Please indicate how much coffee you usually drink next to the following times.

Breakfast ..... cup(s)
Morning tea ..... cup(s)
Lunch ..... cup(s)
Afternoon tea ..... cup(s)
Dinner ..... cup(s)
Supper ..... cup(s)
Other (please specify): .....
.....
.....
.....

3. Does your coffee drinking fluctuate according to your mood? (eg. does it increase with exam-time stress)

Yes ( )
No ( )

4. If so, when do you drink more coffee? .....
.....
.....
.....
.....

SECTION B

Tea Drinking

If you drink tea, please answer the following questions and tick the appropriate response categories. If you don't drink tea, then go on to Section C.

1. What is your typical daily intake of tea?

Irregular (less than daily) _____( )
1 - 3 cups a day _____( )
4 - 7 cups a day _____( )
More than 7 cups a day _____( )
(Please specify) ..... ( )

2. Please indicate how much tea you usually drink, next to the following times.

Breakfast .....cup(s)
Morning tea .....cup(s)
Lunch .....cup(s)
Afternoon tea .....cup(s)
Dinner .....cup(s)
Supper .....cup(s)
Other (please specify).....
.....
.....
.....

3. Does your tea drinking fluctuate according to your mood?

Yes ( )
No ( )

4. If so, when do you drink more tea? .....
.....
.....
.....

SECTION C

Please answer the following questions and tick the response categories where appropriate.

1. What is your usual daily intake of cocoa?

Irregular (less than daily) ( )
Daily ( )
More than once a day (please specify).....( )
.....

2. Do you eat chocolate?

Less than daily? ( )
Daily? ( )
More than once a day? (Please specify) .....( )
.....

3. Do you ever take any tablets which contain caffeine? (e.g. No-Doz, Cafergot, Migril, Ergodryl).

Yes ( )
No ( )

What tablets do you take?

.....

.....

How frequently do you take these tablets?

.....

.....

SECTION D

People drink tea and coffee, and smoke, for a variety of reasons. How important are each of the following statements to YOU? Please circle your response.

N.B. 1. = very, very important
2. = fairly important
3. = not important

Reasons Why Survey Respondents Drink Coffee and Tea.

I drink coffee/tea because:	Coffee			Tea		
1. I like the taste	1	2	3	1	2	3
2. I want to be sociable	1	2	3	1	2	3
3. It helps me to relax	1	2	3	1	2	3
4. The people I know do	1	2	3	1	2	3
5. It keeps me going when I am busy.	1	2	3	1	2	3
6. It is the polite thing to do when I am offered one.	1	2	3	1	2	3
7. I need something to do	1	2	3	1	2	3
8. I am tense and anxious	1	2	3	1	2	3
9. It has a calming effect	1	2	3	1	2	3
10. I am thirsty	1	2	3	1	2	3

very, very important
fairly important
not important
very, very important
fairly important
not important

SECTION E:

2

SELF-EVALUATION QUESTIONNAIRE

STAI FORM X-2

NAME _____ DATE _____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
21. I feel pleasant	①	②	③	④
22. I tire quickly	①	②	③	④
23. I feel like crying	①	②	③	④
24. I wish I could be as happy as others seem to be	①	②	③	④
25. I am losing out on things because I can't make up my mind soon enough	①	②	③	④
26. I feel rested	①	②	③	④
27. I am "calm, cool, and collected"	①	②	③	④
28. I feel that difficulties are piling up so that I cannot overcome them	①	②	③	④
29. I worry too much over something that really doesn't matter	①	②	③	④
30. I am happy	①	②	③	④
31. I am inclined to take things hard	①	②	③	④
32. I lack self-confidence	①	②	③	④
33. I feel secure	①	②	③	④
34. I try to avoid facing a crisis or difficulty	①	②	③	④
35. I feel blue	①	②	③	④
36. I am content	①	②	③	④
37. Some unimportant thought runs through my mind and bothers me	①	②	③	④
38. I take disappointments so keenly that I can't put them out of my mind	①	②	③	④
39. I am a steady person	①	②	③	④
40. I get in a state of tension or turmoil as I think over my recent concerns and interests	①	②	③	④

SECTION F:

If you smoke, please answer the following questions and tick the appropriate response categories.

1. How many cigarettes do you usually smoke daily?

Irregular (less than daily)	( )
1 - 5	( )
6 - 10	( )
11 - 15	( )
16 - 20	( )
More than 20 (please specify)	( )

.....

2. At which of the following times do you smoke?

Breakfast	( )
Morning Tea	( )
Lunch	( )
Afternoon tea	( )
Dinner	( )
Supper	( )
Other (please specify)	

.....

.....

3. I smoke because:

	not important	fairly important	very, very important
1. I like the taste	1	2	3
2. I want to be sociable	1	2	3
3. It helps me to relax	1	2	3
4. The people I know do	1	2	3
5. It keeps me going when I am busy	1	2	3
6. It is the polite thing to do when I am offered one.	1	2	3
7. I need something to do	1	2	3
8. I am tense and anxious	1	2	3
9. It has a calming effect	1	2	3

APPENDIX 7

Use of Coffee and Tea for their Stimulant Effects

In response to the questions '.... when do you drink more coffee/tea??, many of the survey respondents referred to situations in which stimulant effects may be important. Table 25 summarizes the proportions of male and female survey respondents who increase their coffee and tea intake for each situation.

TABLE 25: Times of Increases in the Coffee and Tea Intake of Male and Female Survey Respondents.

	COFFEE		TEA	
	Males (n=161)	Females (n=171)	Males (n=132)	Females (n=150)
Tired/to stay awake	44%	29%	13%	20%
Depressed/ unhappy	6%	7%	3%	13%
Bored/sitting for any length of time	10%	27%	19%	24%
Need to think/requiring concentration	8%	5%	3%	-
Physically busy	8%	3%	9%	9%

The largest proportions of males reported increased coffee intake when tired or to stay awake and increased tea intake when tired or to stay awake and when bored or sitting

for any length of time. The largest proportions of females reported increased coffee and tea intake at these times also.

It cannot be assumed that reports of increased tea and coffee consumption at these times reflect usage of these substances as stimulants, for some respondents may be using coffee and tea as 'time-fillers,' however, the survey findings do show that a high proportion of people are aware of the stimulant properties of coffee and tea, especially as reflected in the high proportion of people who increase their coffee and tea intake when they are tired but want to stay awake.

APPENDIX 8

Time of Day of Coffee and Tea Consumption Among Survey Respondents

The survey gathered information to show the times of the day at which people drink coffee and tea. Table 26 shows that of coffee drinkers most males drink coffee during the day whereas most females drink coffee in the evening. The smallest proportion of coffee-drinkers drink coffee at breakfast although this proportion is still over fifty per-cent for both males and females.

TABLE 26: Time of Day of Coffee Consumption of Survey Respondents.

	MALES (n=161)	FEMALES (n=171)
Breakfast	52%	52%
Morning tea) Lunch) Afternoon tea)	75%	69%
Dinner) Supper) Night-time)	61%	78%

Table 27 shows that, of tea-drinkers, the greatest proportion drink tea at breakfast time in contrast to coffee-drinkers. Similar proportions of male and female tea-drinkers drink tea during the day and during the evening.

TABLE 27: Time of Day of Tea Consumption of Survey Respondents.

	MALES (n=132)	FEMALES (n=150)
Breakfast	59%	58%
Morning tea) Lunch) Afternoon tea)	55%	48%
Dinner) Supper) Night-time)	53%	52%

In an extensive questionnaire looking at coffee drinking amongst housewives, Goldstein and Kaizer (1969) found that heavy coffee drinkers were more likely to drink coffee at breakfast compared with light coffee-drinkers. They explained this finding by the theory that heavy coffee-drinkers are drinking coffee in the mornings to relieve caffeine-withdrawal symptoms. The survey findings supported the findings of Goldstein and Kaizer; 33% of the heavy coffee drinkers (four or more cups a day) reported that they drink coffee at breakfast compared with only 18% of the light coffee-drinkers (less than four cups d day).

Looking at the times of day of coffee consumption may serve as a useful aid to discerning caffeine dependence amongst individuals.

APPENDIX 9

Smoking Behaviour Amongst Survey Respondents.

Section E of the survey was designed to gather information about cigarette smoking. Only 23% of females and 19% of males in the survey population reported smoking regularly and the daily quantities are shown in Table 28.

TABLE 28: Daily Quantities of Cigarettes Smoked by Survey Respondents.

	MALES (n=35)	FEMALES (n=47)
Irregular (less than daily)	34%	40%
1-10 daily	29%	26%
11-20 daily	29%	30%
> 20 daily	8%	4%

It is apparent that most smokers smoke irregularly although approximately 60% of smokers smoke between one and twenty cigarettes a day. Only 8% of males and 4% of females reported smoking more than two packets a day.

Tables 29 and 30 show the importance of physical properties, social situation, activities and beliefs about calming effects in determining cigarette smoking among male and female survey respondents, respectively. Clearly, for smokers, the belief that cigarette smoking has calming effects

defined as four or more cups of coffee per day, and frequent cigarette smoking as six or more cigarettes per day). Such an interaction has been previously reported in a number of studies. (Hickey, Clelland, Harner and Boyce, 1973; Kozlowski, 1976; Parsons and Heims, 1978; Marshall, Epstein and Green, 1980a, 1980b).