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Caffeine : expectancy and pharmacological effects

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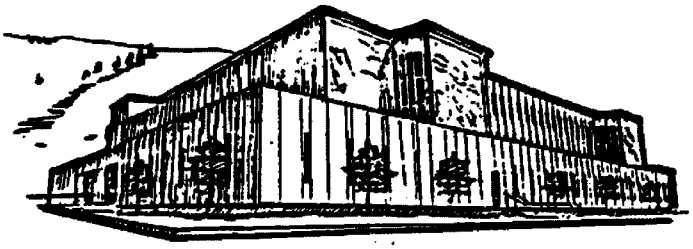

CAFFEINE: EXPECTANCY AND PHARMACOLOGICAL EFFECTS

by

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ABSTRACT

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The present study explored individual differences in reactivity to caffeine due to pharmacological, placebo, expectancy, and personality effects.

A randomized balanced placebo design was used with 100 male undergraduates who were regular caffeine consumers, assigned to four groups: (1) receive caffeinated coffee (150 mg)/expect caffeinated, (2) receive decaffeinated coffee/expect caffeinated, (3) receive caffeinated coffee/expect decaffeinated, and (4)receive decaffeinated coffee/expect decaffeinated. Reactivity to caffeine was assessed by subjective reported effects and changes in pulse rate, blood pressure, mood state, and scores on Digit Symbol and Trailmaking. Scores on the Eysenck Personality Inventory (EPI) and the Eysenck Personality Questionnaire-Revised (EPQ-R) assessed effects of extraversion/introversion. Subjects' ratings of the expected effects of consuming one serving of caffeine were used as the expectancy measure.

Experimental manipulation of expectancies was highly effective; subjects' judgements of the amount of caffeine in their coffee were consistent with their instructional set, regardless of actual caffeine content. Instructional set and caffeine content appeared equally powerful and worked additively to affect subjects' ratings on how much the coffee affected their mood and performance. A main effect for caffeine only was found on pulse, systolic and diastolic blood pressure, and fatigue measures. Caffeinated coffee decreased pulse rate, produced higher systolic and diastolic blood pressure, and reduced fatigue significantly more than decaffeinated coffee.

Planned analyses on the effects of expectancies about caffeine consumption or extroversion/introversion were not significant. Exploratory analyses suggested that subjects in Group 1 alone assessed the effects of their coffee in significant correlation with their expectancies. Exploratory analyses on the effects of extraversion/introversion are discussed.

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Introduction

Caffeine

Caffeine is perhaps the most commonly used stimulant in our society. It is widely available in many forms: in coffee, tea, soft drinks, and many over-the-counter drugs. Most people assume that caffeine is a harmless way to wake up, to decrease the effects of boredom, and to improve performance on a number of behaviors, among other expected benefits. In fact, it is rarely even thought of as a drug.

A review of the literature on the effects of caffeine shows that caffeine is not a benign agent, however, and there is mounting evidence that overuse, and even moderate use, of caffeine can result in a variety of deleterious physiological and psychological effects. In 1980, the American Psychiatric Association included *caffeinism* in the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1980) as an organic mental disorder. The symptoms of caffeinism can include restlessness, rambling flow of thought and speech, diuresis, cardiac arrhythmias, gastrointestinal problems, insomnia, and other symptoms which are quite difficult to separate from anxiety disorders. In a study performed on undergraduate students at the University of Montana and the University of Wyoming, 16.5% of 527 subjects were classified as caffeinism syndrome-present, having endorsed five or more signs of caffeinism on a twelve item checklist modified from

the DSM-III criteria, the same cut off employed in the DSM-III. A replication of the same study on 270 University of Montana students revealed that 23.7% of the students were caffeinism syndrome-present (Bradley & Petree, 1990). Also, Greden et al. (1978) reviewed several surveys of the use of psychotropic drugs in the United States and Canada and found that 20 to 30% reported consuming 500 to 600 mg of caffeine per day. Since caffeinism symptoms begin to appear above this level, this is a concern in the general population as well as the college population.

Caffeine worsens and confounds psychiatric symptomology and can interfere with therapeutic medicine; hence it has been recommended that caffeine intake be limited in psychiatric patients (Pilette, 1983). James et al. (1987) found that heavy caffeine users' somatic and psychological health on many measures greatly resembled that of psychiatric patients, clearly showing caffeine's mood and behavior altering properties. Another study (Gilliland and Andress, 1981) found that high and moderate users of caffeine reported significantly higher levels of anxiety and depression, and that the moderate use group did not differ much from the high users. Christensen and Burrows (1990) report that a diet free of caffeine and refined sucrose significantly reduced depressed subjects' level of depression, even at a three month follow-up. Krietsch, Christensen, and White (1988) found a significant worsening

of mood in previously depressed subjects when administered caffeine. Substantial caffeine reduction significantly reduced anxiety, irritability and sleep disturbance in anxious patients, and is suggested in the management of anxiety (Smith, 1988).

Caffeine (about the equivalent of two cups of coffee) has been shown to increase resting blood pressure and have an additive effect with stress in increasing blood pressure, having clear implications for cardiovascular disease exacerbation (France & Ditto, 1988; Lane, 1983; Lane & Williams, 1987). Lane and Williams (1987) report that this effect is not moderated by regular caffeine use. Thus, although tolerance to caffeine's stimulating effects has been found (Colton, et. al., 1962) this tolerance does not moderate caffeine's blood pressure raising effects.

Additional concern for caffeine consumption come from the possible dangers to children of mothers who consume caffeine during pregnancy. Jacobson et al. (1984) found a positive association between levels of mothers' caffeine consumption and shorter gestation time, poorer neuromuscular development and decreased reflex functioning.

Caffeine has recently begun to be considered as a drug of abuse. Evidence that a tolerance develops to caffeine, that withdrawal symptoms occur when regular users abstain from it, that some people experience difficulty in giving up caffeine, that caffeine is self administered for its

effects, and that it is used up to levels of caffeine intoxication and adverse effects support this idea (Gilliland and Bullock, 1984; Hughes, et. al., 1991). Caffeine is an important factor, then, to consider in both the psychological and physical health of the population.

The Effects of Caffeine

As reported in a review by Sawyer, Julia, and Turin (1982) the general effect of caffeine is to stimulate the central nervous system, affecting the cerebral medullary respiratory, vasomotor and vagal centers. Caffeine produces increases in blood pressure, respiration, anxiety reactions, reduced fatigue, increased anxiety, restlessness, periods of depression, tremors, flushing, and insomnia.

Individual differences in reactivity to caffeine also affect caffeine's stimulating properties. For instance, the time period of caffeine's effects may vary across individuals so that the metabolic half-life of caffeine can vary from 2 1/2 to 10 hours (Gilliland and Bullock, 1984; Horning et al., 1977). High caffeine users appear to develop a tolerance to the drug and show different reactions to caffeine than low caffeine users, which is another factor to consider in individual differences (Colton, et. al., 1968; Loke & Meliska, 1984; Kuznicki & Turner, 1986). Withdrawal symptoms (headache, anxiety, etc.) appear when

regular caffeine consumers abstain from caffeine (Hughes, et. al., 1991; White, 1980). Thus, while caffeine use is associated with increased anxiety, caffeine withdrawal will produce elevated levels of anxiety in regular users. Other factors that interact with caffeine to produce individual differences in reactivity are smoking, which has an antagonistic affect (Rose, 1987), and consumption of alcohol. The interaction between alcohol and caffeine is varied, but the combination generally serves to decrease caffeine's stimulating effect (Obourne & Rogers, 1983). Another variable that interacts with caffeine is estrogen level in females (Arnold et al., 1987).

It is no surprise following a discussion of individual differences in reaction to caffeine to discover that performance effects vary widely. A summary of these effects by Sawyer et al. (1982) shows (1) prolonged and slightly increased ability to perform exhausting activity, (2) and unpredictable effect on simple and complex tasks involving choice and discrimination, (3) hand unsteadiness, (4) possible influences on eye-hand coordination, and (5) improved performance in simple arithmetic, typing, and decoding.

The Effects of Caffeine and Personality Variables

In studying individual differences in reactivity to caffeine, research has supplied evidence that subject groups

differ in reactivity to caffeine due to the subject personality types. Subjects in these studies are divided into groups on the basis of Eysenck's theory of introversion-extraversion (Keister & McLaughlin, 1972; Gilliland, 1980). Eysenck (1967) defines introversion/extraversion as a stable personality variable. He defines extraverts as those who show greater sociability, impulsivity, activity, liveliness, and excitability. Introverts tend to be "thoughtful, reasonable, serious and high principled" (1967, p.36). Eysenck's formulation of introversion-extraversion states that the basic difference between the personality types is that the resting level of cortical arousal is greater in introverts, thus people of this type tend to seek less stimulation from the environment than extraverts. Extraverts, on the other hand, are not as physiologically aroused, and seek arousal from the environment. Also, according to Eysenck, given equally stimulating environments, introverts should show greater physiological arousal.

Research on the arousal level of introverts and extraverts has been extended to include different performance effects after caffeine due to personality type. Keister and McLaughlin (1972) found that, on a task to detect odd-even-odd sequences in a recording of numbers, the performance of extraverts (as measured by the Eysenck Personality Inventory; EPI, Eysenck, 1964) over time

worsened while the performance of introverts remained the same. After 200 mg. of caffeine, however, the performance of both the extraverts and introverts remained constant across time, suggesting that the increased stimulation improved the extraverts performance.

Gilliland (1980) also found that introverts and extraverts, as measured by the Eysenck Personality Inventory (EPI; Eysenck, 1964), reacted differently to the same doses of caffeine. Introverts tended to show dramatic improvement in performance on a Graduate Record Examination practice test with low doses of caffeine (2 mg/kg body weight), followed by even more dramatic decrements when the dose was increased (4 mg/kg body weight). Extraverts showed much less dramatic improvement in performance across increasing doses, and did not appear to have performance decrements even at high levels of caffeine consumption. Gilliland borrowed from the Yerkes Dodson model of optimal arousal to explain the results; that introverts were already physiologically aroused and the high dosage of caffeine placed their arousal above a level that would improve performance. Introverts were too aroused at the higher dosage level, and therefore, their performance was degraded.

Although introversion/extraversion, as measured by the EPI, seems to be an important variable in caffeine research, it is not clear that this unitary variable is the most important variable as it relates to caffeine. There is

important variable as it relates to caffeine. There is evidence that the EPI Extraversion scale is primarily composed of the subfactors Impulsivity and Sociability (Campbell & Reynolds, 1984; Guildford, 1977; Howarth, 1976; Revelle, et al., 1980). Research on these components suggests that Impulsivity in particular may, in fact, better measure the variable under consideration and should be used instead of the more unitary variable of introversion/extraversion (Gray, 1981; Revelle, et al., 1980; Wolfe & Kasmer, 1988).

Revelle, et al. (1980), in a replication and extension of Gilliland's study, report that the Impulsivity subscale of the EPI yields the most robust prediction in regards to differential reactions to caffeine. They state that using the unitary introversion/extraversion measure added nothing and "may even detract from the effects noted" (1980, p. 10).

Revelle and his colleagues state that low and high impulsives, as measured by nine questions from the EPI Extraversion scale, differed in their reactions to caffeine across caffeine levels and time of day. They found that caffeine worsened the performance of the already aroused low impulsives and enhanced the performance of the under-aroused high impulsives only in the morning; in the evening, the opposite was true. Revelle, et al. suggest that the high and low impulsives differed not in their cortical arousal level, but in the phase of their diurnal rhythms.

Therefore, in the morning, the low impulsives are optimally aroused without caffeine and caffeine leads to performance decrements because they become too aroused. In the evening, however, the low impulsives are not as aroused and caffeine aids their performance. For high impulsives in the morning, caffeine aids their performance because they are not optimally aroused. In the evening, they are in their arousal phase, and caffeine leads to performance decrements. Sociability, as measured by the EPI, did not appear to be related to the diurnal rhythm of arousal.

It is difficult to compare the results of these studies, as what constitutes "performance effects" differs from study to study. However, it appears that caffeine may have a differential stimulating effect across levels of the introversion/extraversion (or low impulsive/high impulsive) dimension of personality which can effect performance on different tests. How best to operationalize this personality variable is less clear.

The Placebo Effect and Expectancy

In recent years, research on the behavioral effects of various drugs has been shown to be under the effects of cognitive as well as pharmacological factors. For instance, the expectancy, or belief, of having consumed a drug has been found to have a large impact on ensuing behavior that is separate from the actual effects of the drug. This

research depends upon the use of a placebo, or an inactive ingredient given to the subject when s/he is told that it is the active drug. Placebos have been shown to reduce clinical pain, increase sexual arousal, reduce generalized anxiety and depression, cause or reduce feelings of nausea, and induce feelings of alertness, tension, relaxation, or drowsiness, among others. The subjective responses often occur with corresponding physiological changes, such as changes in heart rate, blood pressure, and galvanic skin response (Barber, 1978; Marlatt & Rohsenow, 1980; Ross & Olson, 1982; Ross & Buckalew, 1983).

Placebo effects generally correspond to the subject's beliefs about the kind of drug that they think they are receiving, i.e. belief that one has consumed alcohol will produce "alcohol-induced" type behavior. Consequently, a causal relationship has been assumed between expectancy and placebo reaction. However, classical conditioning has been proposed as a rival hypothesis to expectancies (eg. Gliedman et al, 1957). In this model, consumption of active drugs are the conditioning trials where the active agent is associated with a variety of concurrent and antecedent stimuli that can elicit the response in placebo trials. The balanced placebo design (Marlatt & Rohsenow, 1980) has been very useful in separating the pharmacological effects from the belief that the drug has been consumed. This design produces a matrix that has the following four conditions:

(1) Subjects are told they will get drug/receive drug

(2) Subjects are told they will get drug/get placebo

(3) Subjects are told they will get placebo/receive drug

(4) Subjects are told they will get placebo/get placebo

This design has shown that some placebo responses are unrelated to the pharmacological effects of the active drug and, therefore, cannot be accounted for by classical conditioning models. For example, the pharmacological effect of alcohol is to decrease sexual arousal (Farkas & Rosen, 1976). However, consistent with popular belief, subjects who thought that they had consumed alcohol showed increased arousal to erotic stimuli (Bridell et al., 1978; Wilson & Lawson, 1976). Although classical conditioning may account for part of placebo effects, it is unlikely that it accounts for all effects.

Placebo and drug effects are generally assumed to be additive. That is, the subject who consumes an active drug and believes that he has consumed the active drug will show more profound behavior of the sort usually associated with that drug than the subject who has consumed a placebo but believes he has consumed the active drug. Thus, using the four conditions of the balanced placebo design, one might hypothesize that the behavior of the subjects in condition 1 will show the most marked effects of the drug and expectancy, and that subjects in condition 4 will show the least marked effects. Conditions 2 and 3 serve to show

whether the drug/effects or the expectancy effects are the strongest, and thus are perhaps the most interesting of the conditions. The balanced placebo design has been used primarily in alcohol research and has suggested that expectancy and pharmacological effects are at least equal in ability to affect behavior. In fact, many studies using the double placebo design with alcohol found that only expectancy set, not alcohol affected such behaviors as sexual arousal and "loss of control drinking" (Briddell, et al., 1978; Marlatt, Demming, and Reid, 1973; Wilson and Lawson, 1976). Also, an early study that isolated pharmacological and placebo effects of amphetamine found that expectancy effects were equal to or greater than pure pharmacological effects (Ross et al., 1962).

Caffeine and Placebo-Type Expectancies

The expectancy of having consumed caffeine has been shown to have a strong effect on performance. In a review by Flory and Gilbert (1943) it was concluded that (1) when college students are given caffeine and a placebo, the placebo group shows performance increases "practically as much" as the caffeine group, and (2) placebo subjects will also report mood effects ranging from extreme irritability to drowsiness. Blount and Cox (1985) had subjects guess whether they had consumed caffeinated coffee or not and the brand of coffee consumed. Subjects were able to identify

brand with a better than chance accuracy, but not caffeination. They conclude that the ability to detect caffeine in coffee is lost below 200 mg/cup.

An important study for placebo tests compared the differences of double-blind versus deceptive administration of decaffeinated coffee as a placebo (Kirsch and Weixel, 1988). The designs differ in that subjects in double-blind placebo tests are informed that they may receive either the active drug or the placebo, while both groups are told they are receiving the drug in deceptive administration. Because deceptive administration does not lead the subjects to suspect that they might be receiving the placebo, greater expectancies for the effects of the drug should result than in double-blind tests. Subjects were led to believe that they were being administered differing levels of caffeinated coffee, although all received decaffeinated. Measures in this design included subjective mood, performance measures (Digit Span, reaction time, and symbol substitution), and physiological measures (blood pressure and pulse rate). Subjects were also asked to report before placebo administration the effects that they thought caffeine had on them, and afterwards estimate the likelihood that they had obtained caffeinated coffee. The authors predicted a response curve from placebo effects that reflected expected levels of caffeine consumption, i.e. performance would increase up to a expected moderate dose of caffeine and

decrease in the higher expected levels. This curve was found on self-reported alertness, tension, systolic blood pressure, and subjective probability of having consumed caffeine, but only among subjects in the deceptive administration condition. The response curve for the double-blind condition on the same measures was in the opposite direction, i.e. performance was degraded with moderate expected doses of caffeine and improved with higher expected doses of caffeine.

Expectancy of Positive or Negative Consequences

Thus far, expectancy has been defined as the subject's belief that he has been given the active drug. This becomes more complicated when one realizes that another type of expectancy is involved in placebo tests - the expectancy that the drug one thinks one is getting will have a specific effect. This type of expectancy has been explored only recently and primarily in the alcohol literature. These studies have found that subjects not only have an expectancy that they have consumed alcohol, but they also have differing expectations about how alcohol makes them feel and behave. These findings have led to a number of studies that focus on this type of expectancy and its effect on the likelihood that people will engage in drinking behavior and to what extreme. In a review by Leigh (1989), several studies are cited that show that the greater the expected

positive reinforcement from alcohol, the greater the likelihood of increased alcohol consumption. Expectancies of this type, then, are seen as risk factors that effect the start and maintenance of drinking. They are considered to be motivational factors to drink.

This result has also been found in recent research on the consumption of caffeine (Bradley & Petree, 1990). Subjects were asked to report caffeine consumption for the month before and mark on a checklist the occurrence of caffeinism (caffeine intoxication) symptoms modified from the DSM-III criteria. A scale was also used to measure expectancies about enhanced performance from caffeine consumption. The scale contained six statements about positive results from caffeine: (1) to wake up in the morning, (2) to wake up or stay awake later in the day or evening, (3) to help with studying or work, (4) to improve performance, (5) to get energy, and (6) to improve concentration. The results showed that subjects who reported higher consumption of caffeine (even up to levels where caffeinism symptoms were present) also reported higher expectancy of positive results of caffeine consumption. Page (1987) also reported that college students who preferred to drink caffeinated beverages perceived more positive consequences of caffeine than those who did not prefer to drink caffeinated beverages.

Expectancy of positive or negative consequences has also been assumed to work like the belief that one has consumed a drug, i.e. in an additive manner with the actual consumption of the drug. Research on this type of expectancy is relatively rare, however, and the few studies that have been done have focused on alcohol effects and have yielded equivocal findings. Rohsenow and Bachorowski (1984) found inconsistent correlations between subjects' scores on two subscales of the Alcohol Expectancy Questionnaire (AEQ; Brown et al., 1980) and aggression following alcohol consumption. Only one of three experiments found a significant relationship between expectancies and aggression in subjects who expected to receive alcohol in a double placebo design. Rohsenow and Bachorowski suggested that subjects have many different expectancies regarding alcohol, and the interaction of these expectancies may produce non-significant results. Also suggested was that there may be a dose effect with expectancies; that aggression may be expected to result only after high doses. Lastly, the authors suggested that there may be individual differences in the effects of expectancies on aggression that muddy the effects of a group design.

Sher (1985) found that expectancies as measured by the AEQ showed the greatest effect on emotional changes after alcohol consumption and in a group setting with a placebo. Expectancies did not affect behavior following the actual

consumption of alcohol, and they were not as effective when subjects were tested individually. Also, the influence of expectancies upon behavior was found to be effective for only a short period. Sher suggested that alcohol expectancies may be specific only for the time period immediately following drinking. Alcohol expectancies may reflect conditioned responses to alcohol related stimuli, and therefore have the greatest influence in the drinking situation.

The only study found that addressed performance-related expectancies in caffeine consumption was the above mentioned one by Kirsch and Weixel (1988). They reported that the failure to find significant between-groups effects on performance measures appeared to be related to the subjects' expectancy about the effects of caffeine on them. Collapsed across experimental conditions, subjects' expectancies about caffeine's effects were significantly correlated with changes on Digit Symbol, reaction time, and rotor pursuit tasks. These correlations suggested to the authors that the placebo improved performance among the subjects who expected improvements and impaired the performance of those who expected impairment. They stated that, "although the magnitude of this effect is relatively small, it appears to be reliable across a variety of empirically unrelated tasks" (p. 322).

Summary and Hypotheses

The effects of caffeine have come under increased scrutiny in recent years. Caffeinism and other detrimental effects of caffeine have led researchers to take another look at this popular drug. The effects of caffeine upon factors such as performance have been discovered to be quite varied, and many individual differences have been noted (Tecce & Cole, 1974; Horning et al., 1977). Factors to consider in individual differences are high or low caffeine use (White, 1980; Loke & Meliska, 1984; Kuznicki & Turner, 1986), smoking (Rose, 1987), alcohol use (Obourne & Rogers, 1983), and sex of subjects (Arnold et al., 1987).

Another important variable to consider is the introversion-extraversion dimension of personality (Keister & McLaughlin, 1972; Gilliland, 1980; Revelle et al., 1980). Research has suggested that introverts are more reactive to the effects of caffeine than extraverts, perhaps because they are more physiologically aroused than extraverts (Eysenck, 1967). It is not clear, however, if introversion/extraversion is the best operationalization of the personality dimension at work; the subfactor of Impulsivity may in fact yield the best prediction in regards to differential reactions to caffeine (Revelle, 1980; Wolfe & Kasmer, 1989).

The behavioral effects of drugs have been shown to be under cognitive as well as pharmacological effects. The

The behavioral effects of drugs have been shown to be under cognitive as well as pharmacological effects. The expectancy of having consumed a drug has an large impact on behavior that is separate from the actual drug effects. This is called the placebo effect, from the finding that subjects will respond to a placebo as if they had received an active drug. The balanced placebo design (Marlatt & Rohsenow, 1980) separates the pharmacological effects from the belief that the drug has been consumed, thus showing the individual contributions of each upon behavior. Studies on the placebo effect of caffeine not using the balanced placebo design have found a strong effect of the expectancy that one has consumed caffeine on behavior (Flory & Gilbert, 1943; Kirsch & Weixel, 1988). It is important to note that the method of placebo administration will produce varied results, with the deceptive administration being superior to double-blind administration in producing the placebo effect (Kirsch & Weixel, 1988).

Another type of expectancy involves the beliefs regarding whether a drug will have certain effects or not. Research on this type of expectancy has come primarily from alcohol literature; this expectancy type has been found to be a motivator in drinking behavior (see Leigh, 1988). In one study of this type of expectancy about caffeine, subjects with higher expectancies of positive results from caffeine consumption consumed more caffeine, even up to

levels where caffeinism was present (Bradley & Petree, 1990).

Research linking expectancy variables with actual performance is relatively limited. The few studies reported in the alcohol literature produced divergent results (Rohsenow & Bachorowski, 1984; Sher, 1985). The only study that addressed performance expectancies concerning caffeine and measured performance was one by Kirsch and Weixel (1988). They reported that "although the magnitude of this effect is relatively small, it appears to be reliable across a variety of empirically unrelated tasks" (p. 322).

The present project attempted to further explore individual differences in reactivity to caffeine and what might affect these differences. The questions that were addressed were: What are the effects of placebo-type expectancies and purely pharmacological actions of caffeine upon behavior of male undergraduate students? What are the effects of the expectancy of caffeine's effect (positive, negative, or neutral) upon the same individuals' behavior? What is the effect of introverted/extraverted personality variables upon behavior following the consumption of caffeine? What is the effect of introverted/extraverted personality variables upon positive or negative expectancies regarding caffeine? Is the Impulsivity subfactor of Extraversion a better variable than global Extraversion to explore in relation to differences in caffeine reactivity?

Exploration of these questions would help to delineate caffeine's effects on performance, what part, if any, expectancies of both types play in performance variabilities, and provide suggestions for helping those who should decrease or avoid caffeine consumption.

The present study was exploratory and it was assumed that those hypotheses which were supported would require additional confirmation in later studies. Hypotheses that were tested were:

(1) Subjects who expected to get caffeinated coffee and actually did (Condition 1) would show greater elevation in mood, scores on performance tests, and physiological measures between Time 1 and Time 2 than subjects in the other conditions.

(2) Subjects who expected to receive decaffeinated coffee and actually did (Condition 4) would show smaller performance test score increases than subjects in the other conditions between Time 1 and Time 2. Mood scores, pulse rate and blood pressure would show no significant changes.

(3) Subjects who expected to get caffeinated coffee and received decaffeinated coffee (Condition 2) and subjects who expected to get decaffeinated coffee and received caffeinated coffee (Condition 3) would have increases in mood scores, performance test scores, and physiological measures between Time 1 and Time 2 which did not differ significantly due to group membership. The increases in

scores for these two groups, however, would be greater than those of subjects in Condition 4 but less than those of subjects in Condition 1.

(4) Subjects in Condition 1 would rate the effects of coffee received during the experiment as greater than subjects in the other conditions.

(5) Subjects in Condition 4 would report no significant effects of coffee received during the experiment.

(6) Subjects in Conditions 2 and 3 would report similar effects of coffee received during the experiment, and these effects would be greater than those of subjects in Condition 4 but less than those of subjects in Condition 1.

(7) Subjects with higher expectancies of caffeine improving mood and performance, who believed that they received caffeinated coffee (Conditions 1 and 2), would show greater improvements on these measures than subjects with lower expectancies in these conditions.

(8) Subjects with higher expectancies of caffeine degrading mood and performance, who believed that they received caffeinated coffee (Conditions 1 and 2), would show decrements on these measures. This effect would be more pronounced on the mood measure as practice effects on the performance tests may have lessened decrements on those tests.

(9) Subjects with higher expectancies of caffeine improving mood and performance, who believed that they had

been given caffeinated coffee (Conditions 1 and 2), would report greater positive effects of coffee received than subjects with lower positive expectancies in these conditions.

(10) Subjects with higher expectancies of caffeine degrading mood and performance, who believed that they had received caffeinated coffee (conditions 1 and 2), would report more negative effects of coffee received than subjects with lower negative expectancies in those conditions.

(11) Subjects who scored as introverts on the EPQ-R would show evidence of greater reactivity to caffeine than subjects who scored as extraverts on the EPQ-R, evidenced by greater increases in pulse rate, blood pressure, mood state and performance scores.

(12) Subjects who scored as introverts on the EPQ-R would score higher on the Effects of Coffee Received scale than subjects who scored as extraverts on the EPQ-R.

Planned exploratory analyses were done using EPI Impulsivity and Extraversion scores in place of EPQ-R Extraversion scores on Hypotheses 11 and 12 to ascertain whether these measures are more significantly related to changes in the dependent variables, as suggested by Revelle et al. (1980). Most of the previous research on Extraversion and drugs used the EPI, but this version will become obsolete and new studies will most likely use the EPQ

means that the relationship of EPI Impulsivity and Extraversion, instead of EPQ-R Extraversion, to drug reactivity may not be addressed. This exploratory analysis was intended to evaluate the impact of these instrumentation differences and to provide continuity in research on caffeine and personality variables.

METHOD

Subjects

Subjects were 100 male undergraduate students between the ages of 18 and 35. Females have been shown to exhibit differential responses to caffeine due to estrogen levels, therefore they were excluded from this study. Subjects were screened to ascertain if they are daily caffeine drinkers (1-4 cups of coffee or its equivalent/day), but not heavy caffeine users (greater than 4 cups of coffee or its equivalent/day), to control for individual differences in reactivity to caffeine due to level of caffeine use, and to ensure regular experience with the effects of caffeine. Subjects were also asked not to consume any caffeine after 6pm the night before testing to control for the effects of caffeine already consumed. Subjects were not allowed to use tobacco during testing to control the antagonistic effects of nicotine on caffeine. Testing was held in the morning to hold constant the possible diurnal variations in reactivity to caffeine and to make less likely that any caffeine had been consumed already that day.

Materials

A standard blood pressure cuff was be used to measure blood pressure. Coffee was be an instant decaffeinated brand. One hundred fifty mg. of Caffeine U.S.P.

(approximately the amount of caffeine in one strong cup of coffee) in powder form was added to the decaffeinated coffee for the caffeinated conditions, to insure the same amount of caffeine for all subjects. Caffeine doses were not varied by subjects' weight as subjects were expecting the caffeine from one cup of regular coffee, not varying levels.

Procedures

Subjects were randomly assigned to the four groups of the balanced placebo design: (1) told they were receiving caffeinated coffee/received caffeinated coffee, (2) told they were receiving caffeinated coffee, received decaffeinated, (3) told they were receiving decaffeinated coffee, received caffeinated, and (4) told they were receiving decaffeinated coffee, received decaffeinated. The administration of the coffee was deceptive administration (see Kirsch & Weixel, 1988) in that subjects were not told that they might receive either caffeinated or decaffeinated coffee. This was done to increase the likelihood that subjects believed what the examiner told them regarding caffeine content. Subjects read an explanation of the study which outlined the procedures that would be followed in the session, except the deceptive administration. All subjects were told that they would receive one cup of coffee, and the most probable effects of a mild dose of caffeine were outlined. Subjects were encouraged to tell the examiner if

any unpleasant reactions to the coffee occurred (see Appendix A).

After reading the explanation of the study, subjects had the following measurements taken:

1. Performance tests:

a. Digit Symbol from the WAIS-R (Weschler, 1981). This test required the subject to fill in the blanks below several rows of numbers with symbols that are matched with the numbers just above the rows, while being timed. It required attention, speed, and accuracy in replicating the symbols, and thus was hoped to be useful in ascertaining caffeine's effects. Digit Symbol has been used extensively in college populations, and often in tests of performance following caffeine consumption (Lieberman et al., 1987; Kirsch & Weixel, 1988). See Appendix B.

b. Trail Making Test, parts A and B (originally part of the Army Individual Test Battery, 1944). Trail Making has been a widely used test of visuomotor tracking, often part of a neuropsychological battery (Lezak, 1983). Subjects must draw lines to connect consecutively numbered and lettered circles while being timed, requiring attention, speed, and accuracy (see Appendix C and D).

3. Pulse: Subjects' pulse rates were measured at the wrist and timed on a stopwatch.

3. Blood pressure: Blood pressure was measured with a standard blood pressure cuff and stethoscope. All subjects

had their blood pressure measured by the same examiner to reduce variability of the measurements.

4. Caffeine Expectancy measure: Subjects completed a scale designed to measure their expectancies of the effects of one cup of coffee upon them. This scale consisted of six questions regarding caffeine's expected effects: five of the questions regarded mood changes from caffeine that resembled five of the scales from the POMS, and the sixth question referred to performance changes from caffeine (see Appendix E). The questions were similar to those used by Bradley and Petree (1990) to measure subjects' expectancy level regarding the effects of caffeine which had very consistent results with two large samples. The present scale included expectancies of positive and negative effects of caffeine, as recommended by Leigh (1989) in regards to alcohol expectancies, as subjects have expectancies of both positive and negative effects of various drugs. The scale was scored from 1-7, with a -3 being a 1, a -2 being a 2, etc. Thus, low scores suggested a higher expectancy of negative effects from caffeine, and a higher score suggested higher expectancy of positive effects.

5. Mood state - Subjects' present mood states were measured on the Profile of Mood States (POMS; McNair, et al., 1971), a standardized test designed to measure six mood types: Tension-Anxiety, Depression-Dejection, Anger-Hostility, Fatigue-Inertia, Vigor-Activity, and Confusion-

Bewilderment. These scores can be combined to obtain a Total Mood Disturbance (TMD) score, as well. All subscales and the TMD were used in the analyses. The Profile of Mood States has been used extensively in college populations and has been judged to be a reliable and valid measure of mood states (see McNair et al., 1971). See Appendix F.

Following these measures, subjects were given coffee with or without caffeine depending on group membership, and were told that they were either receiving caffeinated coffee or that they were "in the control group" and were receiving decaffeinated coffee.

After consumption of the coffee, 30 minutes were allowed to pass for the caffeine to take effect. During this time, subjects had the following measures taken:

1. Introversion/Extraversion and Impulsivity measures: Each subject completed the Eysenck Personality Questionnaire - Revised (EPQ-R) and the Eysenck Personality Inventory (EPI) during the interim. The extraversion scores on these tests were used in this design to differentiate between introverts and extraverts. The Impulsivity subscale scores from the EPI were used in the exploratory analyses. The EPI (see Appendix G) has been used extensively in research with populations similar to this one (Eysenck, 1964). The EPQ-R is a new formulation of the EPQ, and is in the process of being normed (see Appendix H).

2. Weight: a standard bathroom scale was used.

The subjects then had the following six measurements taken, the first five the same as above:

1. Mood State : Profile of Mood States.

2. Pulse : as before.

3. Blood Pressure: as before.

4. Performance tests:

    a. Digit Symbol from the WAIS-R (Weschler, 1981).

    b. Trail Making Test (Army Individual Test Battery, 1944).

5. Effects of Caffeine Received: a scale that asked subjects to rate the effects of the coffee that they received during the experiment, using the same six scales on the Caffeine Expectancy scale. The subjects also marked an additional item that asked them to judge the amount of caffeine that they received, from "no caffeine" to "greater than normal caffeine" (see Appendix I). This was used to gauge the effectiveness of the group manipulations.

Lastly, subjects in Groups 2 and 3, who were deceived as to the actual content of their coffee, were told of the deception. All subjects were invited to leave their name and address to receive the results of the study.

RESULTS

Estimates of Level of Caffeine

To gauge the effectiveness of the experimental manipulation, subjects' responses on item number seven of the Effects of Coffee Received scale (ECR) were analyzed in a 2 x 2 factorial analysis of variance (ANOVA), with two levels of caffeine (none/150 mg.) and two levels of expectancy set (receiving decaffeinated coffee/receiving caffeinated coffee). A significant main effect for expectancy set ($F(1,96)=32.72$, $p<.001$) was found. Subjects who were in the two groups that were told that they were receiving caffeinated coffee rated their coffee as having significantly more caffeine than subjects in the two groups who were told that they were receiving decaffeinated coffee, regardless of the actual caffeine content (M=4.38 vs. 3.00).

Effects of Balanced Placebo Design

To test Hypotheses 1-3, Profile of Mood State (POMS) scores, Digit Symbol (DS) scores, Trailmaking (TM) scores, pulse rate (PR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) from all four conditions from Times 1 and 2 were analyzed in a 2 x 2 factorial multivariate analysis of variance (MANOVA) with two levels of caffeine (none/150 mg.) and two levels of expectancy set (receiving decaffeinated coffee/receiving caffeinated coffee) and one repeated measure (Time). A significant main

effect for level of caffeine administration was found ($F(7,90)=2.598$, $p<.05$), and a significant caffeine by time interaction was found ($F(7,90)=2.4$, $p<.05$). Mauchly's sphericity test and Box's M test were used to test the "symmetry conditions" required for univariate analyses, which state that the variances of the variables should equal, the covariances should be zero, and the variance-covariance matrices for the variables for an effect should be equal for all levels of the between-subjects factors. While both of these tests were significant ($p<.01$), the main effect for level of caffeine administration was judged to be significant enough to compensate ($p=.017$). Therefore, univariate analyses were carried out. Group means are summarized in Table 1.

Univariate analyses of the dependent measures from Times 1 and 2 revealed a significant interaction between level of caffeine administration and Time for PR ($F(1,96)=4.77$, $p<.05$), SBP ($F(1,96)=6.18$, $p<.05$), DBP ($F(1,96)= 8.10$, $p<.01$), and the Fatigue-Inertia (FI) scale on the POMS ($F(1,96)=5.59$, $p<.05$). The grouped means for blood pressure and pulse are summarized in Figures 1-3. Newman-Keuhls comparisons were completed on these means.

A significant main effect for level of caffeine administration ($F(1,96)=9.45$, $p<.01$) was found on DS. It should be noted that the groups differed significantly at Time 1 on DS ($F(3,96)=2.7$, $p=.05$). However, the interaction

between level of caffeine administration and time on DS showed a trend that approached significance ($F(1,96)=3.54$, $p=.063$), with subjects who received caffeinated coffee making greater improvements on their scores than subjects who received decaffeinated coffee (mean improvement: 8.40 vs. 6.56).

A significant interaction between level of caffeine administration and level of expectancy set was found for the Confusion-Bewilderment (CB) scale on the POMS ($F(1,96)=4.15$), $p<.05$). Subjects in the two groups that were deceived about the caffeine content of their coffee (Groups 2 and 3) reported a greater level of confusion than subjects who were not deceived. Neuman-Keuhls comparisons were completed on these measures, showing that Group 3 was significantly higher than Groups 1 and 4.

To test Hypotheses 4-6, Effects of Coffee Received (ECR) scores from all four conditions were analyzed in a 2 x 2 factorial analysis of variance (ANOVA). Significant main effects for level of caffeine administration ($F(1,96)=7.07$, $p<.01$) and for expectancy set ($F(1,96)=10.02$, $p<.01$) were found. Group means are summarized in Table 1a.

Effects of Expectancies Regarding Caffeine

To test hypotheses 7-8, Expected Effects of Coffee (EEC) scores from subjects in Conditions 1 and 2 (those who expected to receive caffeine) were compared to changes from

Time 1 to Time 2 in mood scores, performance scores, pulse rate, and blood pressure using a multiple regression analysis. None of the results were significant. Because subjects in Group 2 did not actually receive caffeine, the analysis was repeated using only scores from Group 1. A significant positive correlation ($F(1,23)=4.54$, $p<.05$) was found between EEC scores and the magnitude of decrease in Total Mood disturbance (i.e. the increase of positive mood).

To test Hypotheses 9-10, EEC scores from subjects in Conditions 1 and 2 were compared to ECR scores using a multiple regression analysis. As above, this analysis was also repeated using only subjects from Group 1. None of these results were significant.

Effects of Personality Variables

To test Hypotheses 11-12, extraversion scores on the Eysenck Personality Questionnaire-Revised (EPQ-R) and the Eysenck Personality Inventory (EPI) from subjects in Groups 1 and 3 (those that received caffeine) were compared to changes in mood scores, performance scores, pulse rate, and blood pressure between Time 1 and Time 2, and to ECR scores. None of these results were significant.

Scores on the EEC were compared to scores on the EPQ-R and the EPI from subjects in to determine whether introverts and extraverts have different expectancies regarding

caffeine in coffee. None of these results were significant.

Effects of Smoking and Subject Weight

An analysis was made of the effect of the subjects' weights, time since last dose of caffeine, and whether or not the subject was smoker upon the effects of the dose of caffeine received. These variables were compared to ECR scores, changes in mood scores, performance scores, pulse rate, and blood pressure in a multiple regression analysis, using data only from the subjects who received caffeinated coffee. Two significant relationships emerged. Weight of the subjects was negatively correlated with changes in SBP between Time 1 and Time 2 ($F(1,48)=6.01$, $p<.05$) and smoking was negatively correlated with changes in DBP between Time 1 and Time 2 ($F(1,48)=4.78$, $p<.05$).

Additional Analyses of Personality Variables

This ends my discussion of the original hypotheses. In reviewing the method used to analyze the personality variables, it was felt that treating these variables as continuous was not a realistic representation of Eysenck's personality types. As an alternative, cutoff points at the high and low ends of the scales may better represent these variables (Arnold et al., 1987; Gilliland, 1980; Keister & McLaughlin, 1972; Revelle, 1980). Therefore, an additional

analysis to test Hypotheses 11-12 was done with the personality variables (EPI extraversion score, EPQ-R extraversion scores, and EPI Impulsivity scores) which were split into three groups: high, medium, and low. These scores were analyzed using three multivariate analyses of variance (MANOVAs), one for each personality variable, with three levels of the personality factor (high/medium/low) and one repeated measure (Time). Mood scores, performance scores, and physiological measures were the dependent variables, and data from only those 50 subjects who received caffeine was used. The overall MANOVA's failed to reach significance (all p's>.05). For descriptive purposes, however, the high, medium, and low group means for each personality variable on each dependent variable were then analyzed using univariate analyses. These group means are tabled in Tables 2, 3, and 4.

On inspection of Tables 2, 3, and 4, those means which appear to differ by level of personality type are of particular interest. Of the 39 comparisons that assessed the interaction between personality type and caffeine, four approached significance (p<.10), all from the EPI. The variables approaching significance are highlighted in Table 2 purely for descriptive reference, since Type I error is so likely.

To analyze Hypothesis 12 using these trichotomized personality variables, three one way analyses of variance

(ANOVAs) were performed using Effects of Coffee Received as the dependent variable and personality type (high/medium/low) as the independent variable. None of these analyses were significant.

An additional exploratory analysis was performed to see if subjects of different personality types appeared better able to distinguish the amount of caffeine in their coffee. Three one way analyses of variance (ANOVA) were performed using question number seven of Effects of Coffee Received as the dependent variable and personality type (high/medium/low) as the independent variable. A significant interaction between level of caffeine administration and Impulsivity was found ($F(2,94)=3.604$, $p<.05$), and the interaction between level of caffeine administration and extraversion as measured by the EPQ-R approached significance ($F(2,94)=2.612$, $p=.079$). The interactions are displayed in Figures 4 and 5.

A Pearson product-moment correlation was calculated for EPI Extraversion and EPQ-R Extraversion to compare the similarity between the two measures. The correlation was significant ($r=.77$, $p.<.01$).

DISCUSSION

Subjects who were told that they were receiving caffeinated coffee judged that the amount of caffeine in their coffee was significantly greater than subjects who were told that they were receiving decaffeinated coffee, regardless of actual caffeine content. Therefore, the experimental manipulation was judged to be effective. Likewise, the results of the balanced placebo design are an accurate reflection of the individual and added contributions of both caffeine and the expectancy of having received caffeine on the behavior of the subjects in this study.

Of all the dependent measures, the results from the Effects of Coffee Received scale (ECR) corresponded most closely with the predicted results, fully supporting Hypotheses 4-6. Significant main effects were found for both level of caffeine administration and expectancy set. That is, subjects who had caffeine in their coffee rated the effects of the coffee to be significantly greater than subjects who did not receive caffeine, and subjects who were told that they were receiving caffeine rated the effects to be significantly greater than subjects who were told they were receiving decaffeinated coffee. Reviewing the mean scores from the four experimental groups revealed that the score values lie in the predicted direction; Group 1 had the

highest score, followed by Groups 2 and 3 with nearly identical scores, and lastly by Group 4 (see Table 1a). Thus, the results of the balanced placebo design with this scale on the subjective effects of caffeine extended the results of previous research on other drugs that found placebo and drug effects to be equal and additive in the ability to effect behavior (Frankenhaeser et al., 1964; Lyerly et al., 1964; Ross et al., 1962).

Unlike the results from the ECR scale, the MANOVA on the other dependent measures found no main effect for expectancy set, but did find a significant main effect for level of caffeine administration and a significant interaction between time and caffeine. Thus, only caffeine had a significant effect on the changes in scores between Time 1 and Time 2. Univariate analyses revealed that caffeine's effect was significant over time for pulse rate (PR), both systolic and diastolic blood pressure (SBP and DBP), level of fatigue, and was near significant for the Digit Symbol (DS) test.

As reported by Sawyer, Julia, and Turin (1982) caffeine acts as a central nervous system stimulant, normally producing increases in blood pressure. Figure 1 reveals that subjects in this study who consumed caffeine experienced only a mild increase in SBP, while those who received decaffeinated coffee experienced a significant drop. Thus, although subjects' SBP differed at Time 2 by

level of caffeine administration, the predicted increase with caffeine was not found. However, subjects who received caffeine experienced the predicted significant increase in DBP, while those who received decaffeinated coffee did not experience a significant change, as can be seen in Figure 2.

Despite the somewhat irregular results from the analysis of SBP, the fact remains that both the subjects' diastolic and systolic blood pressures were higher if he received caffeine. This has important implications for health, as people who regularly consume caffeine could experience a fairly constantly elevated blood pressure throughout the day, especially since research shows that a tolerance to blood pressure elevations does not develop with regular caffeine use (Lane and Williams, 1987). Research showing that caffeine increases blood pressure at a resting rate and works additively with stress to elevate blood pressure even higher suggests that those with tendencies toward high blood pressure should avoid caffeine (France & Ditto, 1988; Lane, 1983; Lane and Williams, 1987). Like the results of these authors, subjects in this study performed the same sustained attention tasks, but those who consumed caffeine experienced a greater increase in blood pressure.

Figure 3 shows that all subjects in the present study experienced a drop in pulse rate, and those who received caffeine experienced a greater drop. I originally hypothesized that caffeine and the expectancy of receiving

caffeine would produce increases in pulse rate. However, additional references which account for the drop in pulse rate found in the present study were recently located (Pincomb, et al., 1985; Smits, et al., 1986; Whitsett et al., 1984). These additional references stated that the entire circulatory system is stimulated by caffeine, but that these actions may be mediated and antagonized by compensatory vagal activity, which decreases heart rate. Such is the case with other cardiovascular effects as well, such as force of heart contractions, cardiac rhythms, and circulation. Thus, caffeine can increase, decrease, or show no effect on a given component of cardiovascular system functioning.

In the present study, the overall drop for all subjects between Time 1 and Time 2 can perhaps be explained by nervousness at Time 1 which was not in evidence at Time 2 because the subjects adjusted to the procedure. Another possible explanation is that subjects often literally ran in hurriedly for the morning appointments, which would increase PR at Time 1 but not at Time 2. However, like the effects of previous research (Pincomb, et al., 1985; Smits, et al., 1986; Whitsett et al., 1984), caffeine showed a greater tendency to decrease pulse rate than did a placebo in the present study.

All subjects, regardless of condition, experienced a drop in level of fatigue, as measured by the POMS, between Time 1 and Time 2. This can be accounted for by the simple passage of time in the morning, the demands of the experimental tasks, and/or perhaps by the effect of coffee or any warm drink such as coffee in general to soothe and reduce fatigue. However, subjects who consumed caffeine experienced a greater drop in fatigue than those who consumed decaffeinated coffee, again pointing to caffeine's generally accepted stimulating effects above and beyond the stimulating effects of the environment or of coffee itself.

Neither of the performance measures were significantly affected by caffeine or expectancy set. The near significant interaction between level of caffeine administration and time for DS, however, was a trend showing support for Sawyer and colleagues' (1982) summary of previous research, which stated that caffeine improves performance in simple decoding tasks. Results from research using Digit Symbol as a performance measure to assess the effects of caffeine on "performance" have been equivocal (File et al., 1982; Lieberman et al., 1987), and it may be that "performance", using tests such as Digit Symbol and Trailmaking, may be a variable that is too broad and complex to assess simply through the use of two psychomotor tasks. As noted by Sawyer et al. (1982),

performance effects of caffeine are unclear at this time, and this study did little to clarify that relationship.

The significant effects of level of caffeine administration found in the present study occurred across both groups who received caffeine, regardless of expectancy set. Thus, although subjects' ratings of the amount of caffeine in their coffee and the effects of their coffee on mood and performance were strongly influenced by their expectancy set, the actual dose of caffeine played the major role in their physiological responses, assessment of level of fatigue, and somewhat more weakly, in their performance on a psychomotor task (DS). These results provide further support, therefore, for caffeine's clear cut effect on the central nervous system, and much less clear effect on mood and performance. It appears that self reported mood and assessment of performance are more easily affected by cognitive influences such as expectancy set than are physiological responses such as pulse rate and blood pressure.

It is difficult to compare these results to other studies because, although descriptions of placebo effects generally assume that physiological responses to a placebo match those of the active drug, the only study found that measured pulse rate and blood pressure (Kirsch and Weixel, 1988) used decaffeinated conditions only and looked at "dose" (expectancy) response curves. They found, however,

that the expectancy of having consumed caffeine could significantly affect alertness, tension, pulse rate, and systolic blood pressure, unlike the results of the present study. Subjects' pulse and blood pressure were significantly affected only by caffeine, not by the placebo, in the present study.

A significant interaction between expectancy set and amount of caffeine on the Confusion-Bewilderment scale of the POMS was found in the present study. Subjects in the two groups that were deceived as to the caffeine content of their coffee (Groups 2 and 3) scored higher than subjects in Groups 1 and 4 on this scale, collapsed across Time 1 and Time 2. Neuman-Keuhls comparisons revealed that the scores of Group 3 were significantly more elevated than those of Groups 1 and 4. This, coupled with the results from the subjects' ratings of the amount of caffeine in their coffee, suggested that subjects in Groups 2 and 3 may have had some awareness that their coffee was not affecting them like it "should" (because they believed the experimenter's statement about the caffeine content). This may have produced an elevation in confusion. This effect was particularly striking for subjects in Group 3, who received caffeine but were told they were receiving decaffeinated coffee. Several of the subjects from Group 3, after being told of the actual content of their coffee, remarked to the experimenter that they "wondered" if the experimenter had misled them because

they could "feel" the physiological effects of the caffeine. However, this was not enough to convince the group as a whole that they did indeed have caffeine in their coffee. Only expectancy set, not dose of caffeine, significantly affected the subjects rating of the amount of caffeine in their coffee.

Results from the original analyses of the effects of the subjects' expectancies of effect from one cup of coffee were not significant. It was thought that including subjects in Group 2 in this analysis was problematic, because although they believed they had received caffeine, they had actually received decaffeinated coffee. Therefore, the analysis was repeated using only subjects in Group 1. This produced a significant positive correlation between the subjects' expectancies and decreases in the Total Mood Disturbance (TMD) on the POMS. Subjects who expected more positive effects from one cup of caffeinated coffee experienced larger improvements in mood than subjects who expected smaller changes. Thus, the results from this analysis suggest that expectancies about caffeine's effect were correlated with mood state following the consumption of the drug. This is not to say, however, that the expectancies directly affected the behavior, which is not possible to ascertain from this analysis. It may be instead that subjects built up these expectancies from many trials of experience with caffeine, and the expectancies simply

reflect the usual way that caffeine affects the individual. The significant correlation between expectancies and TMD was not found when subjects were included in the analysis who were led to believe they had received caffeine but actually received decaffeinated coffee (Group 2). Hence, it does not appear that subjects' positive or negative expectancies about caffeine influenced the behavior of subjects in this study as strongly as did a dose of caffeine.

One possible reason for the lack of results from the dependent measures other than TMD was the content of the questions on the EEC scale. Five of the six questions related to effects similar to the mood scales of the POMS, and the sixth question was a rating of the subjects' expected improvement in performance. Questions regarding physiological changes were not included on the scale because of the intent to have the scale measure positive and negative expectancies, and it was unclear whether increases in pulse rate and blood pressure would be positive or negative. Therefore, a higher score on this scale will not necessarily have any relationship to changes in pulse or blood pressure, but may be more related to changes in total mood state or possibly in performance ability. This was supported by the significant results from the TMD score on the POMS. Future research should use an expectancy measure that better reflects all the dependent measures.

One last problem with this analysis of the effects of positive or negative expectancies was the use of change scores. These scores were not distributed normally for all the dependent measures, and this may have obscured the effects of the manipulation. However, it was felt that use of pre- and post-tests was a better practice than using only Time 2 scores, as this method would make it impossible to ascertain what was the effect of the independent variables and what was simply individual differences.

The relationship between caffeine expectancies and behavior following consumption of caffeine remains unclear. Although caffeine expectancies significantly relate to the amount of caffeine that one consumes (Bradley and Petree, 1990), and one study (Kirsch and Weixel, 1988) reported significant correlations between caffeine expectancies and performance following the consumption of a placebo, it is not possible make the same assertion from my analyses. Sher (1985) found significant effects of expectancies about alcohol upon behavior following the consumption only of an alcohol placebo, but only in the group setting. It would be interesting to test the effects of caffeine expectancies in the group setting as well.

Results from the planned analyses of the effects of the personality variable introversion/extraversion were not significant. However, exploratory analyses which split the personality scores into three levels (high/medium/low)

produced some intriguing results. It was felt that these trichotomized values were a better representation of the variables, as small differences in scores most likely do not reflect noticeable changes in personality (Arnold et al., 1987). Gilliland, 1980; Keister & McLaughlin, 1972; Revelle, 1980). Using these trichotomized scores on Hypotheses 11-12 did not create a significant enough effect for the overall MANOVA's. When this portion of the data were further scrutinized for descriptive and exploratory purposes, 4 of the 39 univariate analyses testing Hypothesis 11 approached significance, all from the EPI. These are discussed for descriptive purposes only, to aid future research in this area. None of the results from the analyses of the Extraversion scale of the EPQ-R or Impulsivity scale of the EPI were significant.

The trends from the EPI extraversion scale suggested that extraverts reacted differently to caffeine than did introverts or ambiverts: extraverts who received caffeine tended to have a greater increase in systolic blood pressure, experience a greater increase in vigor, and a greater decrease in fatigue (see Table 2). From these results, it appeared as though the opposite of what was predicted was revealed: extraverts, rather than introverts, tended to show the greatest changes between Time 1 and Time 2 with caffeine.

Further exploratory analyses revealed a significant interaction between amount of caffeine and Impulsivity on the estimates of the amount of caffeine in the subject's coffee. This interaction is displayed in Figure 4 and shows that low impulsives were most accurate in their assessment of the amount of caffeine they received, rating the decaffeinated coffee lower than the caffeinated coffee. Medium impulsives could not differentiate between the decaffeinated and caffeinated coffee, and high impulsives actually rated the amount of coffee as the opposite of the actual caffeine content, with decaffeinated coffee having significantly more caffeine than caffeinated coffee. A similar trend, summarized in Figure 5, was found for the interaction between extraversion, as measured by the EPQ-R, and amount of caffeine. These results suggested that low impulsives and introverts were more sensitive to the amount of caffeine in their coffee than the other subjects.

The results from this second exploratory analysis fit in better with the predicted results, suggesting that introverts were more reactive to caffeine and, therefore, were better at recognizing when it was present in their coffee. It is difficult to explain this finding, however, when other results noted above showing extraverts reacting more to caffeine than introverts are taken into account.

One point to keep in mind is that all of the results that point to extraverts being more reactive to caffeine

came from the EPI Extraversion scale, and the results that suggested that low impulsives and introverts are more sensitive to caffeine's presence came from the EPI Impulsivity scale and the EPQ-R Extraversion scale. These differences highlight the earlier discussion that, although much of the past research utilized the EPI Extraversion scale, future research will most likely use the EPQ or EPQ-R. In light of this development, the correlation between the EPI and EPQ-R was assessed and found to be high. However, although the EPI and EPQ-R are closely correlated, they do not appear to be measuring the same thing as far as characteristics that relate to reactivity to caffeine goes. More research needs to be completed with these measures before any conclusions can be drawn about the effects of personality type on reactivity to caffeine, and which measure best represents this personality variable. The reader is reminded that all of these analyses on personality types were exploratory and need to be confirmed in further studies.

Multi-trait multi-method approaches often reveal provocative findings in exploratory analyses. The results regarding the relationship of weight and smoking to blood pressure illustrate this point. Among the 50 subjects who received a dose of caffeine, smokers exhibited a greater increase in DBP from Time 1 to Time 2 than non-smokers. Given the reports in the literature of the concomitant use

of caffeine and tobacco and the current trend toward non-smoking work environments, it appeared important to document the finding that, under sustained attention tasks over a one hour period, increases in SBP were greater for smokers deprived of smoking while consuming caffeine. This pattern should be further investigated in terms of "holistic" wellness programs which may, unfortunately, focus on only one aspect of wellness (i.e. smoking cessation). Smokers in the work place who are required not to smoke but are allowed free use of coffee and other forms of caffeine may risk greater increases in blood pressure. Further research should include a condition that allows smokers to smoke during the session, to more fully assess the relationships between caffeine, smoking, and blood pressure . Also of interest is that subjects with greater body weights experienced a greater increase in SBP after consuming caffeine. Thus, not only does excess body weight tend to increase blood pressure, but in this study it acted with caffeine to produce even greater increases in systolic blood pressure than experienced by less heavy people.

Table 1

Mean (Standard Deviation) Comparisons Between Experimental Groups at Time 1 and Time 2

	Groups								F-Ratios			
	1		2		3		4					
	T1	T2	T1	T2	T1	T2	T1	T2	C x T	E x T	C x E	C x E x T
Measure												
DS	61.24 (8.81)	70.20 (8.49)	54.76 (7.73)	60.24 (7.78)	60.68 (8.12)	68.52(10.28)	57.72(10.74)	65.36(12.36)	3.54	0.28	1.98	2.81
TRA	27.56 (9.18)	19.92 (5.13)	28.68 (7.87)	23.56 (7.19)	25.48 (6.25)	20.84 (5.81)	30.40(15.76)	23.32 (8.51)	0.03	0.26	0.12	2.82
TRB	60.24(15.69)	44.36(10.34)	61.36(14.97)	54.20(15.24)	57.40(17.00)	44.32(15.27)	68.32(52.40)	53.60(29.04)	0.96	0.43	0.25	2.06
PR	68.56(10.83)	62.80(12.34)	66.92(11.43)	65.00 (9.88)	70.64(11.03)	64.92 (9.49)	67.84(10.17)	65.08 (8.66)	4.77 *	0.07	0.17	0.08
SBP	123.64(13.66)	121.96(12.90)	117.80(11.94)	114.60(10.81)	119.64 (8.58)	122.20 (7.35)	122.80(12.68)	118.80(12.11)	6.18 *	1.12	2.29	2.41
DBP	76.86 (8.04)	82.24(10.59)	75.28 (9.29)	75.52 (9.67)	75.52(11.39)	79.44(11.88)	75.60(10.83)	76.60(11.09)	8.10 ***	0.09	0.47	0.69
TMD	21.16(18.41)	3.36(15.77)	16.00(23.20)	2.52(15.85)	24.12(26.28)	10.56(20.64)	14.48(23.83)	5.04(17.77)	2.07	1.99	0.36	0.00
TA	7.20 (5.01)	6.44 (5.27)	6.08 (4.49)	5.68 (3.99)	8.12 (5.61)	7.64 (4.90)	6.88 (5.02)	5.36 (3.97)	0.13	0.20	0.24	0.55
DD	4.40 (4.81)	1.72 (2.95)	4.76 (6.47)	1.76 (2.73)	6.68 (9.77)	4.44 (7.54)	3.64 (6.82)	1.88 (4.76)	0.01	0.92	1.70	0.21
AH	3.72 (4.70)	1.88 (2.73)	3.44 (4.25)	1.84 (2.87)	4.24 (6.20)	3.32 (5.56)	1.84 (3.54)	1.24 (2.37)	0.10	1.19	2.07	0.00
VA	10.52 (6.30)	15.24 (6.56)	12.52 (5.49)	15.68 (5.45)	10.84 (5.56)	14.40 (4.40)	11.76 (6.52)	13.80 (6.34)	2.03	1.11	0.26	0.00
FI	10.48 (5.83)	4.96 (5.93)	7.56 (6.18)	4.28 (5.50)	8.56 (6.42)	4.32 (5.42)	8.72 (5.96)	6.40 (6.23)	5.59 *	1.62	1.75	0.03
CB	5.88 (2.11)	3.60 (1.63)	6.68 (4.13)	4.64 (3.52)	7.36 (4.34)	5.24 (1.63)	5.16 (4.11)	3.96 (2.61)	1.57	1.17	4.15 *	0.54

Notes:
n=100, 25 per group
T1=Time 1, T2=Time 2, DS=Digit Symbol, TRA=Trailmaking Part A, TRB=Trailmaking Part B, PR=pulse rate, SBP=systolic blood pressure, DBP=diastolic blood pressure, TMD=Total Mood Disturbance from the Profile of Mood States (POMS), TA=Tension- Anxiety (POMS), DD=Depression-Dejection (POMS), AH=Anger-Hostility (POMS), VA=Vigor-Activity (POMS), FI=Fatigue-Inertia (POMS), CB=Confusion-Bewilderment (POMS).
C=Caffeine, T=Time, E=Expectancy.
*=p≤.05, **=p≤.01, ***=p≤.005.

Table 1a

Mean (Standard Deviation) Comparisons Between Experimental Groups at Time 1 and Time 2 for Effects of Coffee Received and Caffeine Estimate

	Groups				F-Ratios		
	1	2	3	4	C	E	C x E
Measure							
ECR	29.23 (4.04)	27.68 (2.06)	25.56 (2.96)	25.56 (2.96)	7.07 **	10.02 ***	0.04
CAFFEST	4.32 (0.80)	4.44 (1.04)	3.28 (1.49)	2.72 (1.37)	0.83	32.72 ***	1.99

Notes:
n=100, 25 per group.
ECR=Effects of Coffee Received, CAFFEST=caffeine estimate,
C=caffeine, E=expectancy.
*=p≤.05, **=p≤.01, ***=p≤.005.

Table 2

Mean (Standard Deviation) Comparisons Between Level of Extraversion on the EPI at Time 1 and Time 2

	Groups							
	Introverts		Ambiverts		Extraverts		F-Ratio (EPI by Time)	
	T1	T2	T1	T2	T1	T2		
Measure								
DS	62.92 (7.87)	71.17 (8.41)	63.69 (9.28)	72.50(10.44)	57.91 (8.12)	66.09 (8.33)	.09	NS
TRA	27.75(11.48)	21.58 (6.60)	24.38 (5.90)	19.50 (4.41)	27.41 (6.65)	20.36 (5.58)	.64	NS
TRB	55.92(18.09)	44.75(15.11)	62.75(13.08)	42.50 (8.71)	57.55(17.44)	45.46(14.53)	2.77	p.=.073
PR	69.67(12.03)	65.17(10.87)	70.88 (8.20)	64.06(10.28)	68.64(12.23)	63.00(11.85)	.25	NS
SBP	124.50(11.64)	125.08 (7.55)	118.63 (8.32)	117.94 (8.66)	122.27(13.21)	123.46(12.17)	.19	NS
DBP	77.67 (7.08)	80.50(10.69)	75.75(10.71)	78.25(11.24)	75.50(10.63)	82.91(11.59)	3.08	p.=.055
TMD	24.75(31.74)	13.25(23.58)	18.38(20.94)	6.75(19.15)	24.59(17.90)	3.68(14.65)	2.37	NS
TA	8.92 (6.43)	8.53 (4.96)	6.63 (5.14)	6.44 (4.84)	7.27 (4.80)	6.64 (5.34)	.18	NS
DD	6.08 (9.75)	4.83 (8.15)	6.50 (7.09)	3.75 (5.37)	4.55 (7.14)	1.64 (4.44)	.54	NS
AH	4.75 (8.23)	3.17 (6.12)	4.00 (4.73)	2.88 (4.83)	3.55 (4.16)	2.09 (2.88)	.03	NS
VA	9.75 (5.85)	12.25 (5.50)	12.81 (5.88)	15.38 (5.16)	9.64 (5.75)	15.82 (5.64	2.67	p.=.080
FI	7.17 (5.64)	3.25 (3.25)	8.31 (6.67)	5.00 (4.41)	11.69 (6.83)	5.14 (7.29)	2.89	p.=.066
CB	7.58 (5.18)	5.68 (4.96)	5.75 (2.86)	4.06 (2.70)	6.73 (2.62)	4.00 (2.70)	1.02	NS

Notes:
n=50
DS=Digit Symbol, TRA=Trailmaking Part A, TRB=Trailmaking Part B, PR=pulse rate, SBP=systolic blood pressure, DBP=diastolic blood pressure, TMD=Total Mood Disturbance from the Profile of Mood States (POMS),TA=Tension-Anxiety (POMS), DD=Depression-Dejection (POMS), AH=Anger-Hostility (POMS), VA=Vigor-Activity (POMS), FI=Fatigue-Inertia (POMS), CB=Confusion-Bewilderment (POMS).

Table 3

Mean (Standard Deviation) Comparisons Between Level of Extraversion on the EPQ-R at Time 1 and Time 2

	Groups						
	Introverts		Ambiverts		Extraverts		F-Ratio (EPI by Time)
Measure	T1	T2	T1	T2	T1	T2	
DS	60.54 (6.21)	70.31 (6.76)	61.90 (9.98)	69.55(11.03)	60.17 (9.16)	68.41 (9.41)	.82 NS
TRA	25.23(11.07)	19.00 (4.74)	26.35 (6.52)	20.50 (5.40)	27.71 (6.55)	21.29 (6.08)	.04 NS
TRB	55.08(13.38)	41.15 (9.50)	63.25(15.16)	45.20(12.34)	56.47(18.97)	45.77(15.63)	1.69 NS
PR	67.39(10.78)	61.39(10.50)	69.10 (8.64)	63.55 (9.23)	71.88(13.26)	66.12(13.14)	.01 NS
SBP	122.62 (9.64)	120.62 (8.31)	120.80(13.91)	122.90(11.21)	121.88(10.08)	122.24(11.13)	.80 NS
DBP	75.69 (6.82)	79.54(10.11)	78.00(10.26)	82.60(11.61)	74.18(11.14)	79.77(11.96)	.23 NS
TMD	28.47(31.35)	18.39(22.07)	20.85(19.84)	1.60(15.90)	20.29(17.58)	4.53(15.43)	1.41 NS
TA	7.77 (5.99)	9.31 (6.32)	7.85 (5.18)	6.45 (4.37)	7.35 (5.17)	6.00 (4.51)	1.73 NS
DD	7.77 (9.86)	5.85 (8.01)	5.75 (6.89)	2.35 (4.32)	3.59 (6.66)	1.82 (5.03)	.69 NS
AH	5.23 (7.91)	4.46 (5.67)	3.95 (5.34)	2.30 (4.24)	3.06 (2.84)	1.53 (3.09)	.10 NS
VA	9.15 (5.11)	12.46 (5.88)	10.85 (6.04)	15.85 (4.60)	11.65 (6.33)	15.41 (6.05)	.39 NS
FI	9.00 (5.64)	5.31 (4.42)	7.70 (4.45)	2.50 (3.19)	12.06 (7.55)	6.65 (7.75)	.60 NS
CB	7.85 (4.88)	5.92 (4.68)	6.45 (3.03)	3.85 (2.64)	5.88 (2.45)	3.94 (2.05)	.47 NS

Notes:
n=50
DS=Digit Symbol, TRA=Trailmaking Part A, TRB=Trailmaking Part B, PR=pulse rate, SBP=systolic blood pressure, DBP=diastolic blood pressure, TMD=Total Mood Disturbance from the Profile of Mood States (POMS), TA=Tension-Anxiety (POMS), DD=Depression-Dejection (POMS), AH=Anger-Hostility (POMS), VA=Vigor-Activity (POMS), FI=Fatigue-Inertia (POMS), CB=Confusion-Bewilderment (POMS).

Table 4

Mean (Standard Deviation) Comparisons Between Level of Impulsivity on the EPI at Time 1 and Time 2

	Groups						
	Low Impulsives		Medium Impulsives		High Impulsives		F-Ratio
	T1	T2	T1	T2	T1	T2	(EPI by Time)
Measure							
DS	61.50(12.82)	68.67(12.85)	62.93 (7.08)	71.21 (8.89)	57.31 (9.05)	66.38 (8.57)	.37 NS
TRA	29.50(15.37)	20.83 (5.88)	26.21 (6.47)	20.64 (6.18)	25.94 (6.52)	19.75 (4.00)	.69 NS
TRB	60.00(15.56)	52.50(17.25)	60.54(18.85)	43.14(13.27)	55.38(11.13)	43.38 (9.89)	2.15 NS
PR	71.67 (8.24)	71.67 (8.04)	69.57(11.05)	62.61(10.81)	68.88(11.87)	63.13(11.48)	1.71 NS
SBP	127.33(11.57)	123.50(10.43)	120.75 (8.50)	121.79 (9.26)	121.06(15.50)	122.06(12.69)	.75 NS
DBP	82.67 (4.50)	85.00(10.18)	76.64 (9.71)	81.00(10.87)	72.69(10.27)	79.00(12.42)	.79 NS
TMD	12.67(18.29)	4.17(18.36)	22.57(24.28)	7.14(19.53)	26.50(20.65)	7.69(17.88)	.98 NS
TA	7.00 (5.25)	6.33 (4.08)	8.29 (5.72)	6.96 (4.93)	6.81 (4.65)	7.44 (5.87)	.79 NS
DD	4.00 (2.76)	2.83 (1.94)	5.36 (7.68)	3.07 (6.04)	6.44 (9.13)	3.19 (6.65)	.48 NS
AH	1.67 (2.42)	1.33 (3.27)	4.21 (6.09)	2.61 (4.57)	4.44 (5.07)	3.06 (4.60)	.13 NS
VA	10.67 (7.34)	12.83 (8.70)	11.43 (5.20)	14.82 (5.66)	9.38 (6.60)	15.56 (4.15)	1.66 NS
FI	5.83 (3.66)	3.00 (2.97)	9.29 (5.99)	4.75 (5.75)	11.31 (6.73)	5.06 (6.32)	1.43 NS
CB	4.83 (2.32)	3.50 (1.64)	6.86 (4.05)	4.57 (3.64)	6.88 (2.50)	4.50 (3.20)	.46 NS

Notes:
n=50
DS=Digit Symbol, TRA=Trailmaking Part A, TRB=Trailmaking Part B, PR=pulse rate, SBP=systolic blood pressure, DBP=diastolic blood pressure, TMD=Total Mood Disturbance from the Profile of Mood States (POMS), TA=Tension-Anxiety (POMS), DD=Depression-Dejection (POMS), AH=Anger-Hostility (POMS), VA=Vigor-Activity (POMS), FI=Fatigue-Inertia (POMS), CB=Confusion-Bewilderment (POMS).

Figure 1

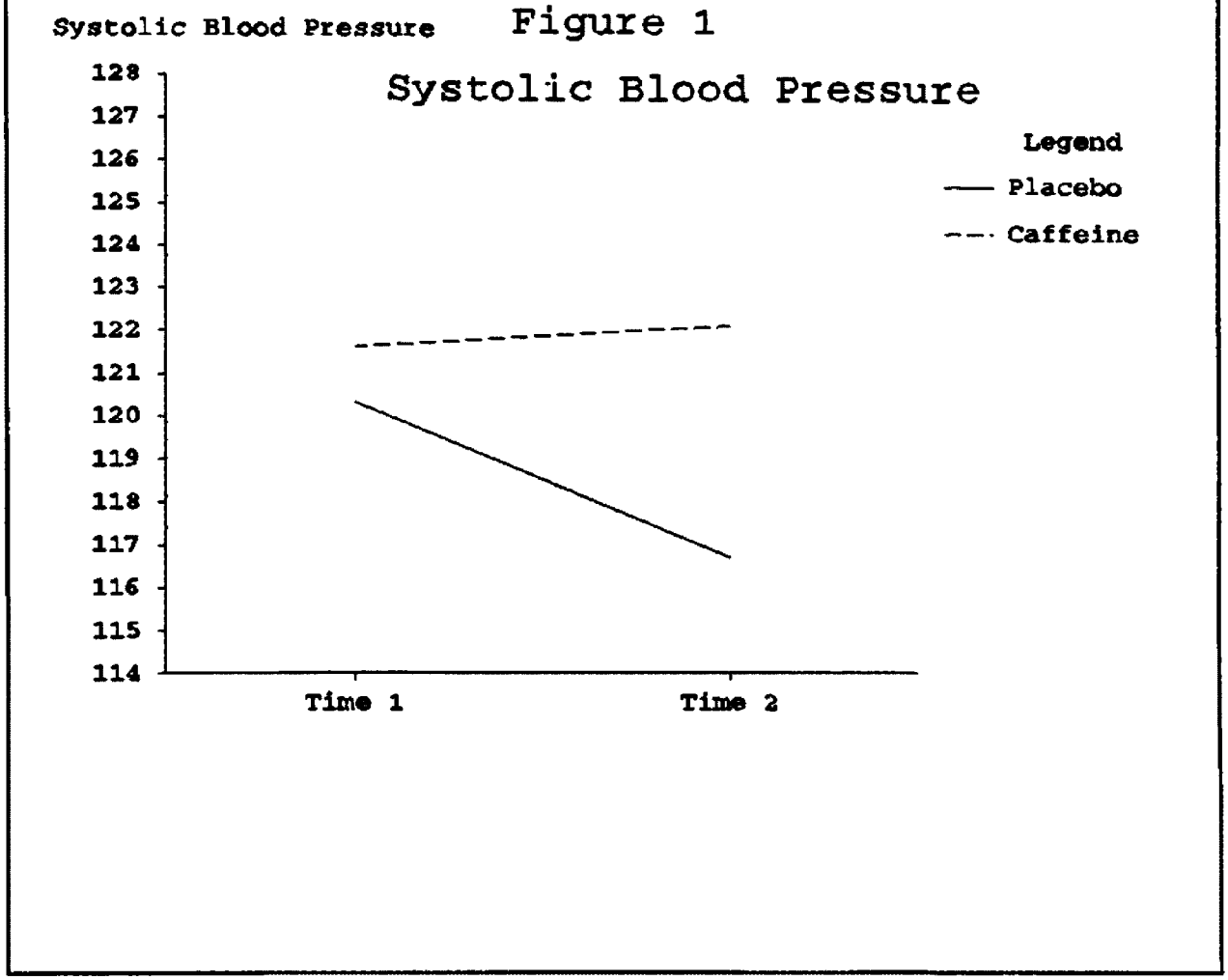


Figure 2

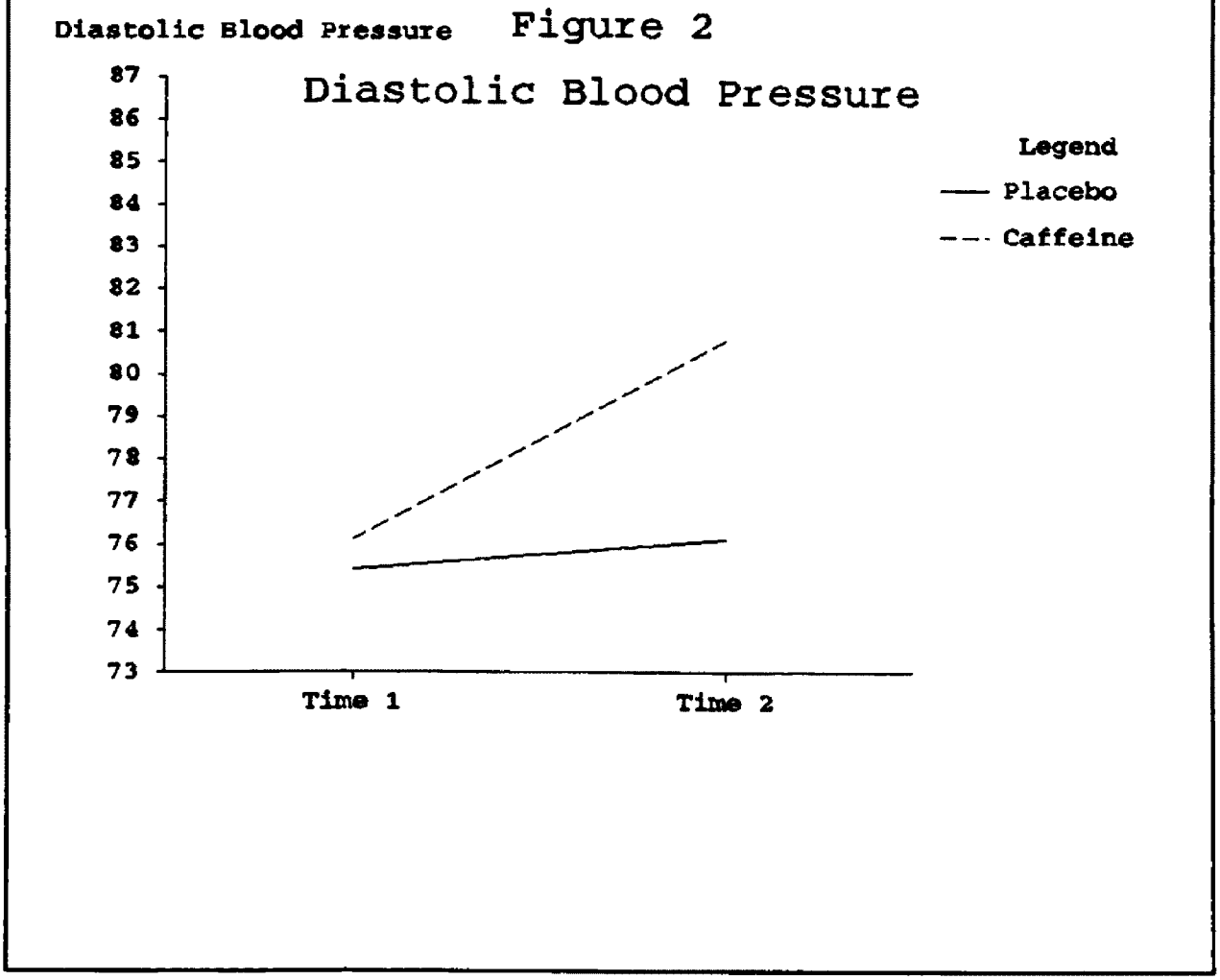


Figure 3

Pulse Rate

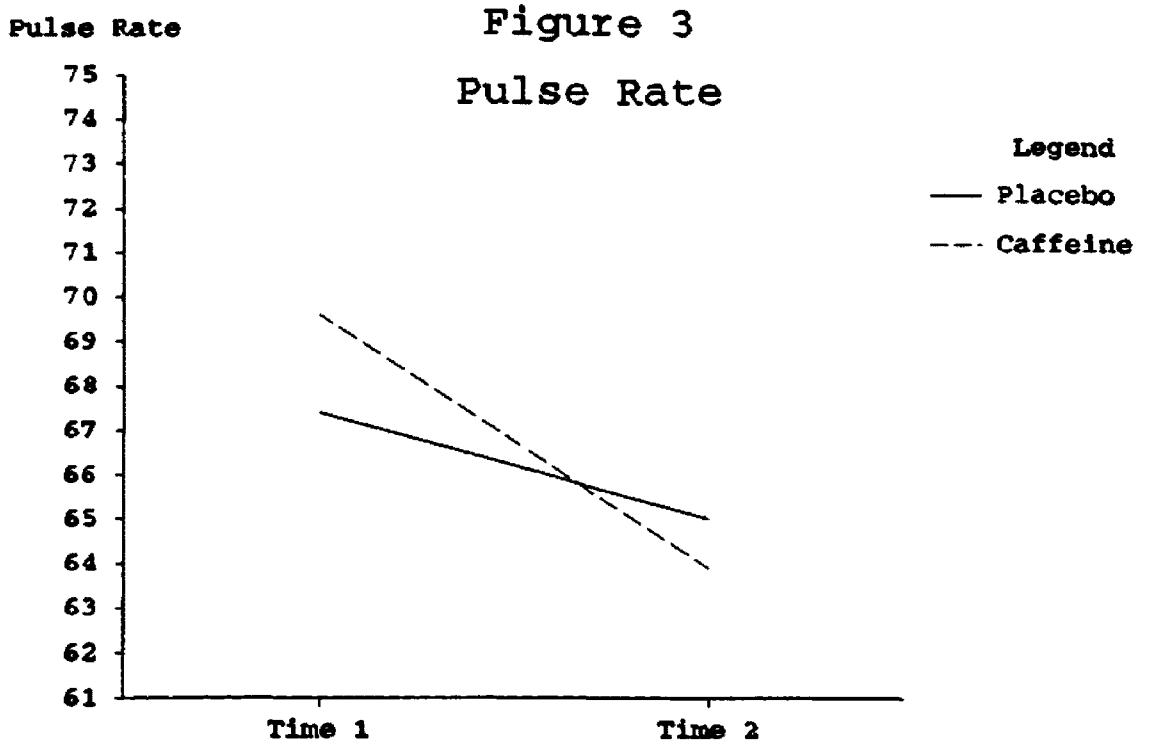


Figure 4

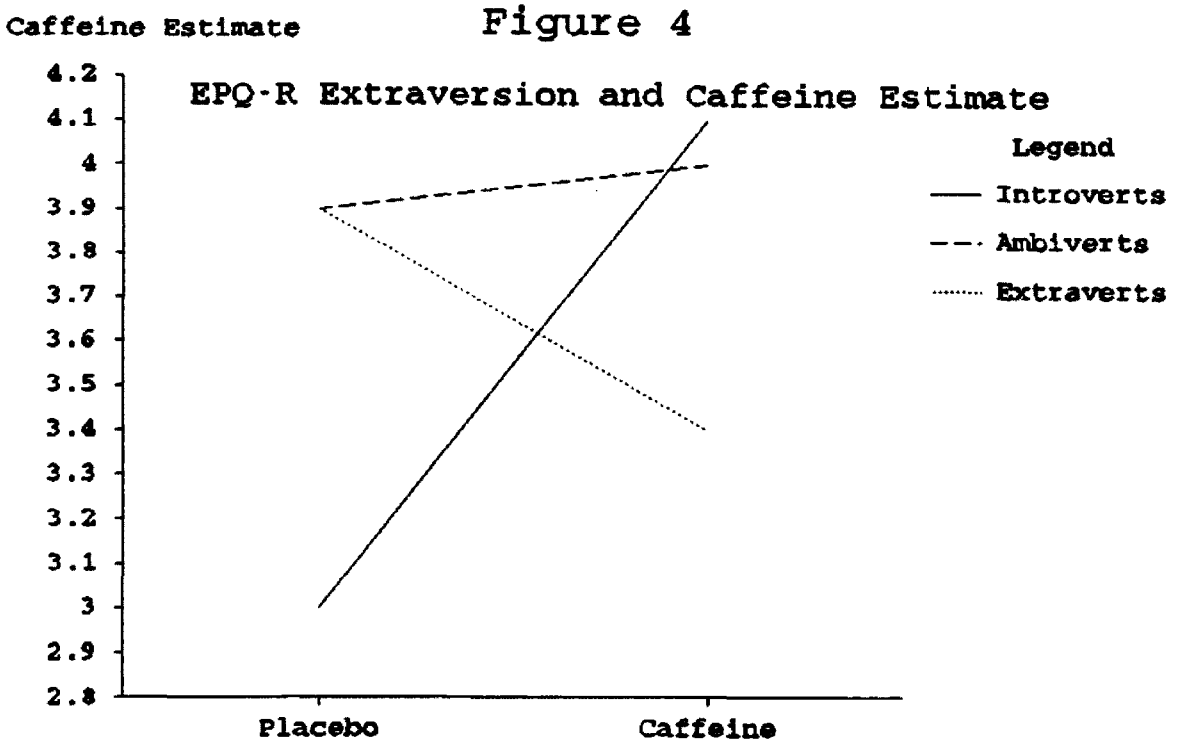
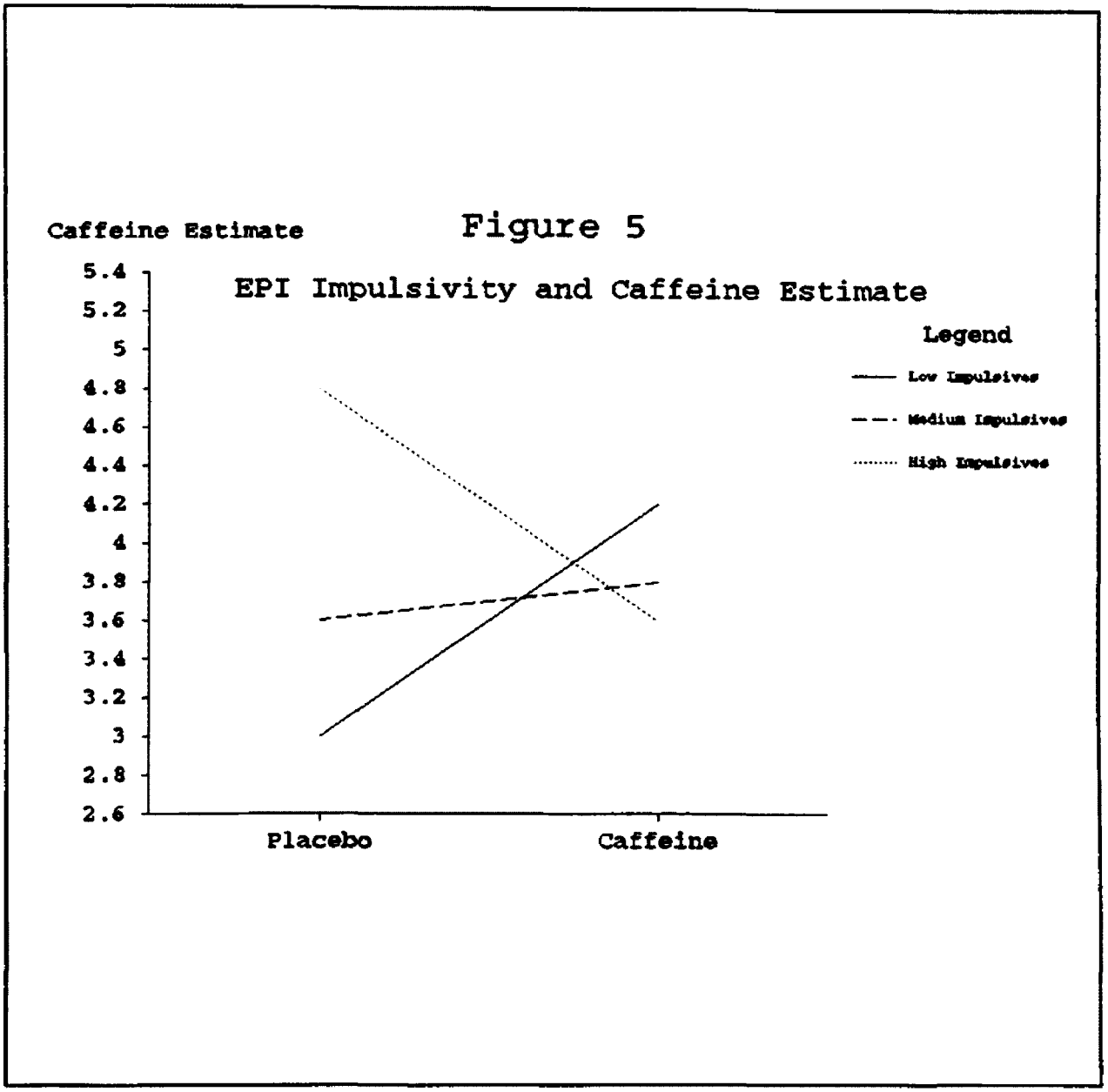


Figure 5



Appendix A

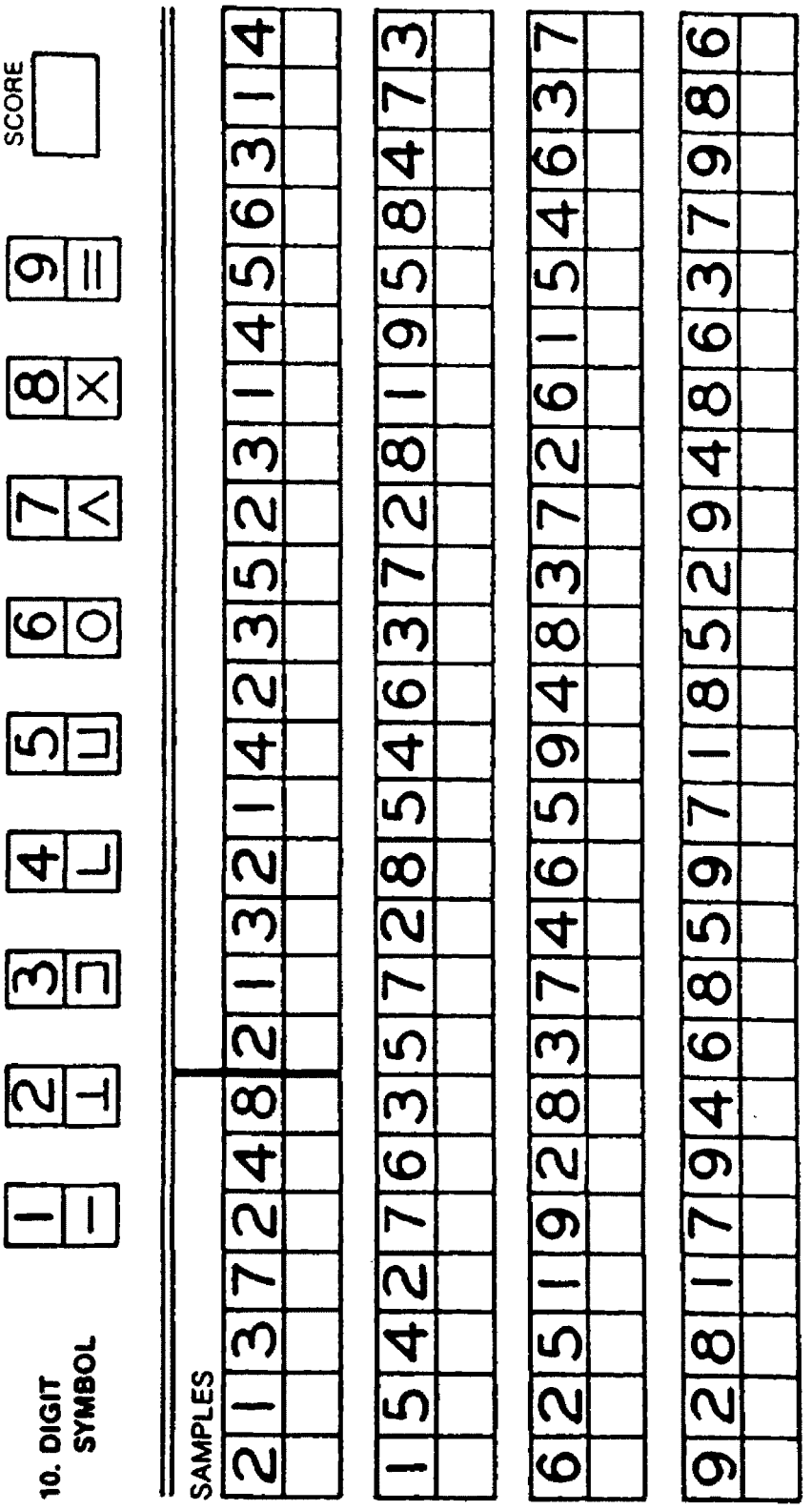
The Effects of Caffeine

This experiment is designed to measure the effects of one serving of caffeine upon performance, mood, and physiological measures. To be a subject in this study, it is important that you are a regular caffeine consumer (consuming from 1 to 4 cups of coffee or its caffeine equivalent per day), that you have not consumed any caffeine today, and that you are not taking any drugs that are similar to caffeine, such as theophylline. Please let the experimenter know if you do not meet these requirements.

During your appointment today, you will complete standard mood and performance measures, and have your pulse and blood pressure taken before consuming one cup of coffee, fill out two personality measures, and then repeat the mood, performance, and physiological measures.

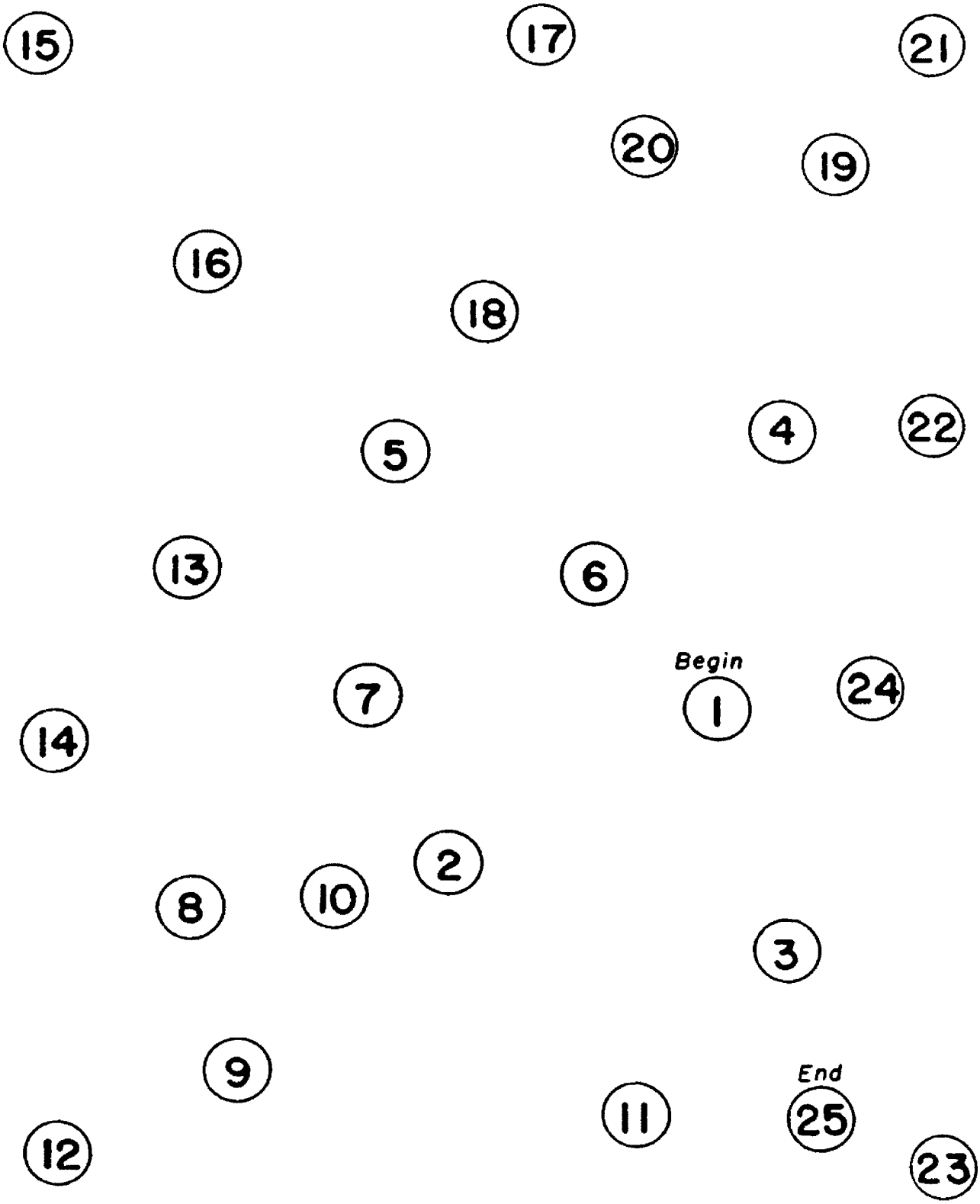
Since you are a regular caffeine consumer, you are aware of the possible effects of one serving of caffeine, such as an increase in energy and alertness, and improved mood and concentration. Although not common, one serving of caffeine can also increase anxiety, and for some people, cause mild discomfort. Please let the experimenter know if you experience any discomfort.

Thank you for your participation in this study!



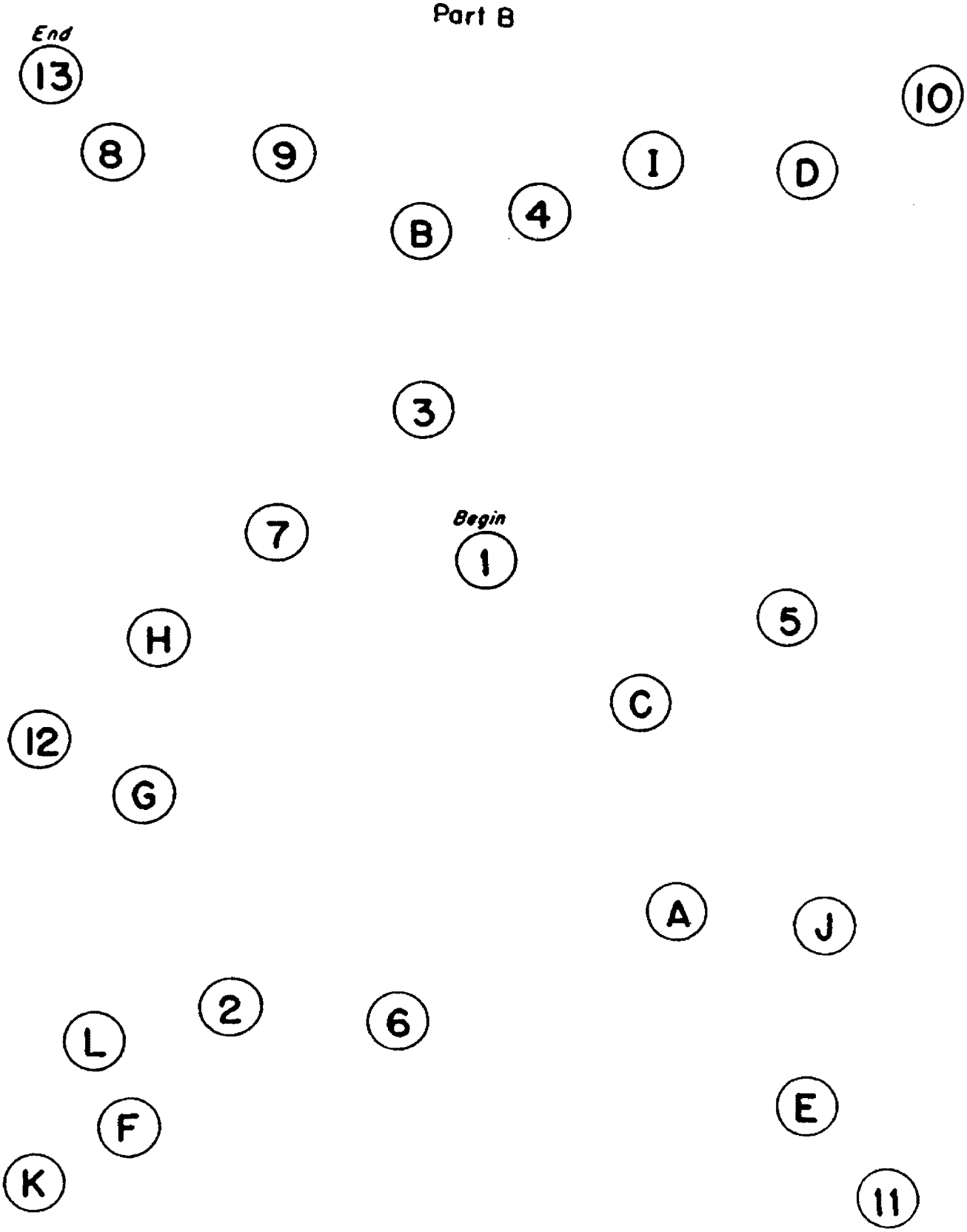
TRAIL MAKING

Part A



TRAIL MAKING

Part B



Appendix E

EXPECTED EFFECTS OF COFFEE

The following questions ask what effects that you expect to receive from consumption of one cup of regular coffee (how it will make you feel, how it will affect your performance, etc). Please circle the number that corresponds best with your answer.

1. A cup of regular coffee makes me

-3	-2	-1	0	1	2	3
much more drowsy			no change			much more alert

2. A cup of regular coffee will

-3	-2	-1	0	1	2	3
worsen my mood greatly			no change			improve my mood greatly

3. A cup of regular coffee makes me

-3	-2	-1	0	1	2	3
much more anxious			no change			much less anxious

4. A cup of regular coffee gives me

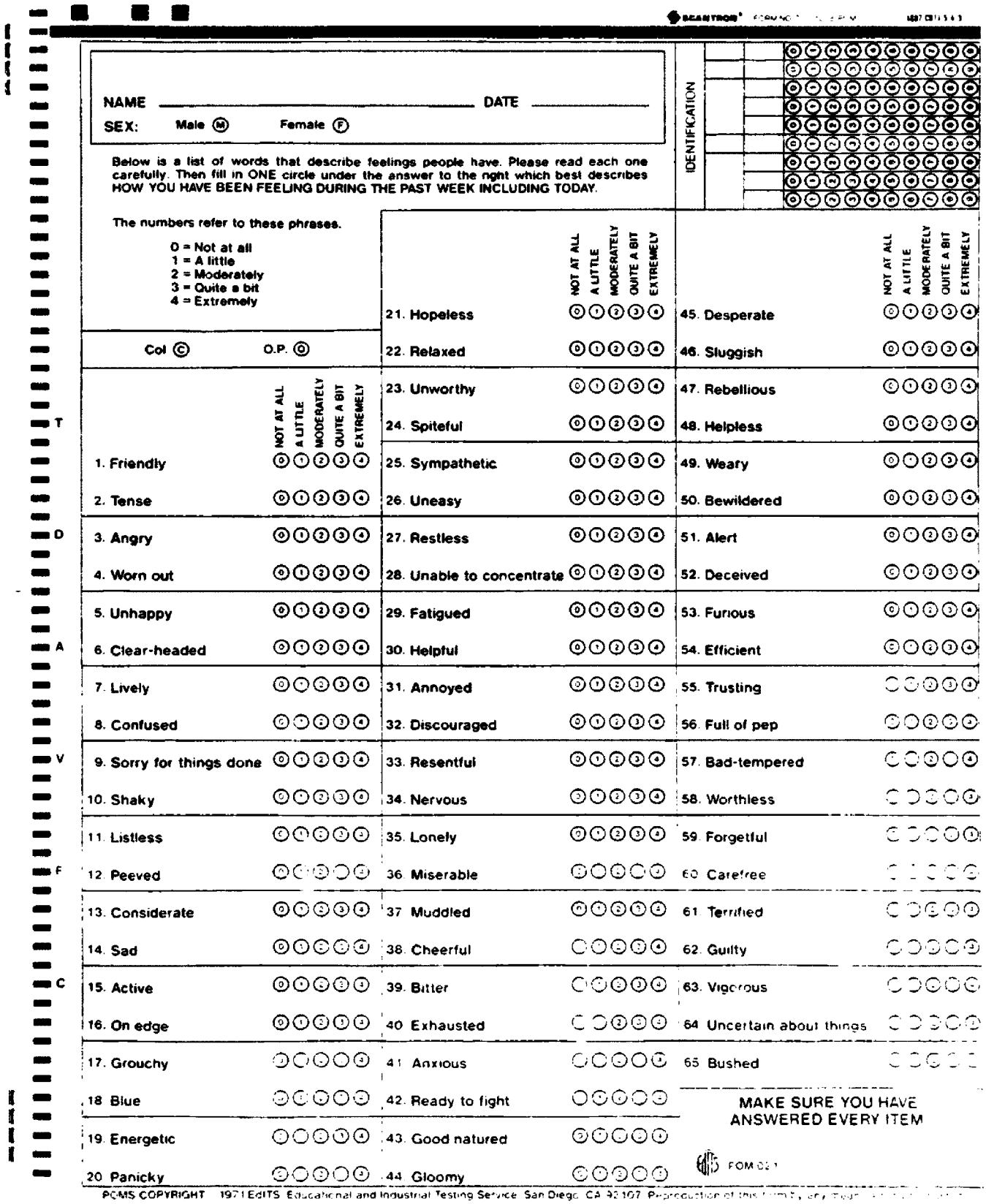
-3	-2	-1	0	1	2	3
much less energy			no change			much more energy

5. A cup of regular coffee

-3	-2	-1	0	1	2	3
worsens my concentration greatly			no change			improves my concentration greatly

6. A cup of regular coffee will

-3	-2	-1	0	1	2	3
worsen my performance greatly			no change			improve my performance greatly



NAME _____ DATE _____

SEX: Male (M) Female (F)

IDENTIFICATION

Below is a list of words that describe feelings people have. Please read each one carefully. Then fill in ONE circle under the answer to the right which best describes HOW YOU HAVE BEEN FEELING DURING THE PAST WEEK INCLUDING TODAY.

The numbers refer to these phrases.

0 = Not at all
1 = A little
2 = Moderately
3 = Quite a bit
4 = Extremely

Col (C) O.P. (O)

	NOT AT ALL	A LITTLE	MODERATELY	QUITE A BIT	EXTREMELY
1. Friendly	0	1	2	3	4
2. Tense	0	1	2	3	4
3. Angry	0	1	2	3	4
4. Worn out	0	1	2	3	4
5. Unhappy	0	1	2	3	4
6. Clear-headed	0	1	2	3	4
7. Lively	0	1	2	3	4
8. Confused	0	1	2	3	4
9. Sorry for things done	0	1	2	3	4
10. Shaky	0	1	2	3	4
11. Listless	0	1	2	3	4
12. Peeved	0	1	2	3	4
13. Considerate	0	1	2	3	4
14. Sad	0	1	2	3	4
15. Active	0	1	2	3	4
16. On edge	0	1	2	3	4
17. Grouchy	0	1	2	3	4
18. Blue	0	1	2	3	4
19. Energetic	0	1	2	3	4
20. Panicky	0	1	2	3	4
21. Hopeless	0	1	2	3	4
22. Relaxed	0	1	2	3	4
23. Unworthy	0	1	2	3	4
24. Spiteful	0	1	2	3	4
25. Sympathetic	0	1	2	3	4
26. Uneasy	0	1	2	3	4
27. Restless	0	1	2	3	4
28. Unable to concentrate	0	1	2	3	4
29. Fatigued	0	1	2	3	4
30. Helpful	0	1	2	3	4
31. Annoyed	0	1	2	3	4
32. Discouraged	0	1	2	3	4
33. Resentful	0	1	2	3	4
34. Nervous	0	1	2	3	4
35. Lonely	0	1	2	3	4
36. Miserable	0	1	2	3	4
37. Muddled	0	1	2	3	4
38. Cheerful	0	1	2	3	4
39. Bitter	0	1	2	3	4
40. Exhausted	0	1	2	3	4
41. Anxious	0	1	2	3	4
42. Ready to fight	0	1	2	3	4
43. Good natured	0	1	2	3	4
44. Gloomy	0	1	2	3	4
45. Desperate	0	1	2	3	4
46. Sluggish	0	1	2	3	4
47. Rebellious	0	1	2	3	4
48. Helpless	0	1	2	3	4
49. Weary	0	1	2	3	4
50. Bewildered	0	1	2	3	4
51. Alert	0	1	2	3	4
52. Deceived	0	1	2	3	4
53. Furious	0	1	2	3	4
54. Efficient	0	1	2	3	4
55. Trusting	0	1	2	3	4
56. Full of pep	0	1	2	3	4
57. Bad-tempered	0	1	2	3	4
58. Worthless	0	1	2	3	4
59. Forgetful	0	1	2	3	4
60. Carefree	0	1	2	3	4
61. Terrified	0	1	2	3	4
62. Guilty	0	1	2	3	4
63. Vigorous	0	1	2	3	4
64. Uncertain about things	0	1	2	3	4
65. Bushed	0	1	2	3	4

MAKE SURE YOU HAVE ANSWERED EVERY ITEM

FOM 021

APPENDIX G

EYSENCK PERSONALITY INVENTORY

FORM A

1. Do you often long for excitement? . . . . . Yes No
2. Do you often need understanding friends to cheer you up? . . . . . Yes No
3. Are you usually carefree? . . . . . Yes No
4. Do you find it very hard to take no for an answer? . . . Yes No
5. Do you stop and think things over before doing anything? . . . . . Yes No
6. If you say you will do something do you always keep your promise, no matter how inconvenient it might be to do so? . . . . . Yes No
7. Does your mood often go up and down? . . . . . Yes No
8. Do you generally do and say things quickly without stopping to think? . . . . . Yes No
9. Do you ever feel "just miserable" for no good reason? Yes No
10. Would you do almost anything for a dare? . . . . . Yes No
11. Do you suddenly feel shy when you want to talk to an attractive stranger? . . . . . Yes No
12. Once in a while do you lose your temper and get angry? . . . . . Yes No
13. Do you often do things on the spur of the moment? . . . Yes No
14. Do you often worry about things you should not have done or said? . . . . . Yes No
15. Generally do you prefer reading to meeting people? . . Yes No
16. Are your feelings rather easily hurt? . . . . . Yes No
17. Do you like going out a lot? . . . . . Yes No
18. Do you occasionally have thoughts and ideas that you would not like other people to know about? . . . . . Yes No
19. Are you sometimes bubbling over with energy and sometimes very sluggish? . . . . . Yes No
20. Do you prefer to have few but special friends? . . . . . Yes No
21. Do you daydream a lot? . . . . . Yes No
22. When people shout at you, do you shout back? . . . . . Yes No
23. Are you often troubled about feelings of guilt? . . . . . Yes No
24. Are all your habits good and desirable ones? . . . . . Yes No
25. Can you usually let yourself go and enjoy yourself a lot at a lively party? . . . . . Yes No
26. Would you call yourself tense or "highly-strung"? . . . Yes No
27. Do other people think of you as being very lively? . . . Yes No
28. After you have done something important, do you often come away feeling you could have done better? . . . . . Yes No
29. Are you mostly quiet when you are with other people? Yes No
30. Do you sometimes gossip? . . . . . Yes No
31. Do ideas run through your head so that you cannot sleep? . . . . . Yes No
32. If there is something you want to know about, would you rather look it up in a book than talk to someone about it? . . . . . Yes No
33. Do you get palpitations or thumping in your heart? . . . Yes No
34. Do you like the kind of work that you need to pay close attention to? . . . . . Yes No
35. Do you get attacks of shaking or trembling? . . . . . Yes No
36. Would you always declare everything at the customs, even if you knew that you could never be found out? . . Yes No
37. Do you hate being with a crowd who play jokes on one another? . . . . . Yes No
38. Are you an irritable person? . . . . . Yes No
39. Do you like doing things in which you have to act quickly? . . . . . Yes No
40. Do you worry about awful things that might happen? . . Yes No
41. Are you slow and unhurried in the way you move? . . . Yes No
42. Have you ever been late for an appointment or work? . Yes No
43. Do you have many nightmares? . . . . . Yes No
44. Do you like talking to people so much that you would never miss a chance of talking to a stranger? . . . . . Yes No
45. Are you troubled by aches and pains? . . . . . Yes No
46. Would you be very unhappy if you could not see lots of people most of the time? . . . . . Yes No
47. Would you call yourself a nervous person? . . . . . Yes No
48. Of all the people you know are there some whom you definitely do not like? . . . . . Yes No
49. Would you say you were fairly self-confident? . . . . . Yes No
50. Are you easily hurt when people find fault with you or your work? . . . . . Yes No
51. Do you find it hard to really enjoy yourself at a lively party? . . . . . Yes No
52. Are you troubled with feelings of inferiority? . . . . . Yes No
53. Can you easily get some life into a rather dull party? . Yes No
54. Do you sometimes talk about things you know nothing about? . . . . . Yes No
55. Do you worry about your health? . . . . . Yes No
56. Do you like playing pranks on others? . . . . . Yes No
57. Do you suffer from sleeplessness? . . . . . Yes No

APPENDIX H

EPQ

INSTRUCTIONS

Please answer each question "Yes" or "No" on the answer sheet marked POI. Use "A" for "Yes" or "B" for "No". There are no right or wrong answers, and no trick questions. Work quickly and do not think too long about the exact meaning of the questions.

PLEASE REMEMBER TO ANSWER EACH QUESTION

1. Do you have many different hobbies?
2. Do you stop to think things over before doing anything?
3. Does your mood often go up and down?
4. Have you ever taken the praise for something you knew someone else had really done?
5. Do you take much notice of what people think?
6. Are you a talkative person?
7. Would being in debt worry you?
8. Do you ever feel "just miserable" for no reason?
9. Do you give money to charities?
10. Were you ever greedy by helping yourself to more than your share of anything?
11. Are you rather lively?
12. Would it upset you a lot to see a child or an animal suffer?
13. Do you often worry about things you should not have done or said?
14. Do you dislike people who don't know how to behave themselves?
15. If you say you will do something, do you always keep your promise no matter how inconvenient it might be?
16. Can you usually let yourself go and enjoy yourself at a lively party?
17. Are you an irritable person?
18. Should people always respect the law?
19. Have you ever blamed someone for doing something you knew was really your fault?
20. Do you enjoy meeting new people?

21. Are good manners very important?
22. Are your feelings easily hurt?
23. Are all your habits good and desirable ones?
24. Do you tend to keep in the background on social occasions?
25. Would you take drugs which may have strange or dangerous effects?
26. Do you often feel "fed-up"?
27. Have you ever taken anything (even a pin or button) that belonged to someone else?
28. Do you like going out a lot?
29. Do you prefer to go your own way rather than act by the rules?
30. Do you enjoy hurting people you love?
31. Are you often troubled about feelings of guilt?
32. Do you sometimes talk about things you know nothing about?
33. Do you prefer reading to meeting people?
34. Do you have enemies who want to harm you?
35. Would you call yourself a nervous person?
36. Do you have many friends?
37. Do you enjoy practical jokes that can sometimes really hurt people?
38. Are you a worrier?
39. As a child did you do as you were told immediately and without grumbling?
40. Would you call yourself happy-go-lucky?
41. Do good manners and cleanliness matter much to you?
42. Have you often gone against your parents' wishes?
43. Do you worry about awful things that might happen?
44. Have you ever broken or lost something belonging to someone else?
45. Do you usually take the initiative in making new friends?
46. Would you call yourself tense or "highly-strung"?
47. Are you mostly quiet when you are with other people?
48. Do you think marriage is old-fashioned and should be done away with?
49. Do you sometimes boast a little?

50. Are you more easy-going about right and wrong than most people?
51. Can you easily get some life into a rather dull party?
52. Do you worry about your health?
53. Have you ever said anything bad or nasty about anyone?
54. Do you enjoy cooperating with others?
55. Do you like telling jokes and funny stories to your friends?
56. Do most things taste the same to you?
57. As a child were you ever cheeky to your parents?
58. Do you like mixing with people?
59. Does it worry you if you know there are mistakes in your work?
60. Do you suffer from sleeplessness?
61. Have people said that you sometimes act too rashly?
62. Do you always wash before a meal?
63. Do you nearly always have a "ready answer" when people talk to you?
64. Do you like to arrive at appointments in plenty of time?
65. Have you often felt listless and tired for no reason?
66. Have you ever cheated at a game?
67. Do you like doing things in which you have to act quickly?
68. Is (or was) your mother a good woman?
69. Do you often make decisions on the spur of the moment?
70. Do you often feel life is very dull?
71. Have you ever taken advantage of someone?
72. Do you often take on more activities than you have time for?
73. Are there several people who keep trying to avoid you?
74. Do you worry a lot about your looks?
75. Do you think people spend too much time safeguarding their future with savings and insurance?
76. Have you ever wished that you were dead?
77. Would you dodge paying taxes if you were sure you could never be found out?
78. Can you get a party going?

79. Do you try not to be rude to people?
80. Do you worry too long after an embarrassing experience?
81. Do you generally "look before you leap"?
82. Have you ever insisted on having your own way?
83. Do you suffer from "nerves"?
84. Do you often feel lonely?
85. Can you on the whole trust people to tell the truth?
86. Do you always practice what you preach?
87. Are you easily hurt when people find fault with you or the work you do?
88. Is it better to follow society's rules than go your own way?
89. Have you ever been late for an appointment or work?
90. Do you like plenty of bustle and excitement around you?
91. Would you like other people to be afraid of you?
92. Are you sometimes bubbling over with energy and sometimes very sluggish?
93. Do you sometimes put off until tomorrow what you ought to do today?
94. Do other people think of you as being very lively?
95. Do people tell you a lot of lies?
96. Do you believe one has special duties to one's family?
97. Are you touchy about some things?
98. Are you always willing to admit it when you have made a mistake?
99. Would you feel very sorry for an animal caught in a trap?
100. When your temper rises, do you find it difficult to control?
101. Do you lock up your house carefully at night?
102. Do you believe insurance schemes are a good idea?
103. Do people who drive carefully annoy you?
104. When you catch a train, do you often arrive at the last minute?
105. Do your friendships break up easily without it being your fault?
106. Do you sometimes like teasing animals?

PLEASE CHECK THAT YOUR HAVE ANSWERED ALL THE QUESTIONS

Appendix I
EFFECTS OF COFFEE RECEIVED

The following questions ask you to rate the effects of the coffee you received in this experiment. Again, please circle the number that corresponds best with your answer.

1. The coffee I received made me

-3	-2	-1	0	1	2	3
much more drowsy			no change			much more alert

2. The coffee I received

-3	-2	-1	0	1	2	3
worsened my mood greatly			no change			improved my mood greatly

3. The coffee I received made me

-3	-2	-1	0	1	2	3
much more anxious			no change			much less anxious

4. The coffee I received gave me

-3	-2	-1	0	1	2	3
much less energy			no change			much more energy

5. The coffee I received

-3	-2	-1	0	1	2	3
worsened my concentration greatly			no change			improved my concentration greatly

6. The coffee I received

-3	-2	-1	0	1	2	3
worsened my performance greatly			no change			improved my performance greatly

7. I would estimate that the coffee I received, in terms of caffeine content, had

-3	-2	-1	0	1	2	3
no caffeine			average caffeine			more caffeine than usual

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