THE EFFECTS OF TASK DIFFICULTY AND TYPE A BEHAVIOR PATTERN ON THE INVERTED-U RELATIONSHIP BETWEEN STRESS LEVEL AND PERFORMANCE

BY

© SUSAN A. VITASSI

A THESIS SUBMITTED TO THE FACULTY OF ARTS
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
A MASTER OF ARTS DEGREE

DEPARTMENT OF PSYCHOLOGY
LAKEHEAD UNIVERSITY
THUNDER BAY, ONTARIO

JULY, 1982

ACKNOWLEDGEMENTS

I would like to thank Dr. John L. Jamieson for his supervision and friendship. I would also like to thank Dr. William T. Melnyk, my second reader; Dr. Hugh N. McLeod, my internal examiner; and Dr. James A. Easterbrook, my external examiner, for their interest in my work.

Special thanks to Dr. James F. Evans for his inspiration and friendship.

Finally, I would like to thank my parents, brother, fiancé and friends for their love and support throughout this endeavor.

Susan A. Vitassi

TABLE OF CONTENTS

	Page
ABSTRACT	vii
INTRODUCTION	1
The Inverted-U Hypothesis	1
Task Difficulty: the Yerkes-Dodson law	2
The Type A Behavior Pattern: Description	5
The Type A Behavior Pattern: Assessment	10
The Type A Behavior Pattern: Arousal and Performance	14
The Present Study	18
METHOD	21
Subjects	21
Type A/B Assignment	21
Confederates	21
Design	22
Apparatus	22
Procedure	24
Scoring of Dependent Measures	27
RESULTS	31
Initial Differences	31
Effects of Competition	31
Correlations	32
Post-Experimental Rating Scale Measures	36
DISCUSSION	39

TABLE OF CONTENTS CONTINUED

	Page
Conclusion.....	44
REFERENCES.....	47
LIST OF APPENDICES.....	63

LIST OF TABLES

		Page
Table 1	Means for Trial 7 and 8 for Each of the Four Groups on the Three Dependent Measures.....	33
Table 2	The Correlation Matrices.....	35

LIST OF FIGURES

		Page
Figure 1	Flow Chart of Experimental Procedure...	29
Figure 2	Scattergram of the Relationship between NPERCHG and HRCHG for Type A and B subjects on the Complex Task.....	37

ABSTRACT

The purpose of this study was twofold: to examine the effects of task difficulty and the Type A Behavior Pattern on the inverted-U relationship between stress level (arousal) and performance, and to examine possible Type A/B differences in response to competition.

A 2 X 2 factorial design was used in this study. The two factors were the type of task (simple or complex) and the behavior pattern of the subject (Type A or Type B). Subjects were 60 males from introductory psychology classes at Lakehead University. Three male confederates were employed to act as competitors against experimental subjects. Subjects practiced either a simple (digit letter) task or a complex (colour letter) task for seven trials, and then competed against a confederate on the eighth trial.

Tonic heart rate was recorded throughout the study as a physiological measure of stress, pleasantness ratings were obtained as a cognitive, evaluative measure of stress, and performance on the task was recorded as a behavioral measure of stress.

The dependent variables were: heart rate change from the seventh to the eighth trial (HRCHG), self-report of pleasantness change from the seventh to the eighth trial (SRCHG), and net performance change from the seventh to the eighth trial (NPERCHG). A post-experimental rating scale was used as an independent variable manipulation check.

Consistent with the Yerkes-Dodson law, competition resulted in a performance increase on the simple (digit letter) task, and a performance decrease on the complex (colour letter) task.

Heart rate significantly increased for all four experimental groups due to the competition. Type A and Type B subjects did not differ in their physiological response to stress, or self-report of pleasantness.

Under the stress of competition, subjects rated the simple task as more pleasant (eustress) and the complex task as less pleasant (distress) compared to the seventh trial.

An inverted-U relationship between NPERCHG and HRCHG was found for the complex task.

As predicted, Type A's performed more poorly than Type B's on the eighth trial of the complex task compared to the seventh trial. Contrary to expectation, Type A subjects did not perform better than Type B subjects during the eighth trial of the simple task compared to the seventh trial.

Stress as defined by Selye (1976), is "the nonspecific response of the body to any demand made on it". The relation between stress level (arousal) and performance has attracted great interest among experimental psychologists. One main finding was activation theory (Hebb, 1955; Lindsley, 1951, 1957), which described the relationship between arousal and performance as an inverted-U curve.

Duffy (1962) has discussed several variables which may affect the inverted-U relationship between arousal and performance. The nature of the task, the stage of practice, the inhibitory ability of the individual, and certain personality variables may separately or in combination alter the shape of the inverted-U. The present study will examine the effects of task difficulty and the Type A Behavior Pattern on the inverted-U relationship between arousal and performance.

The Inverted-U Hypothesis

Long before the discovery of the ascending reticular activating system (ARAS), the experiments of Duffy (1932) and Freeman (1948) had suggested a lawful relationship between arousal and performance. Moreover they suggested that the relationship might be described by an inverted-U curve (Duffy, 1957).

With the discovery of the ARAS (Moruzzi & Magoun, 1949), activation theory was advanced. According to activation theory the relation between arousal and performance follows an inverted-U curve, performance efficiency being poorest at low and high activation levels and best at a moderate level of activation (Hebb, 1955; Lindsley, 1951, 1957). The level of arousal at which performance is best has been generally referred to as the "optimal level of arousal" (Malmo, 1959).

Evidence bearing directly upon the inverted-U hypothesis includes Freeman's (1940) report of a single case in which he used reaction time as a measure of performance and palmar conductance as an index of activation. Among subsequent researchers, Stennett (1957) has produced strong support for the inverted-U hypothesis in his study of the relation between the EMG responses of four different muscle groups and auditory tracking performance. The inverted-U curve has been shown to hold in numerous learning and performance situations where the amount of induced muscle tension was varied systematically (Courts, 1942). Studies by Bindra (1959), Cofer (1959) and Kendler (1959) have also supported the inverted-U hypothesis.

Task Difficulty: the Yerkes-Dodson law

According to the Yerkes-Dodson law, the optimal activation level varies with task complexity: the more difficult the task, the lower is the optimal level of

activation (Sjoberg, 1977). This law was formulated initially by Yerkes and Dodson (1908) in the context of discrimination learning in mice. They found that increasing the intensity of a shock given to mice facilitated the learning of brightness discriminations, but only up to a certain point, above which learning deteriorated. Furthermore, they found that the effects of shock were more pronounced in difficult discriminations, and that the optimum level of shock was higher in easy discriminations. These conclusions were reported in an extremely wide range of situations (Broadhurst, 1957, 1959; Duffy, 1957; Malmo, 1959; Schlosberg, 1954; Sjoberg, 1977; Stennett, 1957; Vitassi, 1980). The Yerkes-Dodson law is generally accepted by the activation theorists (Duffy, 1972; Malmo, 1959).

The Yerkes-Dodson law raises many questions. For example, why does performance deteriorate with increasing activation? Easterbrook (1959) presented a theory which was intended to explain both the decrement of task performance with increasing arousal, and the observation that this decrement occurs sooner in complex tasks than in simple tasks. He proposed that an increase of arousal causes a restriction of the range of cues that the organism uses in the guidance of action.

This hypothesis explains the Yerkes-Dodson law as follows: consider a task which requires the simultaneous processing of a certain number of cues. When arousal is low, selectivity is also low, and irrelevant cues are accepted uncritically. When

arousal increases, selectivity increases also, and performance improves because irrelevant cues are more likely to be rejected. With further increases of arousal, however, the continuing restriction of the range of usable cues eventually causes relevant cues to be ignored, and performance deteriorates again. With the additional assumption that the range of necessary cues is narrower for simple than for complex tasks, this argument implies that the optimal level of arousal should be relatively high in simple tasks.

Easterbrook's (1959) review of the literature demonstrates that high arousal causes attention to be concentrated on the dominant aspects of the situation at the expense of other aspects. Complex tasks often require attention to varied cues, and are therefore performed poorly when arousal is high. Easterbrook found much research support for the narrowing of attention under high arousal (Bahrick, Fitts, & Rankin, 1952; Bursill, 1958; Callaway, 1959; Callaway & Dembo, 1958; Callaway & Stone, 1960; Callaway & Thompson, 1953).

An alternate hypothesis by Vroom (1964) is that high stress leads to physiological involuntary autonomic responses that interfere with performance, and the subject becomes primarily motivated to reduce the stress level rather than to perform the task. At least two other authors have also suggested that intervening processes in the form of the behavioral coping patterns used to combat high stress may account for

performance decrement at high stress levels (Kahn, 1964; Lazarus, 1966). Under conditions of high stress it is hypothesized that individuals will emphasize emotional and defensive coping mechanisms rather than problem-solving, and other appropriate task specific behaviors, leading to a decrement of the performance level.

This relationship raises another issue. Why does performance deteriorate with decreasing activation? According to Kahneman (1973) the subject's performance decrement with decreasing activation can be explained in motivational terms: he fails to concentrate on the task, fails to evaluate the quality of his own performance and so achieves a low level of performance. Vroom (1964), in reviewing a number of studies, also found that the lower performance associated with very low stress levels is usually explained by low motivation that accompanies the low stress and the ease with which the subject is therefore diverted from the problem by extraneous factors.

Sjoberg (1977) found few studies on human subjects that are directly relevant to the Yerkes-Dodson law and most studies dealing with this problem have not included measures of physiological activation.

The Type A Behavior Pattern: Description

The concept of the Type A Behavior Pattern (TABP) was introduced by two pioneering cardiologists, Drs. Meyer Friedman and Ray Rosenman (1959) and is described as "a characteristic action

emotion complex which is exhibited by those individuals who are engaged in a relatively chronic struggle to obtain an unlimited number of poorly defined things from their environment in the shortest period of time, and if necessary against the opposing efforts of other things or persons" (Friedman, 1969, p. 84). The TABP is not considered to represent a homogeneous personality trait, nor a stereotyped stress reaction but rather refers to an overt constellation of behaviors that emerge when a person predisposed by as yet unknown factors (e.g., personality, genetic endowment, parental shaping, sociocultural values) is confronted with challenging or threatening situations (Jenkins, 1971, 1978).

The TABP is characterized by intense striving for achievement, competitiveness, impatience, being easily provoked, time urgency, excesses of drive and hostility, overcommitment to vocation or profession, polyphasic performance, tense facial and bodily musculature, hand or teeth clenching, and abruptness of gestures and speech (Rosenman & Friedman, 1959, 1974). The Type B Behavior Pattern (TBBP) is defined as the relative absence of these characteristics (Friedman & Rosenman, 1974). It is important to note that no one Type A individual manifests all of the characteristics constituting the behavior pattern, and even a Type B individual will show A-like features under various circumstances. However, the TABP has proven to be reliably reproducible over time (Jenkins, Rosenman & Friedman, 1968).

The TABP occurs in both men and women, but appears to be more prevalent among men (Haynes, Feinleib, Levine, Scotch, & Kannel, 1978; Jenkins, Zyzanski, & Rosenman, 1979; Maccoby, 1974; Waldron, 1976, 1978). Also, most research has been conducted with males as subjects (Dembroski, MacDougall, Herd, & Shields, 1980).

Jenkins and Zyzanski (1970) have revealed through factor analysis that the TABP is composed of three major, conceptually and statistically independent dimensions. They have described factor H: hard driving and competitive behavior; factor J: job involvement; and factor S: speed and impatience. A closer look at the three dimensions which comprise the TABP will follow.

Factor H involves the hard driving, competitive, ambitious, and achievement oriented behavior which is observed in Type A individuals (Friedman, 1969). Studies have found that Type A's approach tasks in a hard driving manner, whereas Type B's respond closer to the precise nature of the task requirements (Burnam, Pennebaker, & Glass, 1975; Frankenhaeuser, Lundberg, & Forsman, 1980; Manuck & Garland, 1979). Research has also found that Type A students, as compared to Type B students, studied longer, attended classes more hours per week, took more courses, and had higher grade point averages (Waldron, 1980). Evidence suggests that Type A's receive more academic honours in college (Glass, 1977), achieve higher educational status (Appels, Jenkins, & Rosenman, 1980; Waldron, 1978), and score higher on achievement motivation (Howard, Cunningham, & Rechnitzer, 1977; Ray & Bozek,

1980).

Factor J describes the degree to which the Type A individual is dedicated to or involved in his vocation. Type A's are commonly called "workaholics" since they are commonly deeply engaged in a challenging, high-pressure job that frequently carries excessive supervisory responsibilities. Burke and Weir (1980) state that "one may conclude that the work role and work activities must be of central importance in the value systems of Type A individuals" (p. 36). Studies have found that Type A men, compared to Type B men, work more hours per week (Burke & Weir, 1980; Howard et al., 1977), experience more work overload (Caplan & Jones, 1975; Howard et al., 1977; Keenan & McBain, 1979; van Dijkhuizen, 1979), and achieve higher occupational status (Appels et al., 1980; Waldron, 1978).

Factor S describes the chronic sense of time urgency which is mirrored in the extremely rushed and rapid paced life of the Type A individual. Friedman (1969) found that Type A's eat, think, and talk fast. They commonly hurry others along and become irritated or even angry when forced to slow down their accelerated pace of life. Studies have found that Type A's perceive that time passes quicker than it actually does (Bortner & Rosenman, 1967; Burnam et al., 1975; Glass, 1977; Glass, Snyder, & Hollis, 1974; Price & Clarke, 1978). Verhagen, Nass, Appels, van Basterlaer and Winnibust (1979) suggest that Type A individuals may suffer from "time anxiety"

described as the fear that time passes too quickly. Gastorf (1980) found that Type A's are more punctual than Type B's. Research has found that Type A subjects, presumably because of their greater sense of time urgency and their heightened impatience, show greater decrements in performance on a task which requires low rates of responding than do Type B's (Glass, 1977; Glass et al., 1974; Goldband, Nielson, & Patton, 1981). Also, Type A's exhibit more irritation and anger when forced to slow down their activity level (Carver & Glass, 1978; Glass, 1977; Glass et al., 1974).

People who are competitive, achievement oriented, time urgent and hostile have long been suspected of being at higher risk of clinical coronary heart disease (CHD) (Osler, 1892). There is evidence that the TABP discriminates between coronary and noncoronary populations in numerous western countries (Glass, 1977; Hiland, 1977; Jenkins, 1976; Jenkins, Zyzanski, & Rosenman, 1971; Kenigsberg, Zyzanski, Jenkins, et al., 1974). These findings have been replicated in Britain (Heller, 1979), Holland (Appels et al., 1980; Verhagen et al., 1979), Belgium (Kittel, Kornitzer, Zyzanski, et al., 1978) and Poland (Zyzanski, 1978; Zyzanski, Wreszniewski, & Jenkins, 1979).

In a series of retrospective and prospective studies the TABP was found to be associated with over twice the rate of new coronary events as compared to the TBBP (Friedman & Rosenman, 1974; Rosenman, Brand, Jenkins et al., 1975; Rosenman, Brand, Sholtz, & Friedman, 1976). The TABP has also signif-

icantly predicted recurring coronary events (Jenkins et al., 1971; Jenkins, Zyzanski, & Rosenman, 1976; Rosenman, Friedman, Jenkins, Straus, Wurm, & Kositcheck, 1967; Rosenman et al., 1976). The TABP constitutes a significant and independent risk factor for CHD (Brand, 1978; Brand, Rosenman, Sholtz, & Friedman, 1976; Rosenman et al., 1975; Rosenman et al., 1976) beyond that imposed by age, elevated systolic blood pressure, serum cholesterol, and smoking (Brand et al., 1976; Haynes et al., 1978; Rosenman et al., 1976; Shekelle, Schoenberger, & Stamler, 1976).

The Type A Behavior Pattern: Assessment

The TABP has been assessed by a variety of methods. These include: the Structured Interview (Rosenman, 1978); the Jenkins Activity Survey (Jenkins et al., 1979); the Bortner Test Battery (Bortner & Rosenman, 1967); the Bortner Rating Scale (Bortner, 1969); the Cardiac Risk Test (van Doornen, 1979); the Thurstone Activity Scale (MacDougall, Dembroski, & Musante, 1979); the Gough Adjective Check List (MacDougall et al., 1979); the Framingham Check List (Haynes, Feinleib, & Kannel, 1980); the Vickers Rating Scale (Caplan & Jones, 1975); the Sales Rating Scale (Burke et al., 1980); the Rating of Statements List (van Dijl, 1978; van Dijl & Nagelkerke, 1979); and various assessments of speech stylistics (Friedman, 1969; Schucker & Jacobs, 1977; Sherwitz et al., 1977). Each instrument appears to measure some factor or factors unique to its respective

design (Chesney, Black, Chadwick, & Rosenman, in press; Jenkins, 1978; MacDougall et al., 1979; Rosenman, 1978). However, the two most frequently used for research in this field and considered the most reliable and valid are the Structured Interview and the Jenkins Activity Survey (Dembroski, Weiss, Shields, Haynes, & Feinleib, 1978).

The Structured Interview (SI) was developed by Friedman and Rosenman (1974) for the purpose of assessing the behavior pattern of subjects in the Western Collaborative Group Study (WCGS). The WCGS was a prospective epidemiological study which suggested that the TABP significantly predicts the incidence of both new and recurrent CHD.

The SI designates subjects as Type A or B primarily based upon voice and psychomotor mannerisms by the subject during the course of the 10-15 minute interview, although the actual verbal content is also considered (Dembroski et al., 1980; Rosenman, 1978). The subject is asked questions dealing with his/her ambition, job involvement, work style, competitiveness, aggressiveness, impatience, and sense of time urgency. Currently, subjects are classified on a 4-point scale: extreme Type A (A_1), predominantly Type A (A_2), indeterminant or mixed (Type X), and Type B, when a relative absence of Type A attributes is observed.

The SI is considered to be a valid measure of the TABP (Jenkins, 1978; MacDougall et al., 1979; Rosenman, 1978). Independent raters' interscorer agreement of type classification

most often ranges between 75 and 90% and usually hovers around 85% for the simple A/B dichotomy (Belmaker et al., 1977; Caffrey, 1968; Dembroski and MacDougall, 1978; Friedman et al., 1968; Jenkins et al., 1965, 1968; Keith, Lown, & Stare, 1965; Rosenman, 1978). Test-retest reliability of dichotomous typing in a study of over 1,000 subjects in the WCGS was $\underline{r}$ = +.82 (tetrachloric correlation coefficient) for periods that ranged between 12 and 20 months (Jenkins et al., 1968).

The SI has several weaknesses. First, it is not truly objective since it depends upon the interviewer's subjective interpretation of the subject's behavior. Second, the SI does not provide numerical quantification of Type A. Third, researchers must undergo a period of training in order to effectively administer and assess the SI. Finally, it is costly and time consuming to use the SI since it must be administered individually and tape recordings made of each subject during the SI in order to prevent error of judgment due to fatigue or over the course of a long study.

The Jenkins Activity Survey (JAS) was developed in 1967 by Jenkins, Rosenman and Friedman by utilizing multivariate statistical methods to provide a computer-scored, continuous scale of Type A/B behavior, based on a weighted combination of the responses to the JAS questions. In both the choice of subjects for constructing the JAS scores (WCGS participants) and in the use of the interview behavior assessment as a

criterion, the JAS score was designed to mimic the SI.

The JAS is a self-administered, paper and pencil questionnaire, which consists of the following four subscales: the overall A/B subscale, Hard Driving (H), Job Involvement (J) and Speed and Impatience (S/I) (Dembroski et al., 1980). All of the subscales were standardized in the WCGS to have a mean of zero and a standard deviation of 10, with high scores indicative of Type A behavior. The scoring and quantification of the JAS depend upon the content of the answers to a series of questions that are asked, and therefore, in the final analysis, depend upon a valid self-appraisal by the subject.

The original JAS has undergone numerous revisions (Jenkins, Zyzanski, & Rosenman, 1972), one of which is a student version (Form T) developed by Krantz, Glass, and Snyder in 1974. The advent of Form T made possible the administration of the JAS to a college student population. Some of the items on the Job Involvement subscale were inapplicable to students and were excluded from Form T, leaving the overall A/B subscale, the Hard Driving subscale and the Speed and Impatience subscale.

Studies have found test-retest reliability coefficients between .65 and .76 for periods covering one to four years and high alternate form reliability for the JAS (Jenkins et al., 1968; 1974; Waldron, 1980). However, Jenkins, Rosenman and Zyzanski (1974) note that the JAS was being systematically revised between testing periods which probably led to an underestimate of the true stability of the questionnaire.

Reliability coefficients reflecting the degree of internal consistency range from .73 to .85 (Jenkins et al., 1979; Verhagen et al., 1979). The JAS is considered to be a valid psychometric measure of the TABP (Dembroski et al., 1980; MacDougall et al., 1979).

Overall, the JAS possesses the advantages of relatively easy, cost-efficient, standardized group administration, and objective computerized scoring which does not depend upon clinical or subjective judgments in designating subjects as Type A or Type B.

The Type A Behavior Pattern: Arousal and Performance

Research indicates that the TABP emerges in the presence of certain environmental challenges or stressors (Blumenthal, Williams, Kong, Schanberg, & Thompson, 1978; Burnam et al., 1975; Carver & Glass, 1978; Dembroski et al., 1978; Dembroski et al., 1980; Friedman, 1969; Friedman & Rosenman, 1959, 1974; Glass, 1977; Glass et al., 1974; Krantz et al., 1974; Manuck, Craft, & Gold, 1978). As well, Type A subjects compared to Type B's show evidence of elevated sympathetic nervous system arousal when confronted with appropriately challenging stressors (Dembroski & MacDougall, 1978; Dembroski, MacDougall, & Shields, 1977; Dembroski et al., 1978; Dembroski et al., 1979; Frankenhaeuser et al., 1980; Friedman, 1977; Friedman, Byers, Diamont, & Rosenman, 1975; Glass et al., 1980; Manuck et al., 1978; Manuck & Garland, 1979; Scherwitz, Berton, & Leventhal, 1978;

Sime, Pierrynowsky, & Sharrat, 1977; Stokols, Novaco, Stokols, & Campbell, 1978; Van Egeren, 1979; Van Doornen, 1979; Weidner & Matthews, 1978).

Research has found that Type A's, compared to Type B's, respond to various stressors with significantly greater systolic blood pressure (Dembroski et al., 1977; Dembroski et al., 1978; Dembroski et al., 1979; Glass et al., in press; MacDougall et al., 1981; Manuck et al., 1978; Manuck & Garland, 1979; Weidner & Matthews, 1978), diastolic blood pressure (Dembroski et al., 1978; Dembroski et al., 1979; Glass et al., 1980; Houston & Jorgensen, 1980; Pittner & Houston, 1980; van Doornen, 1979; Waldron et al., 1980), finger pulse amplitude reactivity (Dembroski et al., 1979; van Doornen, 1979; Van Egeren, 1979), plasma norepinephrine levels (Friedman et al., 1960; Friedman et al., 1975; Glass et al., in press), and plasma levels of catecholamines (Frankenhaeuser, 1971; Friedman et al., 1975; Glass et al., in press; Mason, 1972).

It has also been shown that Type A's react to various stressors with significantly greater rest-to-task increases in heart rate than Type B's (Dembroski et al., 1977; Dembroski et al., 1978; Dembroski et al., 1979; Dembroski et al., 1980; Glass et al., 1980; Manuck & Garland, 1979; Pittner & Houston, 1980; Van Egeren, 1979). However, no heart rate differences between Type A's and B's have been reported by Frankenhaeuser et al. (1978), Friedman et al. (1963), Lott & Gatchel (1978), Manuck et al. (1978), and Price & Clarke (1978). These negative

results make it clear that Type A's are not invariably more physiologically responsive than their Type B counterparts and highlight the importance of systematic study of the environmental variables which modulate arousal differences.

One paradigm for studying the response to stress is competition with a similar coactor. A coactive situation occurs when two or more people are simultaneously performing the same task in the presence of one another. A similar coactor is a same-sex competitor who works on the same task, is described as having the same amount of practice as the subject, and performs at the same rate as the subject (Gastorf et al., 1980). The use of same-sex competitors is seen in many studies of competition (Church, 1962; Evans, 1966, 1971, 1972; Evans and Bonder, 1973; Fish, 1978; Gastorf et al., 1980; Wankel, 1972; Wilmore, 1968).

A review of previous research shows that positive effects of competition on performance have been reported by Berridge (1935), Carment (1970), Church (1962), Church, Millward and Miller (1963), Evans (1977), Evans and Bonder (1973), Fish (1978), Freischlag (1973), Moede (1931), Nelson (1962), Triplett (1897), and Wilmore (1968). Negative effects have been reported by Allen and Boivin (1976), Dasheill (1930), Shaw (1958), and Whittemore (1924). Differential or non-significant effects have been reported by Evans (1966, 1968, 1971), Gerdes (1958), Martens and Landers (1969), Triplett (1897), Wankel and Alderman (1971), and Wood (1975). The

majority of studies indicate that competition has a positive effect upon performance.

Studies by Allport (1920), Carment (1970), Fish (1978), Fraser (1953), and Triplett (1897) found that coaction increases the performance of an individual. Zajonc (1965) proposed that working in the presence of a coactor leads to improved performance of well learned (simple) tasks and impaired performance of poorly learned (complex) tasks.

Research concerning the effect of the TABP on the Yerkes-Dodson law is limited. Gastorf, Suls, and Sanders (1980) subjected JAS-defined Type A's and B's to either a simple or complex task while working alone or in the presence of either a similar or superior coactor. For Type A's, the results revealed that the presence of either the similar or superior coactor facilitated performance on the simple task and impaired performance on the complex task. Type B's, by contrast, showed only weak and nonsignificant changes in performance in response to the presence of the similar coactor. Glass (1977) reported that Type A's outperformed Type B's in a simple memorization and recall task for common words and pictures presumably because the Type A subjects were more involved in the task. Frankenhaeuser, Lundberg and Forsman (1978) found that Type A's outperformed Type B's while working on a challenging choice reaction time task. Manuck and Garland (1979) reported that Type A's outperformed Type B's under conditions of no incentive, but performed similarily when given a monetary

incentive. Berlyne (1960) and Fiske and Maddi (1961) found that as Type B subjects became more aroused, they approached an optimum level of performance facilitation. Research has shown that in contrast to B's, A's can exhibit significantly greater physiological responses to a challenging task while no differences in performance are observed (Dembroski et al., 1978; Dembroski et al., 1979; Glass et al., in press; MacDougall et al., 1981).

The Present Study

This study was undertaken with two main goals in mind: to examine the effects of task difficulty and the TABP on the inverted-U relationship between stress level (arousal) and performance, and to examine possible Type A/B differences in response to competition.

As Sjoberg (1977) pointed out, few studies have been conducted with human subjects that are directly relevant to the Yerkes-Dodson law. In addition, little attention has been given to possible individual difference variables that may influence the Yerkes-Dodson law.

The TABP has been shown to influence both physiological and behavioral responses to stressful situations. The present study compared tonic heart rate, self-report of pleasantness ratings, and performance responses of Type A and B males to simple and complex tasks. The stressor was a one minute competition against a similar coactor.

Tonic heart rate has proven to be one of the most reliable measures of activation level (Schnore, 1959). Tonic refers to heart rate during an experimental condition that is intended to induce a motivational state in a subject which is maintained over a relatively substantial period, say of half a minute or more (Elliott, 1969). Research has shown that tonic heart rate is very responsive to incentive and stress manipulations (Elliott, 1969; Malmo, 1962). Competition has been shown to increase tonic heart rate (Evans, 1968, 1972, 1977; Evans & Bonder, 1973; Fish, 1978). Research has also shown that an increase in tonic heart rate is a dependable and consistent indication of an increase in motivation in the typical psychological experiment (Doerr, 1965; Elliott, 1969; Evans, 1972) and reflects an increase in stress caused by cognitive stressors independent of physical stressors (Blix, Stromme, & Ursin, 1974).

In accordance with the Yerkes-Dodson law, it was expected that competition would improve performance on the simple task and decrease performance on the complex task.

Competition was expected to prove more stressful for the Type A subjects than for the Type B subjects as indicated by their heart rates. Since Type A's should show greater physiological arousal to both the simple and complex tasks compared to the Type B's, the Type A males were expected to perform better than Type B's on the simple task and more poorly than B's on the complex task. The Yerkes-Dodson law should be more

clearly demonstrated with the Type A subjects.

Self-reports of pleasantness ratings were obtained as a cognitive, evaluative measure of stress. Selye (1974) makes the distinction between pleasant stress (eustress) and unpleasant stress (distress). When stressed by the competition, both Type A and B subjects should rate a simple task more pleasant and a complex task less pleasant compared to the self-report of pleasantness ratings for the seventh trial. This prediction was based on the assumption that competition would improve performance on the simple task and decrease performance on the complex task.

METHOD

Subjects

Sixty-two male introductory psychology students were recruited at Lakehead University on a voluntary basis. Two subjects were eliminated from the study in order to obtain an equal number of subjects in each of the four experimental groups.

Each of the 60 subjects received a one point credit toward his final mark in the introductory psychology course. The ages ranged from 18 to 37 years. The mean age was 21.97 years. Fifteen subjects were tested in each experimental condition.

Type A/B Assignment

Each subject completed the Jenkins Activity Survey Form T individually. The scores were rank ordered. A score of 7 or above was considered Type A and a score of 6 or below was considered Type B. This procedure yielded 30 Type A males and 30 Type B males.

Confederates

Three male introductory psychology students served as competitors. Their ages were 19, 19, and 20 years. These confederates were thoroughly briefed on the nature of the

study and told to keep their behavior as consistent as possible throughout the study. Each confederate received fifty dollars for his participation when the study was completed.

Design

A 2 X 2 factorial design was used in this study. The two factors were the type of task (simple or complex) and the behavior pattern of the subject (Type A or B). The resulting four groups had 15 subjects in each of the following conditions:

1. Type A/simple task (A/S)
2. Type A/complex task (A/C)
3. Type B/simple task (B/S)
4. Type B/complex task (B/C)

Apparatus

The TABP was assessed by the Jenkins Activity Survey Form T as revised for college students by Krantz, Glass, and Snyder (1974). A copy of the JAS Form T can be found in Appendix A.

Two separate rooms at Lakehead University were used in this study. One room housed the confederate until he was needed for the competitive eighth trial. The other room was used for administering the JAS Form T, the practice trials,

the competitive eighth trial and the post-experimental rating scale. The confederate sat opposite the subject at the same table during the competitive eighth trial.

A buzzer was used to signal the beginning and end of the practice and critical eighth trials. A stopwatch was used to time each of the eight one-minute trials, as well as the five minute relaxation period.

The simple task consisted of eight variations of a digit letter substitution task, one of which has been reprinted in Appendix B. The task involved copying letters as quickly as possible beneath a series of numbers according to a given code. All subjects used the same eight forms with the eighth form duplicated for the competitor. This task was similar to the digit symbol subtest of the WAIS-R (Brace, Harcourt, & Jovanovich, 1981).

The complex task consisted of eight variations of a colour letter task, one of which has been reprinted in Appendix C. This task was the invention of the experimenter and involved copying letters as quickly as possible beneath a series of words which refer to specific colours, according to a colour code (Vitassi, 1980). All subjects used the same eight forms with the eighth form duplicated for the competitor. The subject used ten coloured pencils to carry out this task. The competitor was supplied with ten identical coloured pencils during the eighth trial. See Appendix F (p. 81) for a description of the complex manner in which the response sheet, colour code, and ten coloured pencils are used to perform this task.

The pleasantness scale was presented throughout the study at various times to determine how pleasant or unpleasant the participants found a particular part of the study. The pleasantness scale was a 21 point scale which was labelled from "extremely unpleasant" to "extremely pleasant" at the extremes, and "neither pleasant nor unpleasant" at the middle. The subject was instructed to select the number which represented most accurately his present perception. A copy of the pleasantness scale can be found in Appendix D.

Continuous heart rate recordings were made for all the subjects by means of a Gilson two-channel polygraph with a finger pick-up transducer. The polygraph was situated behind a set of shelves so that the subjects would not be able to see the recording.

A post-experimental rating scale was used in order to collect the following judgments from each subject:

1. The degree of complexity of the task.
2. The degree to which the subject thought his performance on the last trial compared to the second last trial-(improved or deteriorated).
3. The degree to which the subject thought he won or lost the competition.

A copy of the post-experimental rating scale can be found in Appendix E.

Procedure

The subject was greeted by the experimenter and led into the experimental room. Here the subject was asked to be seated at a table and sign a consent form. The subject was given the JAS Form T to complete. Next, the subject was informed that his heart rate would be recorded throughout the session, and the plethysmograph was attached to the index finger of his nonpreferred hand. The heart rate apparatus was put into operation and explained to the subject. The subject was reassured that nothing harmful would happen to him during the course of the experiment. The pleasantness scale was explained thoroughly. The subject was told that at various times throughout the experiment he would be asked to rate how pleasant he found doing something, and that he would be required to give a number from the pleasantness scale. Questions were encouraged at this point.

The subject was now asked to make himself comfortable and relax for five minutes. During the relaxation period the experimenter stood behind a series of book shelves and continuously recorded the subject's heart rate. At the end of the five minute relaxation period the subject was asked to make his first rating of pleasantness. All the subjects were treated identically up to this point.

Subjects were now assigned randomly to either the simple or complex task. The task (simple-digit letter or complex-colour letter) was thoroughly explained and the subject was allowed to ask questions. The code was presented face down

to the subject and at the sound of the buzzer was turned over. After the one minute trial the buzzer was buzzed and the subject stopped and turned over the task. The experimenter marked off on the heart rate recorder the 60 second interval of performing the task. Immediately after the trial, the subject was asked to rate how pleasant he found the trial and the task was scored in front of him. The experimenter showed the subject how to correct any errors and a score was announced for that trial. The second trial was presented with the identical procedures followed in the first trial. Seven identical practice trials in all were presented to each subject. However, seven variations of the task (digit letter or colour letter) were used during the practice trials.

After the seventh practice trial and the seventh rating of pleasantness the experimenter excused herself from the room momentarily and returned with the competitor for the critical eighth trial. The competitor was introduced as another introductory psychology student, was seated across the table from the subject, and was attached to the polygraph by means of a finger pick-up (plethysmograph). The competitor and the subject were able to observe each other's progress on the task during the eighth trial. The competitor was a confederate of the experimenter who was able to perform the task at the same rate as the subject.

The competitive nature of the situation was emphasized.

The subject and the competitor were told that they would be competing against each other to see who could perform the task quicker. They were advised to work as fast as possible, do their very best and try to do better than their opponent in the goal of being declared the winner. The trial began and ended with the sound of the buzzer, and the subject and competitor were asked to rate the pleasantness of the trial. The task was scored and the winner declared. The subject was given the post-experimental rating scale to complete and the confederate was shown out of the room.

A complete debriefing followed. The purpose of the study was disclosed and the role of the competitor was explained. Subjects were asked what they thought the experiment was about, and if they had heard anything about the experiment. They were also asked to keep the details of the experiment confidential. All subjects were thanked for their cooperation and participation, told that they could not be in the experiment again, and reminded that they would be credited one point toward their final grade in introductory psychology. Each experimental session lasted approximately 60 minutes. Appendix F contains a complete set of instructions used during the experiment. A flow chart of the procedure is presented.

Scoring of Dependent Measures

Heart rate scores were counted by hand over a 60 second time period for the relaxation period, the seventh trial, and

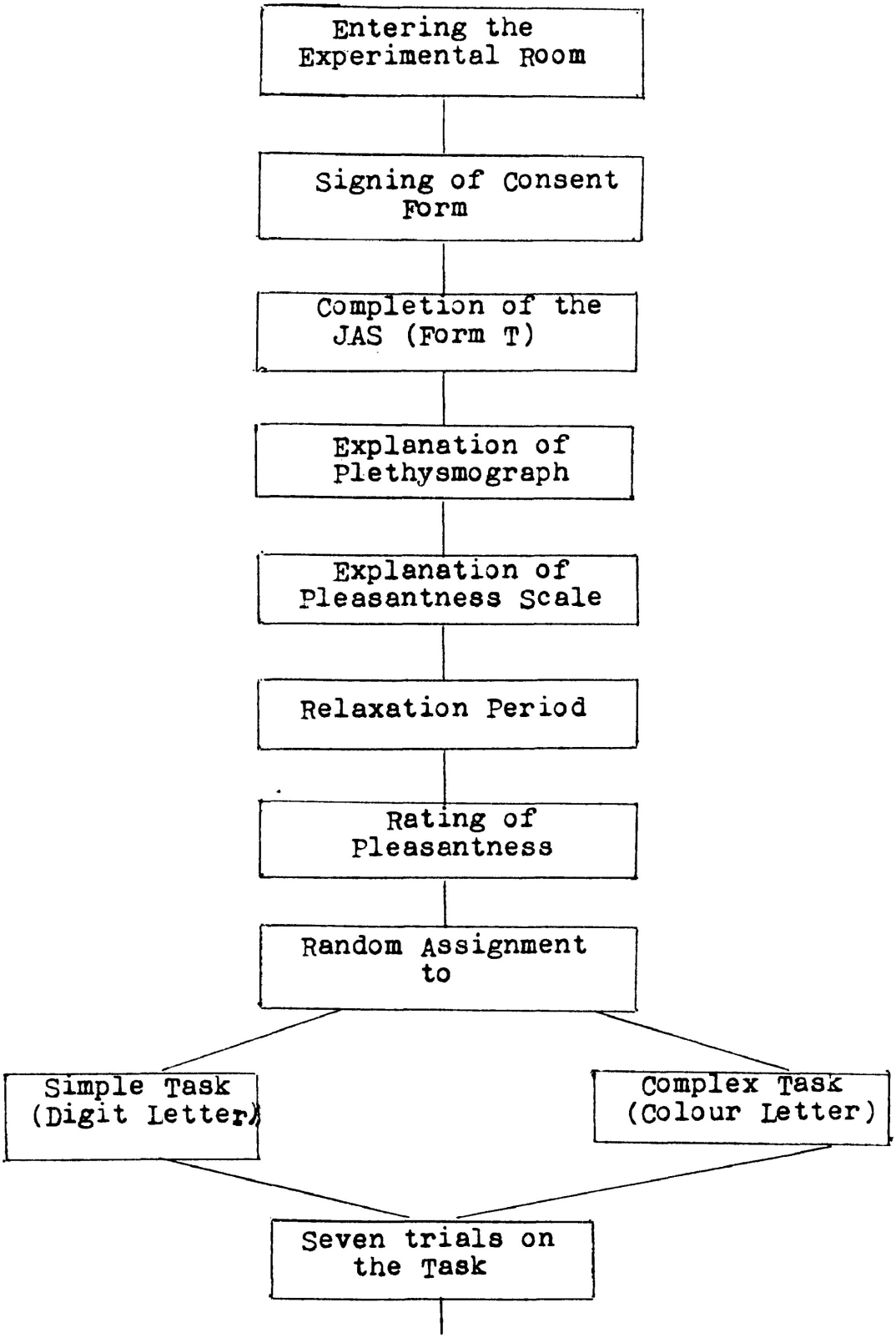
the eighth trial.

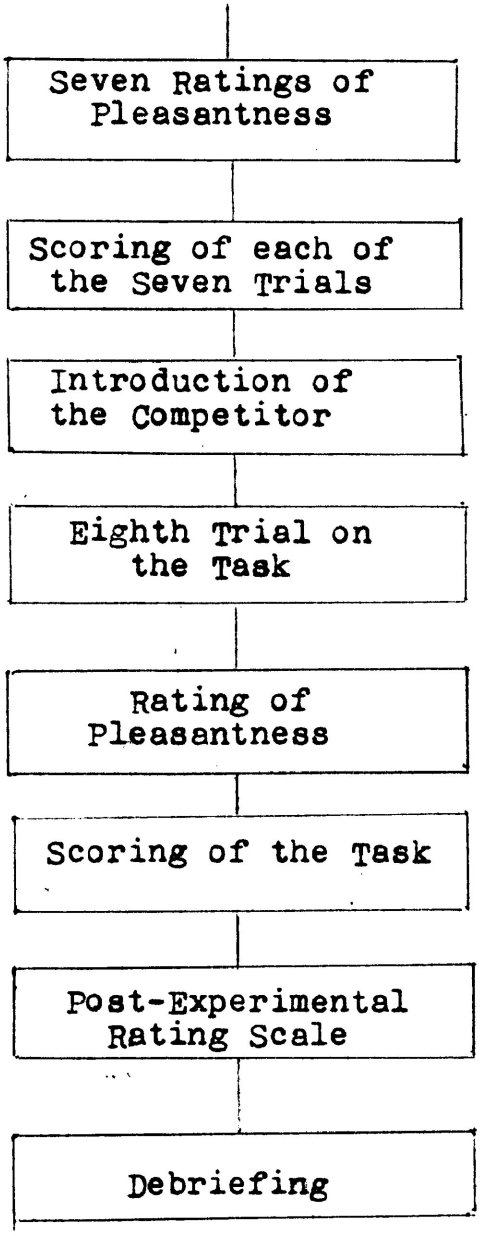
Self-report of pleasantness scores were obtained for the relaxation period, the seventh trial, and the eighth trial.

Performance measures included net performance scores on the seventh trial, and net performance scores on the eighth trial. The net performance scores for the seventh trial were obtained by subtracting the errors for trial seven from the performance score for trial seven. The net performance scores for trial eight were obtained by subtracting the errors for trial eight from the performance score for trial eight.

A complete account of the raw scores collected for this study is presented in Appendix G.

FLOW CHART OF EXPERIMENTAL PROCEDURE




Seven Ratings of Pleasantness
Scoring of each of the Seven Trials
Introduction of the Competitor
Eighth Trial on the Task
Rating of Pleasantness
Scoring of the Task
Post-Experimental Rating Scale
Debriefing

RESULTS

Initial Differences

Five 2 X 2 factorial analyses of variance with the two factors being simple task/complex task and Type A/ Type B were performed on each of the initial measures. No significant differences in heart rate scores or self-report of pleasantness scores during the relaxation period or trial seven were revealed. Appendix H to K contains a summary of these analyses.

The main effect of simple task/complex task for net performance scores for the seventh trial was significant, $F(1,56) = 836.15$, $p < .001$. Performance on the simple (digit letter) task ($M = 48.90$) was better than performance on the complex (colour letter) task ($M = 11.73$). Appendix L contains a summary of this analysis.

Effects of Competition

Change scores were used as dependent measures in order to examine the differential effects of competition on the four experimental groups. The dependent measures were: heart rate change from the seventh to the eighth trial (HRCHG), self-report of pleasantness change from the seventh to the eighth trial (SRCHG), and net performance change from the seventh to the eighth trial (NPERCHG).

Table 1 shows the means for trial seven and eight for each of the four experimental groups on the three dependent measures. Heart rate significantly increased for all four groups. Pleasantness ratings and performance scores increased significantly for groups A/S and B/S, and decreased significantly for group A/C.

A 2 X 2 factorial analysis of variance was performed on each of the dependent measures with the two factors being Task and Type. No significant difference between groups in HRCHG were revealed. Appendix M contains a summary of this analysis.

The main effect of Task for SRCHG was significant, $\underline{F}(1,56) = 35.76$, $\underline{p} < .001$. Under the stress of competition, there was a decrease in self-report of pleasantness on the complex (colour letter) task ($\underline{M} = -1.23$) and an increase in self-report of pleasantness on the simple (digit letter) task ($\underline{M} = 2.37$). Appendix N contains a summary of this analysis.

The main effect of Task for NPERCHG was significant, $\underline{F}(1,56) = 33.55$, $\underline{p} < .001$. There was an increase in net performance on the simple (digit letter) task ($\underline{M} = 3.53$) and a decrease in net performance on the complex (colour letter) task ($\underline{M} = -1.07$). Appendix O contains a summary of this analysis.

Correlations

Intercorrelations were computed among the following: heart rate change from the seventh to the eighth trial (HRCHG),

TABLE 1

Means for Trial 7 and 8
for Each of the Four Groups
on the Three Dependent Measures

Dependent Measures	Groups A/S	A/C	B/S	B/C
HR7	77.13	81.13	82.67	84.07
HR8	95.26	98.40	97.67	95.20
t^1	7.29**	5.48**	4.25**	4.96**
SR7	12.73	11.60	12.27	11.87
SR8	15.20	10.13	14.54	10.87
t^1	4.29**	-3.15**	4.21**	-1.28
NPER7	50.00	12.60	47.80	10.87
NPER8	53.47	10.87	51.40	10.47
t^1	3.71**	-2.52*	3.83**	-0.74

t^1 Paired t test comparing trials 7 and 8 for each group

*$p < .025$

**$p < .005$

self-report of pleasantness change from the seventh to the eighth trial (SRCHG), net performance change from the seventh to the eighth trial (NPERCHG), the degree of task complexity (Q1), the degree to which the subject thought his performance on the eighth trial compared to the seventh trial-improved or deteriorated (Q2), the degree to which the subject thought he won or lost the competition (Q3), and Jenkins Activity Survey scores on the overall A/B subscale of Form T (AB). These correlations were computed for the total data set, and separately for the simple and the complex tasks (see Table 2).

The three analyses generally revealed the following four significant positive correlations: NPERCHG and SRCHG, NPERCHG and Q2, SRCHG and Q2, and Q2 and Q3. As net performance from trial seven to eight increased, self-report of pleasantness also increased, as did ratings of performance on trial eight as improved compared to trial seven. When subjects rated their performance on trial eight as improved compared to trial seven, they also felt that they had won the competition to a greater degree.

The analysis on the total data set revealed the following three significant negative correlations: NPERCHG and Q1, Q1 and Q2, and SRCHG and Q1. As net performance from trial seven to eight increased, subjects rated the task as more simple. As subjects rated the task as more simple, they rated their performance on trial eight as improved compared

TABLE 2

The Overall Correlation Matrix (Simple Task/Complex Task) (N=60)

	HRCHG	SRCHG	NPERCHG	Q1	Q2	Q3	AB
HRCHG		.08	.18	.02	.11	-.01	.10
SRCHG			.60***	-.39***	.66***	.12	.05
NPERCHG				-.33**	.65***	.87	-.08
Q1					-.28*	-.04	.05
Q2						.31*	.05
Q3							-.22

The Simple Task Correlation Matrix (N=30)

	HRCHG	SRCHG	NPERCHG	Q1	Q2	Q3	AB
HRCHG		.09	.16	.07	.14	-.04	.11
SRCHG			.39*	-.01	.48**	.36*	.11
NPERCHG				.10	.50**	.19	.09
Q1					-.01	-.10	.33
Q2						.46**	.17
Q3							-.23

The Complex Task Correlation Matrix (N=30)

	HRCHG	SRCHG	NPERCHG	Q1	Q2	Q3	AB
HRCHG		-.04	.12	.13	.00	.08	.10
SRCHG			.35	-.16	.57***	.20	-.00
NPERCHG				-.21	.59***	.29	-.39*
Q1					-.08	-.22	-.21
Q2						.43*	-.04
Q3							-.21

*$p < .05$
**$p < .01$
***$p < .001$

to trial seven. As self-report of pleasantness increased, subjects rated the task as more simple. These relationships were not revealed by the separate analyses of the simple or complex tasks, and probably reflect the fact that the study included a simple and a complex task.

The separate analysis of the simple task revealed a significant positive correlation between SRCHG and Q3. As self-report of pleasantness increased, subjects also felt that they had won the competition to a greater degree.

The separate analysis of the complex task revealed a significant negative correlation between AB and NPERCHG. As the subjects' A/B scores increased, net performance from trial seven to eight on the complex (colour letter) task decreased.

To examine possible nonlinear relationships between these variables, scattergrams were examined. Only one relationship, between NPERCHG and HRCHG for the complex task, revealed a significant quadratic trend, $\underline{F}(1,27) = 4.75$, $\underline{p} < .05$ (see Figure 2). Further statistical analyses revealed a nonsignificant quadratic trend for the Type A subjects and a nonsignificant linear trend for the Type B subjects.

Post-Experimental Rating Scale Measures

The post-experimental rating scale included the following scores: the degree of task complexity (Q1), the degree to

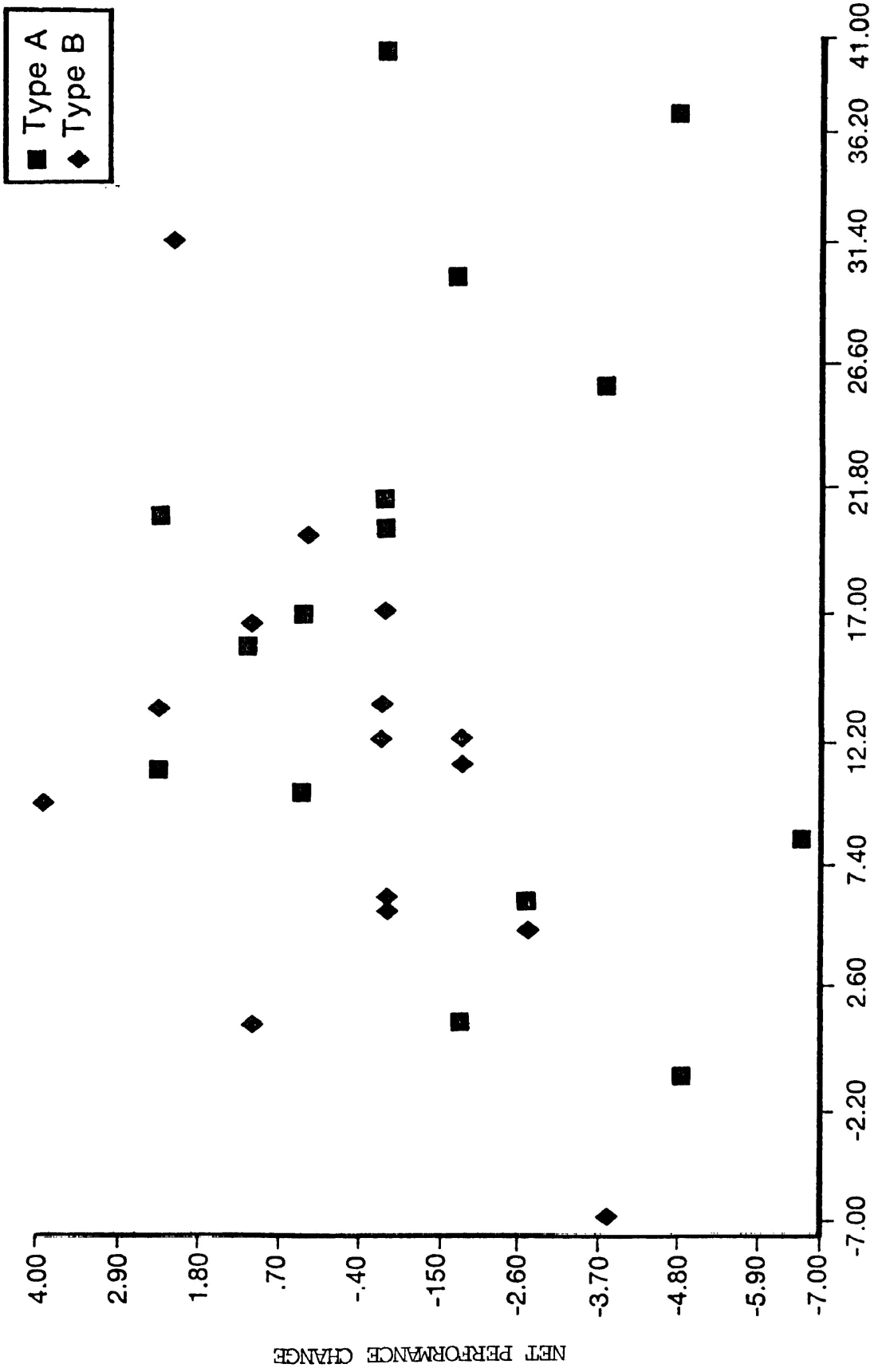


FIGURE 2 RELATIONSHIP BETWEEN NET PERFORMANCE CHANGE AND HEART RATE CHANGE FROM TRIAL 7 (LAST PRACTICE TRIAL) TO TRIAL 8 (COMPETITION) FOR TYPE A AND B SUBJECTS ON THE COMPLEX TASK

which the subject thought his performance on trial eight compared to trial seven-improved or deteriorated (Q2), and the degree to which the subject thought he had won or lost the competition (Q3).

Three 2 X 2 factorial analyses of variance with the two factors being Task and Type were performed on each of the following scores: Q1, Q2, and Q3. The main effect of Task for Q1 was significant, $F(1,56) = 24.40$, $p < .001$. The simple (digit letter) task was rated as more simple ($M = 2.77$) than the complex (colour letter) task ($M = 4.27$). Appendix P contains a summary of this analysis.

The main effect of Task for Q2 was significant, $F(1,56) = 16.11$, $p < .001$. Performance was rated better from trial seven to eight on the simple (digit letter) task ($M = 4.80$) than on the complex (colour letter) task ($M = 3.73$). Appendix Q contains a summary of this analysis.

The analysis on Q3 did not reveal any significant differences. Appendix R contains a summary of this analysis.

DISCUSSION

This study examined the effects of task difficulty and the Type A Behavior Pattern on the inverted-U relationship between stress level (arousal) and performance, and any possible Type A/B differences in response to competition.

As predicted by the Yerkes-Dodson law, there was an increase in net performance on the simple (digit letter) task and a decrease in net performance on the complex (colour letter) task due to the stress of competition. According to the Yerkes-Dodson law, optimal performance on the complex task should occur at a low activation level, whereas, a higher activation level is needed for optimal performance on the simple task. The competition may have increased the subjects' activation level enough to reach the optimal performance level for the simple task, resulting in a net performance increase. The additional stress induced through competition may have surpassed the activation level required for optimal performance on the complex task, resulting in a decrease in net performance.

An unexpected finding was that competition proved equally stressful for the Type A and Type B subjects as indicated by their heart rates. It should be noted that heart rate did significantly increase for all four experimental groups due to the competition (see Table 1). No heart rate differences between Type A's and Type B's have

been reported by Frankenhaeuser et al. (1978), Friedman et al. (1963), Lott & Gatchel (1978), Manuck et al. (1978), and Price & Clarke (1978). The TABP was not a significant determinant of arousal level in either the simple or complex task conditions.

A significant relationship between Type A/B and net performance change was found for the complex task. As predicted, Type A males performed more poorly than Type B males on the eighth trial of the complex task compared to the seventh trial. The complex (colour letter) task required attention to varied cues. Perhaps the Type A subjects, due to their nature (achievement striving, competitive, impatient, time urgent), were cognitively aroused to a greater degree than the Type B subjects. The result may have been a greater restriction of the range of usable cues needed to perform the complex task for the Type A's, compared to the Type B's. Easterbrook (1959) found much research support for the narrowing of attention under high arousal (Bahrick et al., 1952; Bursill, 1958; Callaway, 1959; Callaway & Dembo, 1958; Callaway & Stone, 1960; Callaway & Thompson, 1953).

An alternate explanation is that the Type A's were more cognitively aroused than the Type B's, resulting in physiological involuntary autonomic responses that interfered with their performance on the complex task. The Type A subjects may have been primarily motivated to reduce their stress level rather than to perform the complex task. Various authors

support this explanation (Kahn, 1964; Lazarus, 1966; Vroom, 1964).

The TABP was not a significant determinant of performance on the simple task. Contrary to expectation, Type A subjects did not perform better than Type B's on the simple (digit letter) task during the eighth trial compared to the seventh trial. This finding was probably due to the fact that the Type A's and B's were equally stressed by the competition, based on heart rate analysis. Perhaps the stress of competition did not produce the physiological arousal necessary for Type A/B differences to emerge on the simple task. According to Yerkes and Dodson (1908), the effects of shock on mice were more pronounced in difficult discriminations, and the optimum level of shock was higher in easy discriminations.

The relationship between net performance change and heart rate change was examined within each task condition. Only for the complex task was a significant quadratic trend revealed. Visual inspection of Figure 2 shows the quadratic trend is most apparent for the Type A subjects. A nonsignificant linear trend was apparent for the Type B subjects. From low activation up to a point that is optimal for a given task, level of performance rises monotonically with increasing activation level, but beyond this optimal point the relation becomes nonmonotonic: further increase in activation beyond this point produces a fall in performance level (Malmo, 1959).

When stressed by the competition, the simple (digit letter)

task was rated as more pleasant and the complex (colour letter) task as less pleasant than the previous seventh practice trial. This finding is consistent with Selye's (1974) concepts of eustress and distress. The increase in self-report of pleasantness on the simple task may be attributed to the increase in net performance under the stress of competition. The decrease in self-report of pleasantness on the complex task may be attributed to the drop in net performance under the stress of competition. The increase in net performance on the simple task may be thought of as a pleasant experience (eustress) and the decrease in net performance on the complex task may be thought of as an unpleasant experience (distress).

Although there were no significant physiological differences between the Type A and B subjects, the simple task was rated as more pleasant and the complex task as less pleasant than the previous seventh practice trial. By dissociating physiological from cognitive elements of emotion, it seems reasonable to assume that the situational determinant (competition with a similar coactor) affected the subjects' emotions in either a positive or negative manner. Schacter and Singer's classic study (1962) constituted a strong argument for a common physiological substrate for different emotions.

As net performance from trial seven to eight on both the simple (digit letter) and complex (colour letter) tasks increased, self-report of pleasantness also increased, as did ratings of performance on trial eight as improved compared to

trial seven. It seems reasonable to think that an increase in net performance would increase feelings of pleasantness (eustress), resulting in a higher self-report of pleasantness rating and a rating of performance on trial eight as improved compared to trial seven. Conversely, a decrease in net performance should produce feelings of unpleasantness (distress), resulting in a lower self-report of pleasantness rating and a rating of performance on trial eight as deteriorated compared to trial seven.

Since net performance from trial seven to eight actually did increase for subjects who rated their performance as improved on trial eight, these subjects also felt that they had won the competition to a greater degree. Subjects who rated their performance as deteriorated on trial eight actually did experience a decrease in net performance from trial seven to trial eight and felt that they had lost the competition to a greater degree.

For the simple task, as self-report of pleasantness increased, subjects also felt that they had won the competition to a greater degree. It seems reasonable to think that the increase in pleasantness (eustress) resulted from the net performance increase from trial seven to eight. Subjects may have felt that they had won the competition to a greater degree since their net performance from trial seven to eight increased.

The simple task/complex task independent variable proved to be an effective manipulation. The analysis of initial

differences revealed that net performance on the simple (digit letter) task was better than net performance on the complex (colour letter) task during the seventh trial. Also, subjects rated the simple task as more simple than the complex task on the post-experimental rating scale. These findings were expected. The simple task took less time and concentration to perform than the complex task.

The post-experimental rating scale revealed that subjects rated their performance from trial seven to eight on the simple (digit letter) task as better than on the complex (colour letter) task. This finding was expected. Subjects' performance actually did improve from trial seven to eight on the simple task and deteriorated from trial seven to eight on the complex task.

Finally, in the event of a replication of this study, it would be interesting to administer the Jenkins Activity Survey in a group situation on a separate day. Perhaps the effect of the TABP on the inverted-U relationship between stress level and performance would be more pronounced.

Conclusion

This study has accomplished the following goals: the examination of the effects of task difficulty and the Type A Behavior Pattern on the inverted-U relationship between stress level (arousal) and performance, and the examination of possible Type A/B differences in response

to competition.

Consistent with the Yerkes-Dodson law, competition resulted in a performance increase on the simple (digit letter) task, and a performance decrease on the complex (colour letter) task.

As predicted, Type A males performed more poorly than Type B males on the eighth trial of the complex task compared to the seventh trial. Contrary to expectation, Type A males did not perform better than Type B males during the eighth trial of the simple task compared to the seventh trial.

An inverted-U relationship between net performance change and heart rate change was found for the complex task.

It is recommended that the complex (colour letter) task be studied further since it seems to be a highly sensitive instrument for stress manipulation.

Competition did not prove to be significantly more stressful for the Type A subjects than for the Type B subjects as indicated by their heart rates. However, heart rate did significantly increase for all four experimental groups due to the stress of competition.

Although tonic heart rate is one of the most reliable measures of activation level (Schmore, 1959), there has been much controversy in the literature concerning the use of a single measure of physiological arousal (Elliott, 1969, 1972, 1974; Lacey, 1967, 1974). A multimethod approach (Laux, 1976), such as tonic heart rate in conjunction with

systolic or diastolic blood pressure would be advisable for future research in this area.

Under the stress of competition, subjects rated the simple task as more pleasant (eustress) and the complex task as less pleasant (distress) compared to the seventh trial. Type A and Type B subjects did not differ in their self-report of pleasantness ratings.

REFERENCES

Allen, J.L. & Boivin, M. Women's will to fail in a disjunctive reaction time competitive task. Bulletin of the Psychonomic Society, 1976, 8, 401-402.

Allport, F.H. The influence of the group upon association and thought. Journal of Experimental Psychology, 1920, III, 159-182.

Appels, A., Jenkins, C.D. & Rosenman, R.H. A cross validation of the coronary-prone behavior pattern as measured by the Jenkins Activity Survey in Holland. Manuscript submitted for publication, 1980.

Bahrick, H.P., Fitts, P.M., & Rankin, R.E. Effects of incentives upon reactions to peripheral stimuli. Journal of Experimental Psychology, 1952, 44, 400-406.

Belmaker, R.H., Pollin, W., Jenkins, C.D., & Brensike, J. Coronary-prone behavior patterns in a sample of Type II hypercholesteremic patients. Submitted for publication, 1977

Berlyne, D.E. Conflict, arousal and curiosity. New York: McGraw-Hill, 1960.

Berridge, H.I. An experiment in the psychology of competition. Research Quarterly Supplement, 1935, 6, 37-42.

Bindra, D. Motivation: A systematic reinterpretation. New York: Ronald, 1959.

Blix, A.S., Stromme, S.B., & Ursin, H. Additional heart rate as an indication of psychological activation. Aerospace Medicine, 1974, 45, 1219-1222.

Blumenthal, J.A., Williams, R.B., Kong, Y., Schanberg, S.M. & Thompson, L.W. Type A behavior and angiographically documented coronary disease. Circulation, 1978, 58, 634-639.

Bortner, R.W. A short rating scale as a potential measure of pattern A behavior. Journal of Chronic Diseases, 1969, 22, 591-594.

Bortner, R.W. & Rosenman, R.H. The measurement of pattern A behavior. Journal of Chronic Diseases, 1967, 2, 591-594.

Brace, W., Harcourt, I., & Jovanovich, H. The Wechsler Adult Intelligence Scale-Revised (WAIS-R). The Psychological Corporation: U.S.A., 1981.

Brand, R.J. Coronary-prone behavior as an independent risk factor for coronary heart disease. In T.M. Dembroski et al., (Eds.) Coronary-prone behavior. New York: Springer-Verlag, 1978.

Brand, R.J., Rosenman, R.H., Sholtz, R.I., & Friedman, M. Multivariate prediction of coronary heart disease in the WCGS compared to the findings of the Framingham study. Circulation, 1976, 53, 348-355.

Broadhurst, P.L. Emotionality and the Yerkes-Dodson law. Journal of Experimental Psychology, 1957, 54, 345-352.

Broadhurst, P.L. The interaction of task difficulty and motivation: the Yerkes-Dodson law revived. Acta Psychologica, 1959, 16, 321-338.

Burke, R.J. & Weir, T. The Type A experience: Occupational and life demands, satisfaction and well being. Journal of Human Stress, 1980, 28-38.

Burnam, M.A., Pennebaker, J.W. & Glass, D.C. Time consciousness, achievement striving, and the Type A coronary-prone behavior pattern. Journal of Abnormal Psychology, 1975, 84, 76-79.

Bursill, A.E. The restriction of peripheral vision during exposure to hot and humid conditions. Quarterly Journal of Experimental Psychology, 1958, 10, 113-129.

Caffrey, B. Reliability and validity of personality and behavioral measures in a study of coronary heart disease. Journal of Chronic Diseases, 1968, 21, 191-204.

Callaway, E. The influence of amobarbital (amylobarbitone) and methamphetamine on the focus of attention. Journal of Mental Science, 1959, 105, 382-392.

Callaway, E. & Dembo, E. Narrowed attention: A psychological phenomenon that accompanies a certain physiological change. Archives of Neurological Psychiatry, 1958, 79, 74-90.

Callaway, E. & Stone, G. Re-evaluating the focus of attention. In Drugs and Behavior, eds. L. Uhr & J.G. Miller. New York: John Wiley, 1960, 393-398.

Callaway, E. & Thompson, S-V. Sympathetic activity and perception: An approach to the relationship between autonomic activity and personality. Psychosomatic Medicine, 1953, 15, 443-455.

Caplan, R.D. & Jones, K.W. Effects of work load, role ambiguity, and Type A personality on anxiety, depression, and heart rate. Journal of Applied Psychology, 1975, 60, 713-719.

Carment, C.W. Rate of simple motor responding as a function of coaction, competition, and sex of the participants. Psychonomic Science, 1970, 19(6), 342-343.

Carment, C.W. & Latchford, M. Rate of simple motor responding as a function of coaction, sex of the participants, and the presence or absence of the experimenter. Psychonomic Science, 1970, 20(4), 253-254.

Carver, C.S. & Glass, D.C. Coronary-prone behavior pattern and interpersonal aggression. Journal of Personality and Social Psychology, 1978, 36, (4), 361-366.

Chesney, M.A., Black, G.W., Chadwick, J.H. & Rosenman, R.H. Psychological correlates of the Type A behavior pattern. Journal of Behavioral Medicine, in press.

Church, R.M. The effects of competition on reaction time and palmar skin conductance. Journal of Abnormal and Social Psychology, 1962, 65, 32-40.

Church, R.M., Millward, R.B., & Miller, P. Prediction of success in a competitive reaction time situation. Journal of Abnormal and Social Psychology, 1963, 67, 234-240.

Cofer, C.N. Motivation. Annual Review of Psychology, 1959, 10, 173-202.

Cottrell, N.B. Performance in the presence of other human beings: mere presence, audience, and affiliation effects. In E.C. Simmel, R.A. Hoppe, & G.A. Miller (Eds.), Social Facilitation and Imitative Behavior. Boston: p. 91.

Cottrell, N.B. Social facilitation. In C.G. McClintock (Ed.), Experimental Social Psychology. New York: Holt, Rinehart and Winston, Inc., 1972, 185-236.

Courts, F.A. Relations between muscular tension and performance. Psychological Bulletin, 1942, 39, 347-367.

Dashiell, J.F. An experimental analysis of some group effects. Journal of Abnormal and Social Psychology, 1930, 25, 191-199.

Dembroski, T.M. & MacDougall, J.M. Stress effects on affiliation preferences among subjects possessing the Type A Coronary-prone behavior pattern. Journal of Personality and Social Psychology, 1978, 36, 23-33.

Dembroski, T.M., MacDougall, J.M., Herd, J.A., & Shields, J.L. Effects of level of challenge on pressor and heart rate responses in Type A and B subjects. Journal of Applied Social Psychology, 1979, 9(3), 209-228.

Dembroski, T.M., MacDougall, J.M., Herd, J.A., & Shields, J.L. The Type A Coronary-prone behavior pattern: a review. National Heart, Lung, and Blood Institute, Jan. 1980.

Dembroski, T.M., MacDougall, J.M. & Shields, J.L. Physiologic reactions to social challenge in persons evidencing the Type A Coronary-prone behavior pattern. Journal of Human Stress, 1977, 3, 2-9.

Dembroski, T.M., Weiss, S.M., Shields, J.L., Haynes, S.G. & Feinleib, M. Coronary-prone behavior. New York: Springer-Verlag, 1978.

Doerr, H., & Hokansson, J. A relationship between heart rate and performance in children. Journal of Personality and Social Psychology, 1965, 2, p.70.

Duffy, E. The measurement of muscular tension as a technique for the study of emotional tendencies. American Journal of Psychology, 1932, 44, 146-162.

Duffy, E. The psychological significance of the concept of arousal or activation. Psychological Review, 1957, 64, 265-275.

Duffy, E. Activation and behavior. New York: Wiley, 1962.

Duffy, E. "Activation", Handbook of Psychophysiology, N.S. Greenfield and R.A. Sternback, eds., pp. 577-622. Holt, Rinehart and Winston, New York, 1972.

Easterbrook, J.A. The effect of emotion on cue utilization and the organization of behavior. Psychological Review, 1959, 66, 183-201.

Elliott, R. Tonic heart rate: experiments on the effects of collative variables lead to an hypothesis about its motivational significance. Journal of Personality and Social Psychology, 1969, 12, 211-228.

Elliott, R. The significance of heart rate for behavior: a critique of Lacey's hypothesis. Journal of Personality and Social Psychology, 1972, 22(3), 389-409.

Elliott, R. Further comment on the lacey hypothesis. Journal of Personality and Social Psychology, 1974, 30(1), 19-23.

Elliott, R., Bankart, B., & Light, T. Differences in the motivational significance of heart rate and palmar conductance: two tests of a hypothesis. Journal of Personality and Social Psychology, 1970, 14, 166-172.

Evans, J.F. A comparison of social and nonsocial competition. Unpublished Master's thesis, The University of Alberta, 1966.

Evans, J.F. Components of motivation in a competitive situation. Unpublished doctoral dissertation, The University of Alberta, 1968.

Evans, J.F. Social facilitation in a competitive situation. Canadian Journal of Behavioural Science, 1971, 3, 276-281.

Evans, J.F. Resting heart rate and the effects of an incentive. Psychonomic Science, 1972, 26, 99-100.

Evans, J.F. Psychosocial stressors and health. Lakehead University Review, 1977, 9(2), 47-53.

Evans, J.F. & Bonder, A. A possible relationship between rivalry and impending social comparison. Proceedings of the 81st Annual Convention of the American Psychological Association, 1973, 8, 333-334.

Festinger, L. A theory of social comparison processes. Human Relations, 1954, 7, 117-140.

Fish, T.A. The Stressfulness of a coactive situation. Unpublished Master's thesis, Lakehead University, 1978.

Fiske, D.W. & Maddi, S.R. Functions of varied experience. Homewood, Illinois: Dorsey, 1961.

Frankenhaeuser, M. Behavior and circulating catecholamines. Brain Research, 1971, 31, 241-262.

Frankenhaeuser, M., Lundberg, U. & Forsman, L. Dissociation between sympathetic-adrenal and pituitary-adrenal responses to an achievement situation characterized by high controllability: Comparison between Type A and B males and females. Biological Psychology, 1978, in press.

Frankenhaeuser, M., Lundberg, U. & Forsman, L. Note on arousing Type A persons by depriving them of work. Journal of Psychosomatic Research, 1980, 24, 45-47.

Fraser, D.C. The relation of an environmental variable to performance in a prolonged visual task. Quarterly Journal of Experimental Psychology, 1953, 5, 31-32.

Freeman, G.L. The relationship between Performance level and bodily activity level. Journal of Experimental Psychology, 1940, 26, p. 602.

Freeman, G.L. The energetics of human behavior. Ithaca, New York: Cornell University Press, 1948.

Freischlag, J. A comparison of the effects of sex, competition, and ability on a perceptual motor task. Research Quarterly, 1973, 44, 178-184.

Friedman, M. Pathogenesis of coronary artery disease. New York: McGraw-Hill, 1969.

Friedman, M. Type A behavior pattern: Some of its pathophysiological components. Bulletin of the New York Academy of Medicine, 1977, 53, 593-604.

Friedman, M., Byers, S.O., Diamant, J., & Rosenman, R.H. Plasma catecholamine response of coronary-prone subjects (Type A) to a specific challenge. Metabolism, 1975, 4, 205-210.

Friedman, M. & Rosenman, R.H. Association of specific overt behavior pattern with increases in blood cholesterol, blood clotting time, incidence of arcus senilis and clinical coronary artery disease. Journal of the American Medical Association, 1959, 169, 1286-1296.

Friedman, M., & Rosenman, R.H. Type A behavior and your heart. Greenwich, Conneticut: Fawcett, 1974.

Friedman, M., Rosenman, R.H. & Brown, A.E. The continuous heart rate in men exhibiting an overt behavior pattern associated with increased incidence of clinical coronary artery disease. Circulation, 1963, 28, 861-866.

Friedman, M., Rosenman, R.H., Straus, R., Wurm, M., & Kositchek, R. The relationship of behavior pattern A to the state of the coronary vasculature: A study of 51 autopsied subjects. American Journal of Medicine, 1968, 44, 525-538.

Friedman, M., St. George, S., Byers, S.O., & Rosenman, R.H. Excretion of catecholamines, 17-ketosteroids, 17-hydroxycorticoids, and 5-hydroxyindole in men exhibiting a particular behavior pattern (A) associated with high incidence of clinical coronary artery disease. Journal of Clinical Investigation, 1960, 39, 758-764.

Gastorf, J.W. Time urgency of the Type A behavior pattern. Journal of Consulting and Clinical Psychology, 1980, 48(2), p. 299.

Gastorf, J.W., Suls, J.S., & Sanders, G.S. The Type A coronary-prone behavior pattern and social facilitation. Journal of Personality and Social Psychology, 1980, 38(5), 773-780.

Gerdes, G.R. The effects of various motivational techniques upon performance in selected physical tests. Unpublished doctoral dissertation, Indiana University, 1958.

Glass, D.C. Behavior Patterns, Stress and Coronary Disease. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Glass, D.C., Krakoff, L.R., Contrada, R.C., Hilton, W.F., Kehoe, K., Mannucci, E.G., Collins, C., Snow, B., & Elting, E. Effect of harassment and competition upon cardiovascular and plasma catecholamine responses in Type A and B individuals. Psychophysiology, 1980, 17(5), 453-463.

Glass, D.C., Krakoff, L.R., Finkelman, J., Snow, B., Contrada, R., Kehoe, K., Mannucci, E.G., Isecke, W., Collings, C., Hilton, W.F., & Elting, E. Effect of task overload upon cardiovascular and plasma catecholamine responses in Type A and B individuals. Basic and Applied Social Psychology, in press.

Glass, D.C., Snyder, M.L., & Hollis, J.F. Time urgency and the Type A coronary-prone behavior pattern. Journal of Applied Social Psychology, 1974, 4, 125-140.

Goldband, S., Nielson, W.R. & Patton, D. Physiological response and assessment of the coronary-prone behavior pattern. Paper presented at the meetings of the Society for Psychophysiological Research, Vancouver, 1980. (also in press in abstract Psychophysiology, 1981).

Haynes, S.G., Feinleib, M. & Kannel, W.B. Psychosocial factors and CHD incidence in Framingham: Results from an 8 year follow-up study. American Journal of Epidemiology, 1980, 108, p. 229.

Haynes, S.G., Feinleib, M., Levine, S., Scotch, N. & Kannel, W. The relationship of psychosocial factors to coronary heart disease in the Framingham study: Prevelance of coronary heart disease. American Journal of Epidemiology, 1978, 107, 384-402.

Hebb, D.O. Drives and the Conceptual Nervous System. Psychological Review, 1955, 62, 243-254.

Heller, R.F. Type A behavior and coronary heart disease. British Medical Journal, 1979, 2, p. 368.

Hiland, D. Behavioral characteristics of male VA patients with and without coronary heart disease. Unpublished doctoral dissertation, University of Southern Florida, 1977.

Houston, B.K. & Jorgensen, R. The Type A behavior pattern, sex differences, and cardiovascular response to and recovery from stress. Manuscript submitted for publication, 1980.

Howard, J.H., Cunningham, D.A., & Rechnitzer, R.A. Work patterns associated with Type A behavior: A managerial population. Journal of Human Relations, 1977, 30, 825-836.

Hurlock, E.B. The use of rivalry as an incentive. Journal of Abnormal and Social Psychology, 1927, 22, 278-290.

Jenkins, C.D. Psychologic and social precursors of coronary disease. New England Journal of Medicine, 1971, 284, 244-255, 307-317.

Jenkins, C.D. Recent evidence supporting psychologic and social risk factors for coronary disease. New England Journal of Medicine, 1976, 294, 987-994, 1033-1038.

Jenkins, C.D. Behavioral risk factors in coronary artery disease. Annual Review of Medicine, 1978, 29, 543-562.

Jenkins, C.D., Friedman, M., & Rosenman, R.H. The Jenkins Activity Survey for Health Prediction. Chapel Hill, N.C.: University of North Carolina, 1965.

Jenkins, C.D., Rosenman, R.H., & Friedman, M. Development of an objective psychological test for the determination of the coronary-prone behavior pattern in employed men. Journal of Chronic Diseases, 1967, 20, 371-379.

Jenkins, C.D., Rosenman, R.H., & Friedman, M. Replicability of rating the coronary-prone behavior pattern. British Journal of Preventive and Sociological Medicine, 1968, 22, 16-22.

Jenkins, C.D., Rosenman, R.H., & Zyzanski, S.J. Prediction of clinical coronary heart disease by a test for the coronary-prone behavior pattern. New England Journal of Medicine, 1974, 290, 1271-1275.

Jenkins, C.D., & Zyzanski, S.J. Basic dimensions within the coronary-prone behavior pattern. Journal of Chronic Disorders, 1970, 22, 781-792.

Jenkins, C.D., Zyzanski, S.J. & Rosenman, R.H. Progress toward validation of a computer-scored test for the Type A coronary-prone behavior pattern. Psychosomatic Medicine, 1971, 33, 193-202.

Jenkins, C.D., Zyzanski, S.J. & Rosenman, R.H. The Jenkins Activity Survey for Health Prediction. Chapel Hill, N.C.: C.D. Jenkins, 1972.

Jenkins, C.D., Zyzanski, S.J. & Rosenman, R.H. Risk of new myocardial infarction in middle-aged men with manifest coronary heart disease. Circulation, 1976, 53, 342-347.

Jenkins, C.D., Zyzanski, S.J. & Rosenman, R.H. Jenkins Activity Survey Manual. The Psychological Corporation, 1979.

Kahn, R.L. Conflict and ambiguity: studies in organizational roles and personal stress. New York: Wiley, 1964.

Kahneman, D. Attention and Effort. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1973.

Keenan, A. & McBain, G.D.M. Effects of Type A behavior, intolerance of ambiguity, and locus of control on the relationship between role stress and work related outcomes. Journal of Occupational Psychology, 1979, 52, 277-285.

Keith, R.A., Lown, B., & Stare, F.J. Coronary heart disease and behavior patterns: An examination of method. Psychosomatic Medicine, 1965, 27, 424-434.

Kendler, H.H. Learning. Annual Review of Psychology, 1959, 10, 43-88.

Kenigsberg, D., Zyzanski, S.J., Jenkins, C.D., et al. The coronary-prone behavior pattern in hospitalized patients with and without coronary heart disease. Psychosomatic Medicine, 1974, 36, 344-351.

Kittel, F., Kornitzer, M., Zyzanski, S.J. et al. Two methods of assessing the Type A coronary-prone behavior pattern in Belgium. Journal of Chronic Diseases, 1978, 31, 147-155.

Klinger, E. Feedback effects and social facilitation of vigilance performance: mere coaction versus potential evaluation. Psychonomic Science, 1969, 14(4), 161-162.

Krantz, D.S., Glass, D.C. & Snyder, M.L. Helplessness, stress level and the coronary-prone behavior pattern. Journal of Experimental Social Psychology, 1974, 10, 284-300.

Lacey, J.I. Somatic response patterning and stress: some revisions of activation theory. In M.H. Appley & R. Trumbull (Eds.), Psychological Stress. New York: Appleton Century-Crofts, 1967.

Lacey, J.I. & Lacey, B.C. On heart rate responses and behavior: a reply to Elliott. Journal of Personality and Social Psychology, 1974, 30, (1), 1-18.

Laux, L. The multitrait-multimethod rationale in stress research. In I.G. Sarason & C.D. Spielberger (Eds.), (Vol. 3), Stress and Anxiety. New York: Halstead Press, 1976.

Lazarus, R.S. Psychological stress and the coping process. New York: McGraw-Hill, 1966.

Lindsley, D.B. Emotion. In S.S. Stevens (Ed.), Handbook of Experimental Psychology. New York: Wiley, 1951, p. 473-516.

Lindsley, D.B. Psychophysiology and Motivation. In M.R. Jones (Ed.), Nebraska symposium on motivation. Lincoln: University of Nebraska Press, 1957, p. 44-105.

Lott, G.G. & Gatchel, R.J. A multi-response analysis of learned heart rate control. Psychophysiology, 1978, 15, 576-581.

Maccoby, E.E. & Jacklin, C.N. The Psychology of Sex Differences. Stanford: Stanford University Press, 1974.

MacDougall, J.M., Dembroski, T.M. & Krantz, D.S. Effects of types of challenge on pressor and heart rate responses in Type A and B women. Psychophysiology, 1981, 18(1), 1-9.

MacDougall, J.M., Dembroski, T.M. & Musante, L. The structured interview and questionnaire methods of assessing coronary-prone behavior in male and female college students. Journal of Behavioral Medicine, 1979, 2(1), 71-83.

Malmo, R.B. Activation: A neuropsychological dimension. Psychological Review, 1959, 66, 367-386.

Malmo, R.B. Activation. In A.J. Bachrach (Ed.), Experimental foundations of clinical Psychology. New York: Basic Books, 1962, 386-422.

Manuck, S.B., Craft, S. & Gold, K.L. Coronary-prone behavior pattern and cardiovascular response. Psychophysiology, 1978, 15(5), 403-411.

Manuck, S.B. & Garland, F.N. Coronary-prone behavior pattern, task incentive, and cardiovascular response. Psychophysiology, 1979, 16(2), 136-142.

Martens, R., & Landers, D.M. Effect of anxiety, competition, and failure on performance of a complex motor task. Journal of Motor Behavior, 1969, 1, 1-10.

Mason, J.W. Organization of Psychoendocrine mechanisms: A review and reconsideration of research. In N.S. Greenfield & R.A. Sternbach (Eds.), Handbook of Psychophysiology. New York: Holt, Rinehart and Winston, 1972.

Moede, W. Der wetteifer, seine struktur und sein ausmas. Zeitschrift fur Padagogische Psychologie, 1914, 15, 353-368. Cited by F.H. Allport, Social Psychology, New York: Houghton Mifflin, 1924, p. 280.

Moruzzi, G. & Magoun, H.W. Brain stem reticular formation and activation of the EEG. EEG and Clinical Neurophysiology, 1949, 1, 455-473.

Nelson, J.K. An analysis of the effect of applying various motivational situations to college men subjected to a stressful physical performance. Unpublished doctoral dissertation, University of Oregon, 1962.

Noble, E.E., Fuchs, J.E., Robel, D.P., & Chambers, R.W. Individual vs. Social Performance on two perceptual-motor tasks. Perceptual and Motor Skills, 1958, 8, 131-134.

Osler, W. Lectures on angina pectoris and allied states. New York: Appleton, 1892.

Pittner, M.S. & Houston, B.K. Response to stress, cognitive coping strategies, and the Type A behavior pattern. Journal of Personality and Social Psychology, 1980, 39, 147-157.

Price, K.P. & Clarke, L.K. Behavioral and Psychophysiological correlates of the coronary-prone personality: New data and unanswered questions. Journal of Psychosomatic Research, 1978, 22, 409-417.

Ray, J.J. & Bozek, R. Dissecting the A-B personality type. British Journal of Medical Psychology, 1980, 53, 181-186.

Rosenman, R.H. The interview method of assessment of the coronary-prone behavior pattern. In T.M. Dembroski, S.M. Weiss, J.L. Shields, et al. (Eds.), Coronary-prone behavior. New York: Springer-Verlag, 1978.

Rosenman, R.H., Brand, R.J., Jenkins, C.D., et al. Coronary heart disease in the Western Collaborative Group Study: Final follow-up experience of 8½ years. Journal of the American Medical Association, 1975, 223, 872-877.

Rosenman, R.H., Brand, R.J., Sholtz, R.I., & Friedman, M. Multivariate prediction of coronary heart disease during 8.5 year follow-up in the WCGS. American Journal of Cardiology, 1976, 37, 903-910.

Rosenman, R.H., & Friedman, M. The possible relationship of the emotions to clinical coronary heart disease. In G. Pincus (Ed.), Hormones and Atherosclerosis. New York: Academic Press, 1959, 283-300.

Rosenman, R.H., & Friedman, M. Neurogenic factors in pathogenesis of coronary heart disease. Medical Clinics of North America, 1974, 58, 269-279.

Rosenman, R.H., Friedman, M., Jenkins, C.D., Straus, R., Wurm, M. & Kositcheck, R. Recurring and fatal myocardial infarction on the WCGS. The American Journal of Cardiology, 1967, 19(6), 771-775.

Schacter, S., & Singer, J. Cognitive, social and physiological determinants of emotional state. Psychological Review, 1962, 69, 379-399.

Scherwitz, L., Berton, K., & Leventhal, H. Type A assessment and interaction in the behavior pattern interview. Psychosomatic Medicine, 1977, 39, 229-240.

Scherwitz, L., Berton, K., & Leventhal, H. Type A behavior, self-involvement and cardiovascular response. Psychosomatic Medicine, 1978, 40(8), 593-609.

Schlosberg, H. Three dimensions of emotion. Psychological Review, 1954, 61, 81-88.

Schnore, M.M. Individual patterns of physiological activity as a function of task differences and degree of arousal. Journal of Experimental Psychology, 1959, 58, p.117.

Schucker, B. & Jacobs, D.R. Assessment of behavioral risks for coronary disease by voice characteristics. Psychosomatic Medicine, 1977, 39, 219-228.

Selye, H. Stress without Distress, Scarborough, Ontario: The New American Library of Canada Limited, 1974.

Selye, H. The stress of life (Rev. ed.), New York: McGraw-Hill, 1976.

Shaw, M.E. Some motivational factors in cooperation and competition. Journal of Personality, 1958, 26, 155-169.

Shekelle, R.B., Schoenberger, J.A., & Stamler, J. Correlates of the JAS Type A behavior pattern score. Journal of Chronic Diseases, 1976, 29, 381-394.

Sime, W.E., Pierrynowsky, M., & Sharrat, M. Relationship of exercise and behavior type (A/B) to physiological response to emotional stress. Paper presented at the meetings of the Canadian Association of Sports Sciences, Winnipeg, Manitoba, September, 1977.

Sjoberg, H. Interaction of task difficulty, activation and work load. Journal of Human Stress, 1977, 3, 33-38.

Stennett, R.G. The relationship of performance level to level of arousal. Journal of Experimental Psychology, 1957, 54, 54-61.

Stokols, D., Novaco, R.W., Stokols, J. & Campbell, J. Traffic congestion, type A behavior and stress. Journal of Applied Psychology, 1978, 63, 476-480.

Triplett, N. The dynamogenic factors in pacemaking and competition. American Journal of Psychology, 1897, 9, 507-533.

Van Dijkuizen, N. Measurement and impact of organizational stress. Paper presented at the International Conference on the role of psychosocial factors in the pathogenesis of coronary heart disease. Maastricht, The Netherlands, March, 1979.

Van Dijl, H. The A/B typology according to Friedman and Rosenman and an effort to test some of the characteristics by means of a psychological test (RSL or BUL). Journal of Psychosomatic Research, 1978, 22, 101-109.

Van Dijl, H. & Nagelkerke, N.J.D. A statistical discrimination of male myocardial infarction patients and healthy males by means of a psychological test and a tracing of basic dimensions of the infarction personality. Paper presented at the International Conference on the Role of psychosocial factors in the pathogenesis of coronary heart disease. Maastricht, The Netherlands, March, 1979.

Van Doornen, L.J.P. The coronary risk personality: psychological and psychophysiological aspects. Paper presented at the International Conference on the role of psychosocial factors in the pathogenesis of coronary heart disease, Maastricht, The Netherlands, March, 1979.

Van Egeren, L.F. Cardiovascular changes during social

competition in a mixed-motive game. Journal of Personality and Social Psychology, 1979, 37, 858-864.

Verhagen, F., Nass, C., Appels, A., van Bastelaer, A. & Winnibust, J. A cross-validation of the A/B typology in Holland. Paper presented at the International Conference on the role of psychosocial factors in the pathogenesis of coronary heart disease. Maastricht, The Netherlands, March, 1979.

Vitassi, S. The effects of task difficulty on the Inverted-U relationship between stress level and performance. Paper presented at the 42nd annual convention of the Canadian Psychological Association, Toronto, Ontario, June, 1981.

Vroom, V.H. Work and Motivation. New York: Wiley, 1964.

Waldron, I. Why do women live longer than men? Journal of Human Stress, 1976, 2, 2-13.

Waldron, I. Sex differences in the coronary-prone behavior pattern. In T.M. Dembroski, S.M. Weiss, J.L. Shields, et al., (Eds.), Coronary-prone behavior. New York: Springer-Verlag, 1978.

Waldron, I., Hickey, A., McPherson, C., Butensky, A., Gruss, L., Overall, K., Schmader, A. & Wolmuth, D. Type A behavior pattern: Relationship to variations in blood pressure, parental characteristics, and academic and social activities of students. Journal of Human Stress, 1980, 6(1), 16-27.

Wankel, L.M. Competition in motor performance: an experimental analysis of motivational components. Journal of Experimental Social Psychology, 1972, 8, 427-437.

Wankel, L.M. & Alderman, R.B. The interaction of competition and ability levels in the performance and learning of a motor task. Paper presented at the 19th Biennial convention of C.A.H.P.E.R., Waterloo, Ontario, June, 1971.

Weidner, G. & Matthews, K.A. Reported physical symptoms elicited by unpredictable events and the Type A coronary-prone behavior pattern. Journal of Personality and Social Psychology, 1978, 36(11), 1213-1220.

Whittemore, I.C. The influence of competition on performance: an experimental study. Journal of Abnormal and Social Psychology, 1924, 19, 236-253.

Wilmore, H.H. Influence of motivation on physical work capacity and performance. Journal of Applied Physiology, 1968, 24, 459-463.

Wood, L.E. An investigation of the effects of subject sex, partner sex, and competition on the performance of an achievement related task. Dissertation Abstract, 1975, 36(2B), 958-959.

Yerkes, R.M. & Dodson, J.D. The relation of strength of stimulus to rapidity of habit formation. Journal of Comparative Neurological Psychology, 1908, 18, p.459.

Zajonc, R.B. Social Facilitation. Science, 1965, 149, 269-274.

Zyzanski, S.J. Coronary-prone behavior pattern and coronary heart disease: Epidemiological Evidence. In T.M. Dembroski et al., (Eds.), Coronary-prone behavior. New York: Springer-Verlag, 1978.

Zyzanski, S.J., Wreszniewski, I. & Jenkins, C.D. Cross-cultural validation of the coronary-prone behavior pattern. Social Science in Medicine, 1979, 13(A), 405-412.

LIST OF APPENDICES

		Page
A.	The Jenkins Activity Survey and Answer Sheet.....	65
B.	The Digit Letter Task (Response Sheet and Codes).	71
C.	The Colour Letter Task (Response Sheet and Codes)	74
D.	The Pleasantness Scale.....	77
E.	The Post-Experimental Rating Scale.....	78
F.	The Instructions Used During the Experiment.....	79
G.	Legend for the Raw Scores and Raw Scores.....	85
H.	A 2 X 2 Factorial Analysis of Variance and Statistics on Heart Rate Scores for the Relaxation Period.....	94
I.	A 2 X 2 Factorial Analysis of Variance and Statistics on Heart Rate Scores for the Seventh Trial.....	95
J.	A 2 X 2 Factorial Analysis of Variance and Statistics on Self-Report of Pleasantness Scores for the Relaxation Period.....	96
K.	A 2 X 2 Factorial Analysis of Variance and Statistics on Self-Report of Pleasantness Scores for the Seventh Trial.....	97
L.	A 2 X 2 Factorial Analysis of Variance and Statistics on Net Performance Scores for the Seventh Trial.....	98
M.	A 2 X 2 Factorial Analysis of Variance and Statistics on Heart Rate Change Scores from the Seventh to the Eighth Trial.....	99
N.	A 2 X 2 Factorial Analysis of Variance and Statistics on Self-Report of Pleasantness Change Scores from the Seventh to the Eighth Trial.....	100
O.	A 2 X 2 Factorial Analysis of Variance and Statistics on Net Performance Change Scores from the Seventh to the Eighth Trial.....	101

LIST OF APPENDICES CONTINUED

		Page
P.	A 2 X 2 Factorial Analysis of Variance and Statistics on Post-Experimental Rating Scale Score Q1.....	102
Q.	A 2 X 2 Factorial Analysis of Variance and Statistics on Post-Experimental Rating Scale Score Q2.....	103
R.	A 2 X 2 Factorial Analysis of Variance and Statistics on Post-Experimental Rating Scale Score Q3.....	104

Medical research is trying to determine how life style may influence the health of people. This survey is part of such a research effort.

Please answer the questions on the following pages by marking the answers that are true for you. Each person is different, so there are no "right" or "wrong" answers. Of course, all you tell is strictly confidential--to be seen only by the research team. Do not ask anyone else about how to reply to the items. It is your personal opinion that we want. Please use the answer sheet provided to record your responses to the items in this booklet.

Your assistance will be greatly appreciated.

For each of the following items, please circle the number of the ONE best answer on your answer sheet.

1. Do you ever have trouble finding time to get your hair cut or styled?

   1. Never 2. Occasionally 3. Almost always

2. Does college "stir you into action"?

   1. Less often than most college students
   2. About Average
   3. More often than most college students

3. Is your everyday life filled mostly by

   1. Problems needing solution
   2. Challenges needing to be met
   3. A rather predictable routine of events
   4. Not enough things to keep me interested or busy

4. Some people live a calm, predictable life. Others find themselves often facing unexpected changes, frequent interruptions, inconveniences or "things going wrong." How often are you faced with these minor (or major) annoyances or frustrations?

   1. Several times a day
   2. About once a day
   3. A few times a week
   4. Once a week
   5. Once a month or less

5. When you are under pressure or stress, do you usually:

   1. Do something about it immediately
   2. Plan carefully before taking any action

6. Ordinarily, how rapidly do you eat?

   1. I'm usually the first one finished.
   2. I eat a little faster than average.
   3. I eat at about the same speed as most people.
   4. I eat more slowly than most people.

7. Has your spouse or some friend ever told you that you eat too fast?

   1. Yes often 2. Yes, once or twice 3. No, no one has told me this

8. How often do you find yourself doing more than one thing at a time, such as working while eating, reading while dressing, figuring out problems while driving?

   1. I do two things at once whenever practical.
   2. I do this only when I'm short of time.
   3. I rarely or never do more than one thing at a time.

9. When you listen to someone talking, and this person takes too long to come to the point, do you feel like hurrying him along?

   1. Frequently 2. Occasionally 3. Almost never

10. How often do you actually "put words in his mouth" in order to speed things up?

    1. Frequently 2. Occasionally 3. Almost never

11. If you tell your spouse or a friend that you will meet them somewhere at a definite time, how often do you arrive late?

    1. Once in a while 2. Rarely 3. I am never late.

12. Do you find yourself hurrying to get places even when there is plenty of time?

    1. Often 2. Occasionally 3. Rarely or never

13. Suppose you are to meet someone at a public place (street corner, building lobby, restaurant) and the other person is already 10 minutes late. Will you

    1. Sit and wait?
    2. Walk about while waiting?
    3. Usually carry some reading matter or writing paper so you can get something done while waiting?

14. When you have to "wait in line," such as at a restaurant, a store, or the post office, do you

    1. Accept it calmly?
    2. Feel impatient but do not show it?
    3. Feel so impatient that someone watching could tell you were restless?
    4. Refuse to wait in line, and find ways to avoid such delays?

15. When you play games with young children about 10 years old, how often do you purposely let them win?

    1. Most of the time 2. Half of the time 3. Only occasionally 4. Never

16. Do most people consider you to be

    1. Definitely hard-driving and competitive? 3. Probably more relaxed and easy going?
    2. Probably hard-driving and competitive? 4. Definitely more relaxed and easy going

17. Nowadays, do you consider yourself to be

    1. Definitely hard-driving and competitive? 3. Probably more relaxed and easy going?
    2. Probably hard-driving and competitive? 4. Definitely more relaxed and easy going?

18. How would your spouse (or closest friend) rate you?

1. Definitely hard-driving and competitive? 3. Probably relaxed and easy going?
2. Probably hard-driving and competitive? 4. Definitely relaxed and easy going?

19. How would your spouse (or best friend) rate your general level of activity?

1. Too slow. Should be more active.
2 About average. Is busy much of the time.
3. Too active. Needs to slow down.

20 Would people who know you well agree that you take your work too seriously?

1 Definitely Yes 2. Probably Yes 3. Probably no 4. Definitely No

21 Would people who know you well agree that you have less energy than most people?

1 Definitely Yes 2. Probably Yes 3. Probably No 4. Definitely No

22. Would people who know you well agree that you tend to get irritated easily?

1. Definitely Yes 2. Probably Yes 3. Probably No 4. Definitely No

23. Would people who know you well agree that you tend to do most things in a hurry?

1 Definitely Yes 2. Probably Yes 3. Probably No 4. Definitely No

24. Would people who know you well agree that you enjoy "a contest" (competition) and try hard to win?

1. Definitely Yes 2. Probably Yes 3. Probably No 4. Definitely No

25. Would people who know you well agree that you get a lot of fun out of your life?

1 Definitely Yes 2. Probably Yes 3. Probably No 4. Definitely No

26 How was your "temper" when you were younger?

1. Fiery and hard to control.
2 Strong, but controllable.
3. No problem.
4. I almost never got angry.

27. How is your "temper" nowadays?

1. Fiery and hard to control.
2. Strong, but controllable.
3. No problem.
4. I almost never get angry.

28. When you are in the midst of studying and someone interrupts you, how do you usually feel inside?

1. I feel O.K. because I work better after an occasional break.
2. I feel only mildly annoyed.
3. I really feel irritated because most such interruptions are unnecessary.

(Remember, the answers on these Questionnaires are confidential information and will not be revealed to officials of your school.)

29. How often are there deadlines in your courses? (If deadlines occur irregularly, please circle the closest answer below.)

1. Daily or more often. 2. Weekly. 3. Monthly. 4. Never

30. Do these deadlines usually

1. Carry minor pressure because of their routine nature?
2. Carry considerable pressure, since delay would upset things a great deal?

31. Do you ever set deadlines or quotas for yourself in courses or other things?

1 No 2 Yes, but only occasionally 3. Yes, once per week or more often.

32 When you have to work against a deadline, is the quality of your work

1. Better? 2. Worse? 3. The same? (Pressure makes no difference)

33. In school do you ever keep two projects moving forward at the same time by shifting back and forth rapidly from one to the other?

1. No, never. 2. Yes, but only in emergencies. 3. Yes, regularly.

34 Do you maintain a regular study schedule during vacations such as Thanksgiving, Christmas, and Easter?

1. Yes 2. No 3. Sometimes

35. How often do you bring your work home with you at night or study materials related to your courses?

1. Rarely or never. 2. Once a week or less often. 3. More than once a week.

36. How often do you go to the school when it is officially closed (such as nights or weekends)? If this is not possible, circle 0.

1. Rarely or never. 2. Occasionally (less than once a week). 3. Once or more a week.

37. When you find yourself getting tired while studying, do you usually

1. Slow down for a while until your strength comes back.
2. Keep pushing yourself at the same pace in spite of the tiredness.

38 When you are in a group, do the other people tend to look to you to provide leadership?

1. Rarely. 3. More often than they look to others.
2. About as often as they look to others.

39. Do you make yourself written lists of "things to do" to help you remember what needs to be done?

1. Never 2. Occasionally 3. Frequently

IN EACH OF THE FOLLOWING QUESTIONS, PLEASE COMPARE YOURSELF WITH THE AVERAGE STUDENT AT YOUR SCHOOL. PLEASE CIRCLE THE MOST ACCURATE DESCRIPTION.

40. In amount of effort put forth, I give

1. Much more effort 2. A little more effort 3. A little less effort 4. Much less effort

41 In sense of responsibility, I am

1. Much more responsible 2. A little more responsible 3. A little less responsible 4. Much less responsible

42 I find it necessary to hurry

1. Much more of the time 2. A little more of the time 3. A little less of the time 4. Much less of the time

43. In being precise (careful about detail), I am

1. Much more precise 2. A little more precise 3. A little less precise 4. Much less precise

44 I approach life in general

1. Much more seriously 2. A little more seriously 3. A little less seriously 4. Much less seriously

JENKINS ACTIVITY SURVEY
ANSWER SHEET

PLEASE CROSS OUT THE NUMBER OF THE ONE BEST ANSWER TO EACH ITEM IN THE JENKINS ACTIVITY SURVEY.

1)	1	2	3			23)	1	2	3	4
2)	1	2	3			24)	1	2	3	4
3)	1	2	3	4		25)	1	2	3	4
4)	1	2	3	4	5	26)	1	2	3	4
5)	1	2				27)	1	2	3	4
6)	1	2	3	4		28)	1	2	3	
7)	1	2	3			29)	1	2	3	4
8)	1	2	3			30)	1	2		
9)	1	2	3			31)	1	2	3	
10)	1	2	3			32)	1	2	3	
11)	1	2	3			33)	1	2	3	
12)	1	2	3			34)	1	2	3	
13)	1	2	3			35)	1	2	3	
14)	1	2	3	4		36)	1	2	3	
15)	1	2	3	4		37)	1	2		
16)	1	2	3	4		38)	1	2	3	
17)	1	2	3	4		39)	1	2	3	
18)	1	2	3	4		40)	1	2	3	4
19)	1	2	3			41)	1	2	3	4
20)	1	2	3	4		42)	1	2	3	4
21)	1	2	3	4		43)	1	2	3	4
22)	1	2	3	4		44)	1	2	3	4

NAME: _____
(PLEASE PRINT)

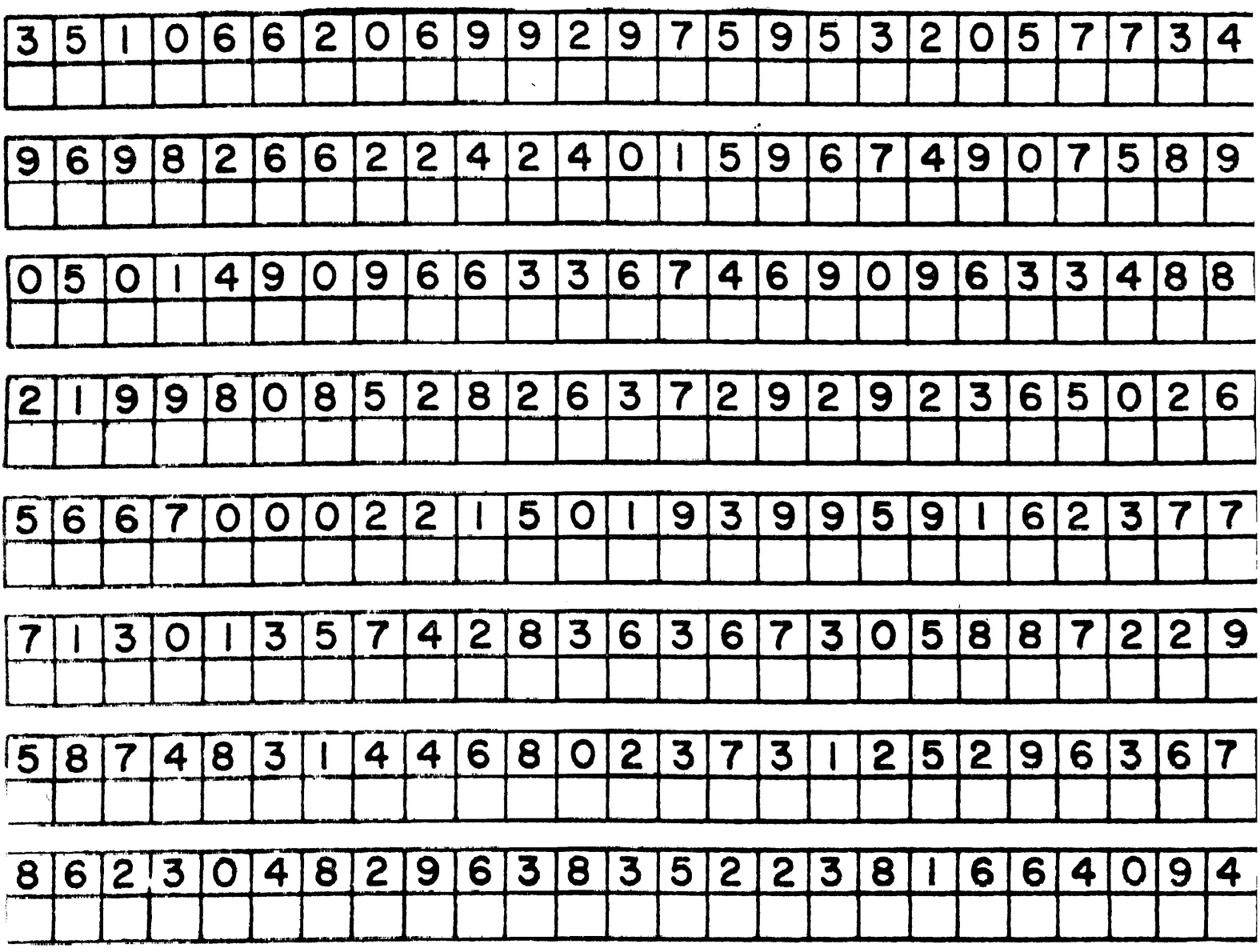
AGE: _____

STUDENT CLASSIFICATION: _____

Thank you for your cooperation.

APPENDIX B

The Digit-Letter Task Response Sheet



APPENDIX B CONTINUED

The Digit-letter Task Codes Sheet

Trial 1

0	1	2	3	4	5	6	7	8	9
E	N	W	X	H	K	L	V	T	A

Trial 2

0	1	2	3	4	5	6	7	8	9
W	X	H	K	1	V	T	A	E	N

Trial 3

0	1	2	3	4	5	6	7	8	9
T	A	E	N	W	X	H	K	L	V

Trial 4

0	1	2	3	4	5	6	7	8	9
X	H	K	L	V	T	A	E	N	W

APPENDIX B CONTINUED

The Digit-letter Task Codes Sheet

Trial 5

0	1	2	3	4	5	6	7	8	9
K	L	V	T	A	E	N	W	X	H

Trial 6

0	1	2	3	4	5	6	7	8	9
A	E	N	W	X	H	K	L	V	T

Trial 7

0	1	2	3	4	5	6	7	8	9
N	W	X	H	K	L	V	T	A	E

Trial 8

0	1	2	3	4	5	6	7	8	9
L	V	T	A	E	N	W	X	H	K

APPENDIX C

The Colour-Letter Task Response Sheet

YELLOW	PINK	BROWN	BLUE	ORANGE	BLACK

BLACK	GREY	PURPLE	GREEN	BLUE	RED

BLUE	BROWN	GREY	PINK	GREEN	YELLOW

GREY	RED	YELLOW	PURPLE	BLACK	ORANGE

BLUE	GREY	PURPLE	ORANGE	BROWN	PINK

BLACK	PURPLE	BLUE	RED	BROWN	GREY

YELLOW	GREEN	GREY	ORANGE	PURPLE	BLUE

GREY	ORANGE	YELLOW	BROWN	RED	GREEN

RED	PURPLE	ORANGE	BLACK	RED	BROWN

GREEN	PINK	YELLOW	GREEN	GREY	PURPLE

APPENDIX C CONTINUED

The Colour-Letter Task Codes Sheet

Trial 1

RED	BLUE	YELLOW	ORANGE	PURPLE	GREEN	BLACK	PINK	BROWN	GREY
B	W	Q	G	F	E	R	A	Y	K

Trial 2

BLUE	YELLOW	ORANGE	PURPLE	GREEN	BLACK	PINK	BROWN	GREY	RED
B	W	Q	G	F	E	R	A	Y	K

Trial 3

YELLOW	ORANGE	PURPLE	GREEN	BLACK	PINK	BROWN	GREY	RED	BLUE
B	W	Q	G	F	E	R	A	Y	K

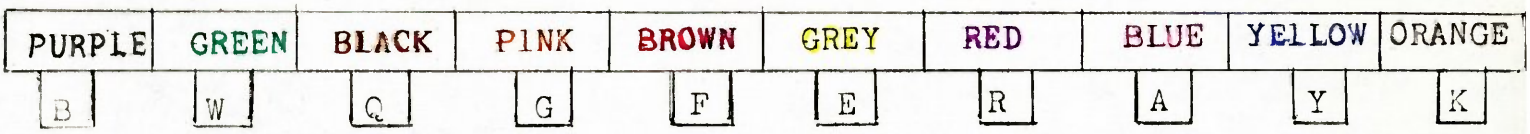
Trial 4

ORANGE	PURPLE	GREEN	BLACK	PINK	BROWN	GREY	RED	BLUE	YELLOW
B	W	Q	G	F	E	R	A	Y	K

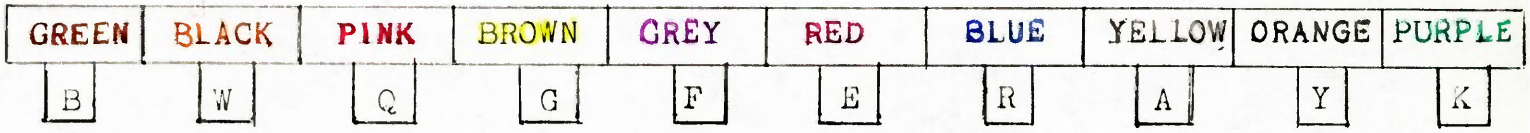
APPENDIX C CONTINUED

The Colour-Letter Task Codes Sheet

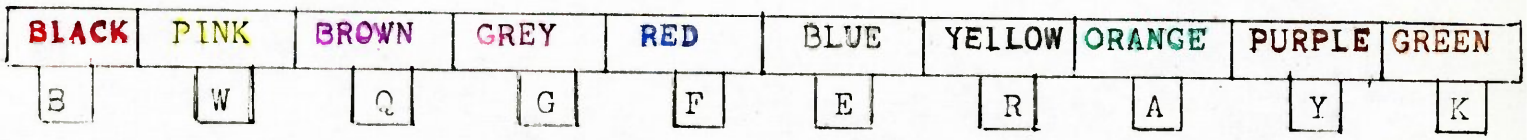
Trial 5



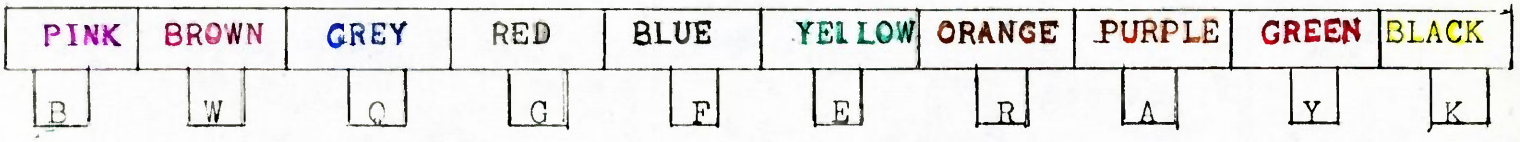
Trial 6



Trial 7



Trial 8



APPENDIX D

The Pleasantness Scale

21

20

19 extremely pleasant

18

17 very pleasant

16

15 pleasant

14

13 slightly pleasant

12

11 neither pleasant nor unpleasant

10

9 slightly unpleasant

8

7 unpleasant

6

5 very unpleasant

4

3 extremely unpleasant

2

1

Please rate the degree of complexity of the task.

Rating Scale

1	2	3	4	5	6	7
Extremely Simple	Simple	Slightly Simple	Neither Simple Nor Complex	Slightly Complex	Complex	Extremely Complex

Rating ——

Please rate the degree to which you think your performance on the last trial, compared to the second last trial, improved or deteriorated.

Rating Scale

1	2	3	4	5	6	7
Deteriorated to a Great Degree	Deteriorated	Deteriorated Slightly	Neither Improved Nor Deteriorated	Improved Slightly	Improved	Improved to a Great Degree

Rating ——

Please rate the degree to which you think you won or lost the competition.

Rating Scale

1	2	3	4	5	6	7
Lost to a Great Degree	Lost	Lost Slightly	Neither Won or Lost	Won Slightly	Won	Won to a Great Degree

Rating ——

APPENDIX F

The Instructions Used During the Experiment

- put sign on door, bring subject in, ask his name and introduce yourself. Sit the subject down and have him sign the consent form. Have him complete the JAS. Explain that you are going to keep a record of his HR during the study. Attach the plethysmograph to the index finger of his nonpreferred hand. Explain how the plethysmograph works and inform the subject that it must be kept still if it is to function properly. Get the HR recording working satisfactorily. Read the following instructions.

I want you to sit here for awhile-about five minutes-and relax completely so that I can get a record of your heart rate at a resting level. Just relax and try not to think about the experiment. There is nothing to worry about and I promise that you will not be hurt.

Every once in awhile during this experiment I am going to ask you to rate how pleasant you found doing something. For example, at the end of the relaxation period I will ask you: How pleasant were the last few seconds of the relaxation period? You must simply give me a number from the pleasantness scale right here (point to the scale). You should say 17 (point to the scale) if you found the relaxation period very pleasant. Or, if you found the relaxation period very unpleasant you should say 5 (point to the scale). Or, if you cannot decide whether it was pleasant or unpleasant, you should say 11 (point to the scale). So, whenever I ask you to rate how pleasant something was you will give me a number anywhere from 1 to 21 (point to the scale). OK?

During the relaxation period you will have to keep the plethysmograph as still as possible. You should move around as little as possible, and you will not be able to ask any questions. So, if you have any questions you should ask me now. (Encourage questions). Now you should make yourself as comfortable as possible so that you will be able to stay still and relaxed during the relaxation period.

- go behind the shelves and ask the subject if he is relaxed and comfortable. Press the event marker to indicate the beginning of the relaxation period on the polygraph. Remain absolutely quiet and still during the subject's relaxation period. After exactly five minutes, press the event marker again.

OK - the relaxation period is finished. How pleasant did you find the last few seconds of the relaxation period?

- record the subject's response. Bring out the first trial of the task and place it on the table in front of the subject. After the subject has been randomly assigned to either the simple or complex task, read the appropriate instructions.

- The digit-letter task will require the following istructions.

This is a digit-letter substitution task. What you have to do is this: under each of these numbers (point) I want you to put the appropriate letter from above. For example, under the 6 you would put in a L, under the 9 you would put in an A, and so on. You are to start here (point) and continue on without skipping any. When you reach the end of the line simply go on to the next line. You have to do the substitutions in the order they appear down here (point). You are not allowed to do all the 0's, then all the 1's, then all the 2's, etc. Also, if you make any mistakes, simply go on. Any questions? Get

yourself into a comfortable position for doing the task and remember that you have to keep the plethysmograph as still as possible.

- The colour-letter task will require the following instructions.

This is a colour-letter task. You will use a response sheet (point), a colour code (point) and ten coloured pencils (point) to perform the task. The ten coloured pencils correspond to the ten colours found in the colour code. The ten colours are: red, blue, yellow, orange, purple, green, black, pink, brown, and grey (point to colour code while naming the colours). Now, I would like you to pick up the correct coloured pencil as I call out all the ten colours once again. This will ensure me that you are familiar with the colours. OK? Good, now we can proceed.

In front of you is a response sheet (point). Words referring to specific colours are printed on this sheet. Below each word is a space (point) which you must fill with the correct response. What you must do is this: find the colour (point to the colour code) which is indicated by the word on the response sheet. For example, if the word YELLOW is printed on the response sheet you must find the <u>colour</u> yellow in the colour code. You will notice that the coloured word in the code refers to a specific colour (point). For example, the word ORANGE may be coloured in YELLOW. Your task is to print the letter found below the colour code in the colour indicated by the word in the code. For example,

if the letter B is found below the word RED, you must print the B in RED. Or, if the letter K is found below the word GREY, you must print the K in GREY.

To summarize the task, you must look for the colour indicated by the word on the response sheet and print the letter below in the colour indicated by the word on the colour code. Any questions?

You are to start here (point to the response sheet) and continue on without skipping any. When you reach the end of the line simply go on to the next line. You have to do the task in sequential order. You cannot do all the YELLOW's, then all the RED's, etc. Also, if you make any mistakes, simply go on. Any questions? Get yourself into a comfortable position for doing the task and remember that you have to keep the plethysmograph as still as possible.

-turn the code upsidedown on the table. Pick up the buzzer and read the following:

When I am ready to have you begin the task I will say "turn over your code", and you will turn the code over with your free hand, remembering to keep the plethysmograph still. Then I'll say "ready?". And when you are ready you should say "yes". After you have said yes I will say "OK", and I'll buzz the buzzer like this (demonstrate). When I buzz the buzzer, you begin doing the task as quickly as possible. When time is up I'll buzz again and you'll have to stop immediately, put your pencil down, and turn the task over. Once again remember that you have to keep the plethysmograph

still even when you are doing the tasks. Any questions?

- run the first trial. As soon as the trial is finished, say: How pleasant did you find the trial?

- score, point out errors, show the subject how to correct errors, and give the score. Bring out the second trial and place it face down on the table in front of the subject. Read the following instructions.

This is another variation of the same task. You do it the same way as the first one. Remember to work as quickly as possible.

- run the second trial the same way as the first, then trials 3 through to 7. At the end of the seventh trial, excuse yourself from the room momentarily to get the competitor.

- bring the competitor into the room, introduce him as another introductory psychology student, seat him opposite the subject, and attach the plethysmograph. Bring out two codes for trial 8 and place them face down on the table.

By now you both know how to do the task. I want you both to do another form of the same task. The only difference between this one and the earlier trials is that instead of doing the task as quickly and as well as possible, I also want you to try and do it faster than the other person. In other words, we are going to have a competition. I'll let you know who won at the end of the experiment. When I am ready to have you compete I'll say "turn over your codes", and you should turn your codes over with your free hand, remembering to keep your other hand still. Then I'll say "ready?", and when you are ready to begin you should both say "yes". After you both have said yes, I'll say OK, and I'll press the buzzer like this (demonstrate). When I buzz the buzzer, you begin doing the task as quickly and as well as possible, while at

the same time trying to beat the other person. When time is up I'll buzz the buzzer again (demonstrate), and you will have to stop immediately, put your pencils down, and turn over your tasks. Please remember to keep your plethysmograph still. Any questions?

- run the competition trial. When the trial is finished say, "How pleasant did you find the trial?", first to the subject and then to the competitor (competitor is instructed to give the same rating as the subject).
- remove the plethysmograph, take 60 seconds to score the trial and announce the winner. Ask the subject to complete the post-experimental rating scale. Thoroughly debrief the subject. The confederate is shown out of the room before the subject is given the post-experimental rating scale.

Debriefing

- ask subject what he thought the experiment was about.
- ask subject if he had heard anything about the experiment.
- explain the experiment to the subject.
- tell the subject that he cannot be in the experiment again.
- remind the subject that he will be credited.
- ask the subject to keep the details of the experiment confidential.
- thank the subject for his cooperation and participation.

Legend for the Raw Score Pages

GROUP

A/S Type A/simple task

A/C Type A/complex task

B/S Type B/simple task

B/C Type B/complex task

Note: Each of the four experimental groups had fifteen subjects.

HRREST heart rate scores for the relaxation period

HR7 heart rate scores for the seventh trial

HR8 heart rate scores for the eighth trial

SRREST self-report of pleasantness scores for the relaxation period

SR7 self-report of pleasantness scores for the seventh trial

SR8 self-report of pleasantness scores for the eighth trial

PER7 performance scores for the seventh trial

PER8 performance scores for the eighth trial

ER7 errors for the seventh trial

ER8 errors for the eighth trial

A/B Jenkins Activity Survey Scores on the overall A/B subscale

Q1 the degree of complexity of the task

Q2 the degree to which the subject thinks his performance on the last trial compared to the second last trial-improved or deteriorated

Q3 the degree to which the subject thinks he won or lost the competition

Raw Scores

GROUP A/S	HRREST	HR7	HR8	SRREST	SR7	SR8	PER7
1	86	82	98	11	8	15	55
2	70	79	100	7	16	19	50
3	74	90	117	15	17	17	54
4	45	51	67	17	15	15	50
5	77	80	97	13	15	17	53
6	61	77	80	15	19	19	47
7	77	79	90	9	13	13	55
8	83	100	132	15	10	12	46
9	58	59	70	16	13	15	50
10	57	67	93	10	9	16	47
11	67	84	119	10	7	11	49
12	71	76	80	15	12	15	55
13	64	74	99	11	9	12	41
14	72	80	99	17	14	16	51
15	71	79	88	11	14	16	47

GROUP A/S	PER8	ER7	ER8	A/B	Q1	Q2	Q3
1	57	0	0	9	4	6	6
2	57	0	0	8	4	5	5
3	53	0	0	9	5	6	5
4	49	0	0	12	4	3	3
5	55	0	1	8	4	4	3
6	50	0	0	10	2	6	4
7	56	0	2	8	4	3	3
8	47	0	0	7	1	4	4
9	57	0	0	7	2	6	6
10	51	0	0	15	4	5	3
11	58	0	0	10	4	6	3
12	60	0	0	7	3	5	5
13	46	0	0	7	2	6	3
14	52	0	0	12	2	5	3
15	59	0	2	15	3	5	2

GROUP	HRREST	HR7	HR8	SRREST	SR7	SR8	PER7
A/C							
1	72	89	125	13	13	9	16
2	81	98	118	15	12	9	14
3	67	78	93	12	15	15	12
4	65	72	78	15	13	16	13
5	82	75	76	11	12	10	10
6	62	81	107	15	11	7	15
7	89	91	99	11	11	11	18
8	60	64	75	15	11	9	8
9	71	74	115	16	13	11	17
10	52	59	80	15	11	9	12
11	65	98	108	15	11	11	11
12	81	91	107	13	10	10	15
13	64	78	97	11	7	5	13
14	85	89	88	13	11	9	13
15	68	80	110	15	13	11	18

GROUP	PER8	ER7	ER8	A/B	Q1	Q2	Q3
A/C							
1	15	1	5	7	5	2	4
2	15	1	0	7	2	3	5
3	12	2	1	8	5	4	3
4	10	0	0	9	5	3	4
5	8	0	0	9	5	4	2
6	12	0	1	8	5	2	3
7	12	0	1	19	2	4	4
8	8	3	1	10	3	5	5
9	14	4	2	8	5	3	4
10	11	0	0	9	4	3	3
11	11	1	1	9	5	5	4
12	14	2	1	15	5	5	5
13	13	1	2	9	5	3	4
14	8	0	0	9	4	2	4
15	19	1	4	11	5	4	4

GROUP	HRREST	HR7	HR8	SRREST	SR7	SR8	PER7
B/S							
1	89	104	150	11	17	17	51
2	81	87	97	13	13	17	41
3	89	98	91	15	13	15	36
4	83	86	90	11	11	11	55
5	66	80	96	14	11	12	40
6	82	83	103	17	15	17	56
7	81	96	119	15	13	17	50
8	75	83	108	16	13	14	44
9	74	89	117	14	12	15	59
10	56	61	91	14	10	13	49
11	84	85	93	9	9	17	45
12	64	67	77	15	9	12	41
13	71	80	86	12	13	14	51
14	57	57	61	13	11	13	37
15	75	84	86	14	14	14	63

GROUP B/S	PER8	ER7	ER8	A/B	Q1	Q2	Q3
1	53	0	0	4	2	4	3
2	47	0	0	6	5	5	5
3	38	0	0	5	1	5	4
4	56	0	0	4	4	4	2
5	44	1	0	6	4	5	4
6	57	0	0	4	3	5	4
7	54	0	0	6	1	5	5
8	48	0	1	5	1	5	3
9	66	0	0	5	2	5	5
10	61	0	0	5	3	5	5
11	53	0	2	3	1	6	5
12	41	0	1	6	1	4	4
13	49	0	0	2	2	3	3
14	44	0	0	4	4	3	3
15	64	0	0	6	1	5	5

GROUP	HRREST	HR7	HR8	SRREST	SR7	SR8	PER7
B/C							
1	71	84	77	11	10	7	11
2	69	68	84	15	15	9	8
3	61	72	79	16	9	7	11
4	88	89	90	10	11	11	9
5	78	99	110	17	13	9	13
6	63	83	90	13	11	9	16
7	62	80	93	16	14	15	13
8	84	98	130	11	11	17	15
9	71	77	87	13	7	11	10
10	98	104	116	16	12	9	10
11	78	89	108	16	15	14	12
12	85	92	104	12	11	10	14
13	71	73	78	15	15	14	12
14	68	80	93	16	11	11	15
15	63	73	89	14	13	10	14

GROUP	PER8	ER7	ER8	A/B	Q1	Q2	Q3
B/C							
1	8	0	1	6	4	2	3
2	10	1	2	6	3	4	4
3	11	0	1	4	5	4	5
4	9	1	0	3	3	4	5
5	12	1	2	3	5	2	3
6	13	4	2	6	3	3	5
7	13	3	1	2	5	5	4
8	17	0	0	5	3	6	5
9	12	2	0	4	3	5	4
10	9	1	1	4	6	5	5
11	11	1	0	6	4	5	6
12	9	4	1	6	4	3	5
13	11	0	2	3	5	5	5
14	15	1	2	2	5	4	5
15	13	1	1	4	5	3	5

APPENDIX H

Heart Rate Scores for the Relaxation Period

Source of Variation	SS	df	MS	F	Probability
Main Effects	329.93	2	164.97	1.45	.24
Type	326.67	1	326.67	2.87	.10
Task	3.27	1	3.27	.03	.87
Type X Task	38.40	1	38.40	.34	.56
Explained	368.33	3	122.78	1.08	.37
Residual	6370.40	56	113.76		
Total	6738.73	59	114.22		

TOTAL POPULATION

M	72.23
SD	10.69
N	60

TYPE

	A	B
M	69.90	74.57
SD	10.46	10.57
N	30	30

TASK

	Simple	Complex
M	72.00	72.47
SD	10.90	10.65
N	30	30

	A/S	A/C	B/S	B/C
M	68.87	70.93	75.13	74.00
SD	10.66	10.53	10.56	10.92
N	15	15	15	15

APPENDIX I

Heart Rate Scores for the Seventh Trial

Source of Variation	SS	df	MS	F	Probability
Main Effects	378.17	2	189.08	1.36	.26
Type	268.82	1	268.82	1.94	.17
Task	109.35	1	109.35	.79	.38
Type X Task	25.35	1	25.35	.18	.67
Explained	403.52	3	134.51	.97	.41
Residual	7767.73	56	138.71		
Total	8171.25	59	138.50		

TOTAL POPULATION

M	81.25
SD	11.77
N	60

TYPE

	A	B
M	79.13	83.37
SD	11.59	11.75
N	30	30

TASK

	Simple	Complex
M	79.90	82.60
SD	12.42	11.12
N	30	30

	A/S	A/C	B/S	B/C
M	77.13	81.13	82.67	84.07
SD	11.69	11.54	12.91	10.89
N	15		15	15

APPENDIX J

Self-Report of Pleasantness Scores for the Relaxation Period

Source of Variation	SS	df	MS	F	Probability
Main Effects	12.17	2	6.08	1.08	.35
Type	4.82	1	4.82	.86	.36
Task	7.35	1	7.35	1.31	.26
Type X Task	.42	1	.42	.07	.79
Explained	12.58	3	4.19	.75	.53
Residual	314.40	56	5.61		
Total	326.98	59	5.54		

TOTAL POPULATION

M	13.52
SD	2.35
N	60

TYPE

	A	B
M	13.23	13.80
SD	2.54	2.16
N	30	30

TASK

	Simple	Complex
M	13.17	13.87
SD	2.65	2.00
N	30	30

	A/S	A/C	B/S	B/C
M	12.80	13.67	13.53	14.07
SD	3.14	1.76	2.10	2.25
N	15	15	15	15

APPENDIX K

Self-Report of Pleasantness Scores for the Seventh Trial

Source of Variation	SS	df	MS	F	Probability
Main Effects	8.97	2	4.48	.70	.50
Type	.15	1	.15	.02	.88
Task	8.82	1	8.82	1.37	.25
Type X Task	2.02	1	2.02	.31	.58
Explained	10.98	3	3.66	.57	
Residual	361.20	56	6.45		
Total	372.18	59	6.31		

TOTAL POPULATION

M	12.12
SD	2.51
N	60

TYPE

	A	B
M	12.17	12.07
SD	2.81	2.23
N	30	30

TASK

	Simple	Complex
M	12.50	11.73
SD	2.19	2.05
N	30	30

	A/S	A/C	B/S	B/C
M	12.73	11.60	12.27	11.87
SD	3.51	1.80	2.19	2.33
N	15	15	15	15

Net Performance Scores for the Seventh Trial

Source of Variation	SS	df	MS	F	Probability
Main Effects	20778.43	2	10389.22	419.24	.00
Type	58.02	1	58.02	2.34	.13
Task	20720.42	1	20720.42	836.15	.00
Type X Task	.82	1	.82	.03	.86
Explained	20779.25	3	6926.42	279.51	.00
Residual	1387.73	56	24.78		
Total	22166.98	59	375.71		

TOTAL POPULATION

M	30.32
SD	19.38
N	60

TYPE

	A	B
M	31.30	29.33
SD	19.35	19.70
N	30	30

TASK

	Simple	Complex
M	48.90	11.73
SD	6.47	2.84
N	30	30

	A/S	A/C	B/S	B/C
M	50.00	12.60	47.80	10.87
SD	4.02	3.16	8.24	2.26
N	15	15	15	15

Heart Rate Change Scores from the Seventh to the Eighth Trial

Source of Variation	SS	df	MS	F	Probability
Main Effects	406.03	2	203.02	1.61	.21
Type	322.02	1	322.02	2.55	.12
Task	84.02	1	84.02	.67	.42
Type X Task	33.75	1	33.75	.27	.61
Explained	439.78	3	146.59	1.16	.33
Residual	7062.40	56	126.11		
Total	7502.18	59	127.16		

TOTAL POPULATION

M	15.38
SD	11.28
N	60

TYPE

	A	B
M	17.70	13.07
SD	10.81	11.43
N	30	30

TASK

	Simple	Complex
M	16.57	14.20
SD	11.73	10.87
N	30	30

	A/S	A/C	B/S	B/C
M	18.13	17.27	15.00	11.13
SD	9.63	12.21	13.68	8.69
N	15	15	15	15

Self-Report of Pleasantness Change Scores from the Seventh to the Eighth Trial

Source of Variation	SS	df	MS	F	Probability
Main Effects	194.67	2	97.91	17.91	.00
Type	.27	1	.27	.05	.83
Task	194.40	1	194.40	35.76	.00
Type X Task	1.67	1	1.67	.31	.58
Explained	196.33	3	65.44	12.04	.00
Residual	304.40	56	5.44		
Total	500.73	59	8.49		

TOTAL POPULATION

M	.57
SD	2.91
N	60

TYPE

	A	B
M	.50	.63
SD	2.83	3.05
N	30	30

TASK

	Simple	Complex
M	2.37	-1.23
SD	2.13	2.46
N	30	30

	A/S	A/C	B/S	B/C
M	2.47	-1.47	2.27	-1.00
SD	2.23	1.81	2.09	3.02
N	15	15	15	15

Net Performance Change Scores from the Seventh to the Eighth Trial

Source of Variation	SS	df	MS	F	Probability
Main Effects	325.47	2	162.73	17.20	.00
Type	8.07	1	8.07	.85	.36
Task	317.40	1	317.40	33.55	.00
Type X Task	5.40	1	5.40	.57	.45
Explained	330.87	3	110.29	11.66	.00
Residual	529.87	56	9.46		
Total	860.73	59	14.59		

TOTAL POPULATION

M	1.23
SD	3.82
N	60

TYPE

	A	B
M	.87	1.60
SD	4.09	3.56
N	30	30

TASK

	Simple	Complex
M	3.53	-1.07
SD	3.57	2.45
N	30	30

	A/S	A/C	B/S	B/C
M	3.47	-1.73	3.60	-.40
SD	3.62	2.66	3.64	2.10
N	15	15	15	15

Post-Experimental Rating Scale

Q1

Source of Variation	SS	df	MS	F	Probability
Main Effects	37.50	2	18.75	13.55	.00
Type	3.75	1	3.75	2.71	.11
Task	33.75	1	33.75	24.39	.00
Type X Task	2.02	1	2.02	1.46	.23
Explained	39.52	3	13.17	9.52	.00
Residual	77.47	56	1.38		
Total	116.98	59	1.98		

TOTAL POPULATION

M	3.52
SD	1.41
N	60

TYPE

	A	B
M	3.77	3.27
SD	1.25	1.53
N	30	30

TASK

	Simple	Complex
M	2.77	4.27
SD	1.33	1.05
N	30	30

	A/S	A/C	B/S	B/C
M	3.20	4.33	2.33	4.20
SD	1.15	1.11	1.40	1.01
N	15	15	15	15

Post-Experimental Rating Scale

Q2

Source of Variation	SS	df	MS	F	Probability
Main Effects	17.13	2	8.57	8.09	.001
Type	.07	1	.07	.06	.80
Task	17.07	1	17.07	16.11	.00
Type X Task	3.27	1	3.27	3.08	.09
Explained	20.40	3	6.80	6.42	.001
Residual	59.33	56	1.06		
Total	79.73	59	1.35		

TOTAL POPULATION

M	4.27
SD	1.16
N	60

TYPE

	A	B
M	4.23	4.30
SD	1.30	1.02
N	30	30

TASK

	Simple	Complex
M	4.80	3.73
SD	.92	1.14
N	30	30

	A/S	A/C	B/S	B/C
M	5.00	3.47	4.60	4.00
SD	1.07	1.06	.74	1.20
N	15	15	15	15

Post-Experimental Rating Scale

Q3

Source of Variation	SS	df	MS	F	Probability
Main Effects	4.17	2	2.08	2.12	.13
Type	2.82	1	2.82	2.86	.10
Task	1.35	1	1.35	1.37	.25
Type X Task	1.35	1	1.35	1.37	.25
Explained	5.52	3	1.84	1.87	.15
Residual	55.07	56	.98		
Total	60.58	59	1.03		

TOTAL POPULATION

M	4.08
SD	1.01
N	60

TYPE

	A	B
M	3.87	4.30
SD	1.04	.95
N	30	30

TASK

	Simple	Complex
M	3.93	4.23
SD	1.11	.90
N	30	30

	A/S	A/C	B/S	B/C
M	3.87	3.87	4.00	4.60
SD	1.25	.83	1.00	.83
N	15	15	15	15