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TYPE A BEHAVIOR, HARDINESS, AND THE SUBJECTIVE AND CARDIOVASCULAR RESPONSE TO PERFORMANCE CHALLENGE

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TYPE A BEHAVIOR, HARDINESS, AND THE SUBJECTIVE AND CARDIOVASCULAR RESPONSE TO PERFORMANCE CHALLENGE

By

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Abstract

TYPE A BEHAVIOR, HARDINESS, AND THE SUBJECTIVE AND CARDIOVASCULAR RESPONSE TO PERFORMANCE CHALLENGE

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Type A (coronary-prone) individuals show greater physiological responses to stress than (non-coronary-prone) Type B's. It has been proposed that biological reactivity contributes to enhanced coronary risk. However, while the relationship between Pattern A and reactivity appears reliable, the association is rather modest in magnitude. This has led to interest in psychosocial variables predicting physiological reactivity independently of, or in interaction with, Type A behavior.

Accordingly, the present study examined two factors in addition to Pattern A which may influence physiological reactivity to performance challenge: (1) Hardiness, a personality style which confers resistance against stress-induced illness, and (2) subjective responses, including performance strategies, affect, and attributions. It was predicted that Type A's low in Hardiness would show the greatest cardiovascular response while evincing inferior performance strategies, self-attribution for failure, and negative affect.

Pattern A and Hardiness were assessed in a sample of male undergraduates who subsequently performed a difficult psychomotor task. Periodic measurements were made of systolic and diastolic blood pressure (SBP and DBP) and heart rate. Subjects verbalized thoughts and feelings while working on the task. Verbalizations were tape-recorded and transcribed for content analysis. Subjective responses also were obtained using a post-task questionnaire.

Results for cardiovascular measures confirmed predictions. Type A's showed greater SBP and DBP elevations than Type B's, and DBP responses were significantly higher among subjects low compared to high in Hardiness. Moreover, DBP data yielded a significant univariate interaction, indicating particularly low DBP elevations among Type B's high in Hardiness. However, the corresponding multivariate effect was not reliable. Verbalization measures did not confirm predictions regarding subjective responses. Post-task measures provided some support, but relevant multivariate tests were not reliable.

Discussion focuses on the possible role of reduced biological reactivity in mediating the salutory effects of Hardiness upon stress-induced illness. It also is proposed that a multivariate approach taking into account variables other than Pattern A, such as Hardiness, may contribute to greater understanding of psychophysiological hyperresponsiveness. Methodological factors influencing verbalization data are noted, along with ways of circumventing them in future research.

To my family, friends, and teachers

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CHAPTER I

INTRODUCTION AND BACKGROUND

The social and behavioral sciences have become increasingly significant for problems of health. Recent advances point to the emergence of a biobehavioral approach to physical illness which focuses on the mechanisms whereby psychosocial and behavioral factors interact in the onset, course, treatment, and prevention of somatic disorders (Schwartz & Weiss, 1978a, 1978b). Progress has been particularly evident in the understanding of biobehavioral processes involved in the etiology and pathogenesis of the major cardiovascular disorders (Krantz, Glass, Contrada, & Miller, 1981). A most noteworthy development within this area of study is the identification of the Type A behavior pattern (Friedman & Rosenman, 1959), which bears a reliable, prospective association with the clinical manifestations of coronary heart disease (Dembroski, Weiss, Shields, Haynes, & Feinleib, 1978; Review Panel, 1981).

A limitation of the Type A variable is its lack of specificity. An epidemiologic concept, the specificity problem refers to the fact that measures of Pattern A falsely identify as coronary-prone many individuals who do not develop the disorder (Krantz, Glass, Schaeffer, & Davia, 1982). A similar problem has emerged in research concerned with the relationship between Type A behavior and biological responses believed to underly cardiovascular dysfunction--the association appears reliable, but leaves unexplained a significant portion of the variance (Contrada, Wright, & Glass, in press). These observations

have stimulated efforts to improve epidemiologic specificity, and to increase precision in the prediction of pathogenic responses culminating in coronary disease.

One approach has been to fractionate the global Type A construct into more specific dimensions which then can be studied in relation to biological responses (Dembroski, MacDougall, Shields, Petitto, & Lushene, 1978) and disease end points (Matthews, Glass, Rosenman, & Bortner, 1977). Another involves integration of Pattern A research with the study of other psychosocial variables affecting somatic health, such as uncontrollable stress (Glass, 1977) and certain aspects of personality (Kobasa, 1982b). In addition to increasing epidemiologic specificity, research along these lines should enhance our understanding of Type A behavior from a psychological perspective (Matthews, 1982) and clarify its role in the etiology and pathogenesis of coronary disease (Glass, 1982; Williams, 1979).

The study described below addresses these issues by examining two factors that may moderate the relationship between Type A behavior and cardiovascular reactivity to a demanding psychomotor task: (1) subjective reactions, including the performance strategies, affective responses, and attributions reported by subjects as they work on the task, and (2) the hardy personality style, a dimension of individual differences in resistance to the illness-inducing effects of psychological stress (Kobasa, 1982b). Theoretical considerations suggest that both factors are related to cognitive-appraisal processes underlying the physiologic responsiveness of Type A individuals engaged in stressful transactions with their environments. This

proposition was tested by assessing the degree of improvement in the prediction of cardiovascular reactivity which is made possible when subjective reactions and hardiness are taken into account in addition to the Type A behavior pattern.

The Nature of Coronary Disease

Coronary atherosclerosis is a symptomless condition characterized by narrowing and deterioration of the coronary arteries, the blood vessels which nourish the heart. An excess accumulation of cholesterol and related lipids forms a mound of tissue, or atherosclerotic plaque, on the inner walls of one or more coronary arteries (Hurst, Logue, & Wenger, 1978). The formation and growth of atherosclerotic plaques may proceed undetected for years, affecting cardiac function only when they cause a degree of obstruction sufficient to diminish blood supply to the heart. Once this occurs, coronary artery disease has progressed to coronary heart disease (CHD).

Two major forms of CHD are angina pectoris (AP) and myocardial infarction (MI). Angina involves recurring instances of inadequate blood supply to the heart (ischemia), which causes severe attacks of chest pain. Although it does not reflect permanent tissue damage, AP is a painful condition which can lead to serious complications. Myocardial infarction, or heart attack, is a more severe and frequently fatal form of CHD, in which a prolonged state of ischemia results in death of a portion of myocardial tissue. Many infarctions are associated with thrombosis, suggesting that clot formation within an occluded artery may be the precipitating event. However, the etiologic significance of thrombosis has been the subject of much

debate in recent years. Indeed, there is no evidence of occlusive thrombosis, or even atherosclerosis, in many cases of sudden cardiac death (SCD), which observation has led some researchers to argue that MI and SCD are two different forms of myocardial necrosis associated with distinct pathophysiologic mechanisms (Eliot, 1979).

Magnitude of the Problem

In 1900, the leading causes of death in the United States were infectious disorders such as pneumonia, influenza, and tuberculosis. Changing patterns of illness since that time have been marked by the ascendancy of cardiovascular disease as the chief cause of death in this country (National Science Foundation, 1980). Despite a recent decline in cardiovascular mortality, heart and blood vessel diseases still account for over half of all deaths in the United States (Levy & Moskowitz, 1982). Estimates indicate that approximately 3,400 Americans suffer a heart attack each day--a rate of more than two infarctions per minute (National Center for Health Statistics, 1980). Cardiovascular dysfunction is not solely a disease of the elderly; about one-third of deaths from all causes in persons between the ages of 35 and 64 are due to coronary heart disease (Levy & Moskowitz, 1982). The total economic cost of cardiovascular disorders is estimated to be in excess of $60 billion annually, more than one-fifth of the total cost of illness in the United States (Eighth Report of the Director of the National Heart, Lung, and Blood Institute, 1982).

Risk Factors for Coronary Disease

Individuals who are likely to develop coronary heart disease may be identified with a modest degree of accuracy. This is possible

because a set of risk factors has been identified in recent years. A CHD risk factor is an attribute that appears to increase the incidence of one or more of the clinical manifestations of coronary disease. Among the variables which have been proposed are the following: (1) aging; (2) being male; (3) high levels of cholesterol and related lipids in the blood; (4) dietary intake of animal fats and cholesterol; (5) high blood pressure; (6) cigarette smoking; (7) diabetes mellitus; (8) other specific diseases such as hypothyroidism; (9) family history of coronary disease; (10) obesity; (11) sedentary life-style; (12) specific anomolies of the electrocardiogram, such as left ventricular hypertrophy (Kannel, McGee, & Gordon, 1976).

The best combinations of these biomedical risk factors fail to identify most new cases of heart disease (Jenkins, 1971). Some variable or set of variables appears to be missing from the predictive equation. This limitation in knowledge has led to a broadened search for influences contributing to coronary risk; it now included social indicators, such as socioeconomic status and social mobility, and psychological factors, such as anxiety and neuroticism. The most promising psychosocial risk factors to emerge in recent years are psychological stress and the Type A coronary-prone behavior pattern (Jenkins, 1971, 1976).

CHAPTER II

PSYCHOLOGICAL STRESS AND COPING

Seyle (1956) first popularized the notion of stress, which he defined as the body's non-specific physiologic response to noxious agents. Stress also has been defined as a class of stimuli (Margetts, 1975; Symonds, 1947), as the interaction between stimulus and response (Mechanic, 1970), and in terms of transactions, or processes that intervene between stimulus and response (Lazarus, 1966). While a consensus has not been achieved within the scientific community, most psychologically-oriented investigators find it congenial to think of stress as an internal state of the individual resulting from the perception of actual or potential danger to his or her physical or psychic well-being (e.g., Cox, 1978; Cofer & Appley, 1964; Glass & Singer, 1972; Lazarus, 1981; McGrath, 1970). In this view, the state of stress may be inferred on the basis of affective, behavioral, and biological responses evoked by aversive events that are recalled, ongoing, anticipated, or imagined (Appley & Trumbull, 1967).

This usage of the term stress places an emphasis on the perception of stimuli that have significance for the individual's well-being, or primary appraisal, as well as the individual's felt ability to cope with the demands imposed by such stimuli, or secondary appraisal (Lazarus, 1966). Appraisals likely to initiate a stress response may involve harm/loss, threat, or challenge (Lazarus, 1981). Harm/loss refers to injury or damage already done, as, for example, in bereavement, loss of physical function or self-esteem, and the like.

Threat refers to the same kinds of events when they have not yet occurred, but are anticipated. Challenge means an opportunity for growth, mastery, or gain. While it does involve circumstances in which there is the threat of harm or loss, challenge implies that the possibility of a positive outcome also exists, and is more salient than the possibility of a negative one.

Coping refers to efforts to master stressful circumstances, which may take the form of cognitive processes or overt action. Lazarus (1981) discusses two functions of coping, namely, (1) to alter the situation that initially gave rise to the perception of threat, referred to as problem-solving or instrumental coping, and (2) to regulate the subjective component of the stress response, referred to as emotion-focused or palliative coping. A distinction may be drawn between coping strategies and coping styles (Lazarus, 1966). Coping strategies are responses that occur within the context of a particular situation. Coping styles refer to characteristic modes of responding to stressful events that show some degree of consistency within the individual across different situations.

Psychological Stress and Coronary Heart Disease

Several indices of psychogical stress have been studied in relation to the development of coronary disease. For example, there is evidence to suggest that excessive work and responsibility enhance coronary risk, especially when they approach the limits of the individual's felt capacity to control his or her work environment (Haynes, Feinleib, & Kannel, 1980; House, 1975; Theorell, Lind, & Floderus, 1975). Another job-related stressor that appears related to

CHD is reported dissatisfaction with aspects of the work environment, such as lack of recognition by superiors, poor relations with co-workers, and inferior work conditions (House, 1975). Other life dissastisfactions, including problems and conflicts in the areas of finance and family relations, also have been linked to the presence and future development of coronary disease (Floderus, 1974; Haynes et al., 1980; Medalie, Snyder, & Groen, 1973).

The occurrence of a single, traumatic life event has long been suspected as a cause of clinical CHD (e.g., Cannon, 1942). More recently, it has been suggested that the cumulative effects of repeated adjustments required by life changes drain the adaptive resources of the individual and increase susceptibility to a variety of diseases (Holmes & Masuda, 1974). To test this notion, an objective assessment device, the Social Readjustment Rating Scale (SRRS), was developed by Holmes and Rahe (1967) to measure the impact of such events as the death of a spouse, a change to a different line of work, and having a son or daughter leave home.

Several retrospective studies have employed the SRRS in an effort to link the accumulation of life events to the occurrence of coronary disease (for a review, see Garrity & Marx, 1979). For example, a number of investigations have documented greater recent life changes among MI patients as compared to healthy controls (e.g., Connolly, 1976; Theorell & Rahe, 1971). Other research, in which information regarding life events prior to sudden cardiac death was obtained from a survivor of the deceased, has revealed an accumulation in the intensity of life change in the 6 months preceding death (e.g., Rahe & Lind, 1971).

Although the foregoing results have been replicated (see Garrity & Marx, 1979), negative findings have been reported as well (e.g., Hinkle, 1974). Most critical is the lack of association between stressful life events and coronary disease in a prospective study of the SRRS (Theorell et al., 1975). This finding raises the possibility that the positive results described earlier are an artifact of defects inherent in the retrospective study of life events (Dohrenwend & Dohrenwend, 1978). It will be recalled, however, that evidence for an association between life stress and coronary disease was obtained in studies utilizing prospective designs that are not subject to the limitations of retrospective research (e.g., Haynes et al., 1980; Medalie et al., 1973).

Another consideration is that the relation of stress to pathological outcomes undoubtedly depends upon the capacity of the individual before the stressor occurs and the resources marshalled in response to its occurrence (Cohen et al., 1982). Relevant variables include biological factors (e.g., genetic susceptibility), psychological attributes (e.g., felt ability to cope), aspects of the immediate context in which the stressor occurs (e.g., whether the stressor is perceived as controllable), sociocultural variables (e.g., social support), and factors related to the life course (e.g., the particular stage of life during which a stressful event occurs). These and other factors moderating the impact of stress must be taken into account in order to gauge the predictive validity of stress as a risk factor for coronary disease.

The case for an association between psychological stress and

coronary disease gains further support when one considers findings linking stress to biological responses that may be related to atherosclerosis and/or to the precipitation of angina, myocardial infarction, and sudden cardiac death. For example, stress has been shown to induce hemodynamic adjustments, such as increased heart rate and elevated blood pressure (Obrist, 1981), cardiac disturbances, such as arrhythmias (Taggart, Carruthers, & Somerville, 1973) and other EKG aberations (Lapiccirella, 1966), and biochemical changes, such as lipid mobilization (Dimsdale, 1981), and enhanced blood-platelet coagulability (Friedman, Rosenman, & Carroll, 1957). These responses are thought to reflect activation of two neuroendocrine systems: the sympathetic-adrenomedullary system, and the hypothalamic-pituitary-adrenocortical axis. Sympathetic activation may be especially important in linking psychological stress to coronary disease, through the release of catecholamines, particularly epinephrine and norepinephrine, which produce many of the physiologic and biochemical changes mentioned above (Herd, 1978). The relationship between psychological stress and neuroendocrine activity is well-established (Mason, 1972).

CHAPTER III

TYPE A BEHAVIOR: A REVIEW OF THE LITERATURE

It has long been suspected that people who are competitive, achievement-oriented, time-urgent, and hostile--the core descriptive elements of Type A behavior--are most likely to develop coronary heart disease (e.g., Osler, 1892). Jenkins (1971, 1976) reviews the results of several cross-sectional studies, and a few prospective investigations, in which various measures of these and related characteristics have been associated with CHD. However, the major impetus for research validating this hypothesis comes from the work of cardiologists Myer Friedman and Ray H. Rosenman (1959), who developed the Type A concept on the basis of their observations of coronary patients. Friedman (1969) defined Pattern A as "a characteristic action-emotion complex exhibited by those individuals who are engaged in a relatively chronic struggle to obtained 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 in the same environment" (p. 34). Type B designates those individuals who are relatively uninvolved in this type of struggle and, therefore, do not exhibit the descriptive elements of Pattern A.

Pattern A has been conceptualized as the outcome of a person-situation interaction in which the defining behaviors are exhibited when a susceptible individual is confronted by appropriately challenging and/or stressful events (Rosenman & Friedman, 1974). The Type A concept does not, therefore, refer to the conditions which

elicit Pattern A, nor solely to the behavioral response itself, nor to a hypothetical personality trait that produces the behavior. It is not a typology, but an observable pattern of behavior which is displayed by everyone, in varying degrees, in response to demanding environmental conditions.

Measurement of Pattern A

The principal tools for assessing Type A behavior are the Structured Interview (Rosenman, 1978), the Jenkins Activity Survey (Jenkins, Zyzanski, & Rosenman, 1979), and the Framingham Type A Scale (Haynes, Levine, Scotch, Feinleib, & Kannel, 1978). A number of other measures have been used to assess Type A behavior. These include the Bortner (1969) Rating Scale, the Bortner Test Battery (Bortner & Rosenman, 1967), the Sales (1969) Type A questionnaire, Vickers' (1973) adaptation of the Sales measure, and the Activity subscale of Thurstone's (1949) Temperament Schedule. There also have been efforts to assess Type A behavior in children (Matthews & Seigel, 1982). However, of all these measures, only the Thurstone Activity Scale (Brozek, Keys, & Blackburn, 1966) and the Bortner Rating Scale (Belgium-French Pooling Project, 1984) have been linked prospectively to the development of CHD.

Structured Interview. The Structured Interview, or SI, contains approximately 25 questions in which the individual is asked about his or her characteristic manner of responding to a variety of situations that might be expected to elicit competitiveness, achievement-striving, impatience, and hostility (Rosenman, 1978). The questions are delivered in a brisk, challenging fashion, with emphasis on key

words and phrases. Some are asked in a manner specially designed to elicit Type A behavior during the interview itself. For example, a question may be asked in a slow, hesitant way, in order to induce impatience. The prototypical Type A will hurry the interviewer along with insistent head-nods, or interrupt and answer prior to completion of the question. In addition, the interviewer occasionally will express doubt concerning the accuracy of an answer, or interrupt a reponse with a follow-up question, in an attempt to arouse irritation. Thus, the SI is chiefly a vehicle for eliciting and observing the defining characteristics of Type A behavior. The content of the interviewee's answers is given less weight than the manner and tone of his or her responses.

Numerous motor and vocal mannerisms exhibited during the SI are considered diagnostic of Pattern A, including: (1) loud and explosive vocal intonation; (2) rapid and accelerated speech; (3) short response latencies; (4) evidence that the subject is competing for control of the interview, for example, interruptions, talk-overs, excessive qualification, and "disagreeing with the question;" (6) frequent sighing; (7) rhythmic movements of the hand and feet; (8) rapid eye-blinking; (9) fist-clenching; (10) gesticulation (Jenkins, 1975; Rosenman, 1978). On the basis of these and related signs, and a (less-heavily-weighted) consideration of the self-report of Type A characteristics, an individual is classified into one of four categories: A1, or fully-developed Type A; A2, or incompletely developed Type A; X, or an equal representation of Type A and B characteristics, and Type B, or the relative absence of Type A characteristics.

Interjudge agreement of classification usually ranges between 75% and 90%, with greater concordance where a dichotomous, Type A/B scoring system is employed (Dembroski, 1978). Test-retest over periods from 12 to 20 months shows an agreement rate of between 70% and 80% where, again, greater reliability is achieved using simple, A/B ratings (Caffrey, 1968).

Data on internal consistency come from studies employing a component-scoring procedure which generates independent ratings for stylistic variables and four self-report dimensions that may be derived from the SI (Dembroski, 1978). The stylistic variables are: (1) loud and explosive speech (LE), (2) rapid and accelerated speech (RA), (3) short response latencies (SRL), (4) competition for control of the interview (CC), and (5) potential for hostility (PH), an assessment based mainly on the manner and tone of the subject's responses. The content dimensions are (1) competitive drive (CD), (2) self-report of hostility (H), (3) speed (S), and (4) impatience (I).

Dembroski et al. (1978) report an analysis of these variables based on Structured Interviews of about 80 male college students. Correlations among the components ranged from .33 to .79, with the largest coefficients obtained for the speech stylistic dimensions LE, RA, and SRL (r's from .72 to .79) and between the more inferential PH and CC ratings (r=.76). The lowest were those involving the content variables (r's from .33 to .57). Dembroski et al. (1978) also present correlations between the Pattern A components and overall A/B classification (where B = 1; A2 = 2; A1 = 3). Coefficients for the stylistic dimensions were substantial, ranging from .65 to .71. Those

for content were lower, r = .51 for a composite score reflecting both S and I, and r = .46 for a score reflecting CD and H.

Jenkins Activity Survey. The Jenkins Activity Survey, or JAS, contains approximately 50 questions similar to those comprising the SI (Jenkins, Zyzanski, & Rosenman, 1979). Scoring is based on item weights generated in a series of discriminant function analyses in which SI assessments of a sample of nearly 3000 adult males served as the criterion (Jenkins, Rosenman, & Friedman, 1967; Jenkins, Zyzanski, & Rosenman, 1971). Twenty-one items contributed substantially in the prediction of SI classification, and these comprise the JAS A/B scale. A linear transformation has been incorporated into the scoring procedure such that the mean score is 0, and the standard deviation, 10.0. Positive scores are in the Type A direction, and negative scores, the Type B direction. The 21 items that constitute the JAS A/B scale have been unit-weighted in some studies. Glass and Contrada (unpublilshed data) obtained an r of .91 for the correlation between weighted and unweighted scores in a sample of over 80 middle-aged men.

A version of the JAS used frequently in A/B research is one adapted for use with college students (Form T; Krantz, Glass, & Snyder, 1974). In constructing Form T, six of the original items, dealing for the most part with job-related behavior, were modified to refer instead to academic activities. Responses to Form T generally are unit-weighted and summed to yield an A/B score, although some investigators have weighted the items with the discriminant function coefficients used to score the adult version. Dembroski and MacDougall (1978) report an r of .86 between weighted and unweighted scoring of Form T in a sample of about 50 male and female college

students.

Test-retest reliabilities for the adult JAS fall between .60 and .70 for intervals of from 1 to 4 years. The internal consistency of the A/B scale, using a modification of coefficient alpha for differentially-weighted items, is .83 (Jenkins et al., 1979). Glass (1977) reports data pertaining to the stability of scores on Form T. Eighty-three male undergraduates completed the JAS on two occasions ranging from 2 weeks to 4 months apart. For the most part, Type A and B subjects were selected as those scoring in either the upper or lower third of the distribution of A/B scores. However, approximately one-third were classified on the basis of a median split. Only about 9% of the subjects showed changes in their behavior pattern assessment (i.e., from Type A to Type B, or vice versa), indicating a fair amount of stability over the time interval studied.

Factor analysis of the JAS items consistently reveals three, substantially independent dimensions: Hard-driving Competitiveness, Speed and Impatience, and Job Involvement (Zyzanski & Jenkins, 1970). These factors appear both in analyses of the 21 A/B items and when all items from the original pool are factored. Analysis of Form T yields a similar solution, except that the Job-Involvement dimension does not emerge, as a result of elimination of work-related items in the construction of the questionnaire (Glass, 1977). It should be noted that only the original A/B scale has been prospectively associated with the development of CHD (Jenkins, Rosenman, & Zyzanski, 1974).

Framingham Type A Scale. The Framingham Type A scale is a self-report measure containing 10 items. Six refer in a general way to

traits such as competitive drive, dominance, and time urgency. The remaining items deal more specifically with thoughts and feelings pertaining to work, e.g., job-related time-pressure and dissatisfaction (Haynes, Levine, Scotch, Feinleib, & Kannel, 1978). The items are unit-weighted and summed to yield a Type A score, with higher values reflecting more A-like behavior.

Haynes et al. (1978) obtained a coefficient alpha of .71 for the Framingham Type A scale, but report no information regarding test-retest reliability. Although the full 10-item scale was used in linking the Framingham measure to CHD (see below), Haynes currently recommends scoring only the six trait-referent items, on the basis of results obtained in unpublished factor analyses (see personal communication cited by MacDougall, Dembroski, & Musante, 1979).

Association with Coronary Disease

Coronary heart disease. The most convincing demonstration of an association between Type A behavior and CHD comes from the Western Collaborative Group Study, or WCGS (Rosenman et al., 1964; Rosenman et al., 1966; Rosenman et al., 1970; Rosenman et al., 1975). The WCGS is a prospective epidemiologic investigation of CHD incidence in a sample of 3,154 men ranging in age from 39 to 59 years. The subjects were white, middle- and upper-class men holding white-collar positions in 10 California corporations. All were devoid of CHD at the inception of the study in 1960-1961. Comprehensive data were collected at intake and annually thereafter for a follow-up period of 8 1/2 years.

On the basis of Structured Interview assessments, 1,589 subjects were classified as Type A, and 1,565 as Type B. Two-hundred and fifty-seven subjects developed myocardial infarction or angina

pectoris over the course of the follow-up period. Of these cases, 178 were Type A, and 79 were Type B. Thus, Type A's were 2.37 times as likely to develop CHD compared to their Type B counterparts. Behavior pattern assessment was weakly correlated with some of the biomedical risk factors. However, after controlling for these associations, Type A's remained 1.97 times as likely as B's to develop CHD (Brand, 1978).

Evidence for a prospective association between JAS scores and CHD also derives from the WCGS (Jenkins et al., 1974). Of 2,750 subjects who completed the JAS in 1965, 120 developed MI or AP over the next four years. The JAS scores of these cases were compared to those of a control group ($\underline{N}$ = 524) consisting of a 20% random sample of the remaining cases, excluding those who had developed EKG abnormalities. The mean JAS A/B score for CHD cases was +1.70, which was reliably higher ($\underline{p}$ = .01, one-tailed) than that of healthy controls ($\underline{M}$ = -0.60). An analysis of the total sample indicated that those scoring in the upper third of the distribution of JAS scores incurred 1.70 times the incidence of CHD of those scoring in the lower third. As noted earlier, the factor-analytically derived subscales of the JAS were not predictive of CHD incidence.

Like the SI, the JAS appears only weakly related to biomedical risk facors (Jenkins et al., 1979), suggesting that its association with CHD is largely independent of these variables. This was confirmed in a series of multivariate analyses reported by Brand, Rosenman, Jenkins, Sholtz, & Zyzanski (1978). The Brand et al. study also examined the relative predictive powers of the SI and JAS in the WCGS. The results indicated that the SI is more strongly related to

CHD than the JAS, and that the bulk of the predictive power of the JAS derives from its ability to mimic SI assessments.

The findings reviewed above focus on the association between Pattern A and the incidence of angina and MI in initially healthy men. It should be noted, therefore, that data from the WCGS also indicate a relationship between Type A behavior and recurrent MI (Jenkins, Zyzanski, & Rosenman, 1976; Rosenman, Friedman, & Jenkins, 1967), and between Pattern A and sudden cardiac death (Friedman et al., 1973). It also should be noted that the prospective findings of the WCGS are supplemented by the results of retrospective studies indicating associations between the SI and JAS and the prevalence of CHD in research conducted in the United States, Europe, and Australia (Jenkins, 1978).

The Framingham Type A scale was studied along with a variety of other psychosocial variables in an eight-year prospective epidemiologic investigation initiated in 1965 (Haynes, Levine, et al., 1978; Haynes, Feinleib, Levine, Scotch, & Kannel, 1978; Haynes, Feinleib, & Kannel, 1980). The sample included 1,674 white men and women between the ages of 44 and 77. There were both working and non-working women, and men in both blue- and white-collar occupations. The association between Type A scores and CHD was assessed in a series of multivariate analyses in which simultaneous adjustments were made to control for the influence of both biomedical and psychosocial risk factors. The disease endpoints studied included AP and MI.

The results for working women ages 45 to 65 revealed a reliable association between Type A scores and CHD. A null finding for non-working women in the same age range was the result of a correlation

between Type A scores and a measure of chronic tension, which did show an independent relationship to CHD. When the tension variable was excluded from the analysis, the effect for Type A scores attained significance. Multivariate analysis for male subjects showed an independent relationship between Type A behavior and CHD among white-collar workers between the ages of 45 and 64. However, the association fell short of significance among blue-collar workers (p = .07).

It is important to note that several recent investigations have failed to demonstrate a predictive relationship between Type A behavior and coronary heart disease. Negative results were obtained in the Honolulu Heart Project (Cohen & Reed, in press), which examined the relationship between JAS scores and CHD in a sample of men of Japanese descent--a group characterized by a low incidence of coronary heart disease. Other prospective research reporting null results focused on populations of high risk individuals, for example, smokers with high blood pressure and elevated serum cholesterol levels (Shekelle et al., 1983).

On balance, the epidemiologic evidence is consistent in demonstrating that Type A behavior is a risk factor for coronary heart disease, but only in population-based studies. The data are strongest for white-collar men, since both the WCGS and Framingham Heart Study detected a reliable association among this group. The available data do, however, indicate that Pattern A is also predictive of coronary heart disease among housewives and employed women. Type A behavior does not appear to be a risk factor among extremely low- and

high-risk individuals.

Coronary artery disease. Pattern A also has been studied in relation to coronary artery disease (CAD). An autopsy study revealed evidence of greater coronary occlusion in SI-defined Type A's compared to B's (Friedman, Rosenman, Straus, Wurm, & Kositchek, 1968). The relationship between Type A behavior and coronary atherosclerosis also has been studied in living subjects through the use of angiographic procedures. Among studies employing the SI, three have yielded evidence of a positive association between Pattern A and severity of coronary artery disease (Blumenthal, Williams, Kong, Schanberg, & Thompson, 1978; Frank, Heller, Kornfeld, & Sporn, 1978; Williams et al., 1980), one has revealed a marginally reliable ($p < .07$) effect (Krantz, Sanmarco, Selvester, & Matthews, 1979), and three detected no relationship (Dimsdale, Hackett, Hutter, Block, & Catanzano, 1979; Krantz et al., 1981; Scherwitz et al., 1983). Also relevant here is a study by Kahn et al. (1982) which reported a positive association between SI A/B assessments and coronary atherosclerosis using a recently-developed non-invasive measure of arterial stenosis known as the thallium stress test.

A positive association between JAS A/B scores and severity of atherosclerosis was reported by Zyzanski, Jenkins, Ryan, Flessas, & Everist (1976). However, after recruiting additional subjects, reanalysis indicated no relationship between A/B scores and coronary artery disease (Silver, Jenkins, Ryan, & Melidossian, 1980). Krantz et al. (1979) found no relationship between JAS A/B scores and severity of atherosclerosis on initial angiographic examination. However, JAS-defined Type A's were more likely than Type B's to show

an increase in occlusion as detected by a follow-up angiogram conducted an average of 17 months after the first. The Blumenthal et al. (1978) study showed no association between JAS scores and coronary artery disease, while Dimsdale et al. (1979) found evidence of greater occlusion among JAS-defined Type B's as compared to Type A's.

The Bortner Rating Scale was employed in three angiographic studies, none of which detected a positive association between Type A behavior and atherosclerosis (Bass & Wade, 1982; Kornitzer et al., 1982; Pearson, 1983). Young and associates (Young, Barboriak, Anderson, & Hoffman, 1980; Young, Barboriak, Hoffman, & Anderson, 1984) studied Type A behavior and angiographically-documented coronary artery disease using a questionnaire measure that has not been linked to coronary heart disease, but does show moderate relationships with both SI and JAS assessments. Results indicated no evidence of more severe disease among subjects with high Type A scores.

The findings reviewed above do not document a reliable association between Type A behavior and coronary artery disease. In the case of the SI, there are about as many studies yielding null results as there are yielding positive resuults. Where Pattern A was assessed using the JAS, the data are weaker, with the majority of studies reporting no relationship or a reversal. Findings for the Bortner Rating Scale, as well as for the ad hoc questionnaire employed by Young and associates, are uniform in failing to show reliable A/B differences in atherosclerosis.

A null association between Type A behavior and atherosclerosis would suggest that Pattern A precipitates clinical CHD (i.e., angina,

myocardial infarction, sudden cardiac death) independently of a relationship with underlying arterial disease. However, such a conclusion must be considered premature, in the light of methodological difficulties inherent in angiographic studies. (Matthews & Haynes, 1984). The chief problem is that groups of patients referred for coronary angiography constitute highly select populations. Specifically, they are patients who are strongly suspected by their physicians to have significant disease. Perhaps as a consequence, angiography studies have tended to involve samples with a high prevalence of Type A subjects, a factor which is likely to reduce statistical power and limit generalizability of results. In any event, whatever the explanation, available evidence for an association between Pattern A and coronary artery disease must be considered equivocal.

Theoretical Issues

On the basis of research outlined above, it may be concluded that Pattern A (1) can be measured with adequate reliability, (2) bears an independent, predictive relationship with clinical manifestations of coronary disease, and (3) appears related to coronary atherosclerosis, the disease that may underly most forms of CHD. These observations indicate that substantial progress has been made since Friedman and Rosenman published their initial observations of Type A behavior some twenty-five years ago. Yet, some key questions remain unanswered: What is the status of Pattern A as a psychological construct? What are the mechanisms that account for the association between Type A behavior and CHD? Does modification of Pattern A represent a viable means of reducing coronary risk? Resolution of these issues will

require programmatic research guided by the development of a comprehensive theory of Type A behavior. To date, there have been only preliminary efforts in this direction (Glass, 1977; Matthews, 1982; Price, 1982).

Research pertinent to a theoretical understanding of Type A behavior, in addition to the epidemiologic work already discussed, falls into five general categories. The first is concerned with the convergent validity of the SI, JAS, and Framingham Type A Scale. The second involves efforts to show that Type A individuals behave in a manner consistent with the descriptive elements of Pattern A. The third examines the relationship between Pattern A behavior and biological responses that may be involved in the etiology and pathogenesis of coronary disease. The fourth consists of intervention studies designed to modify Type A behavior as a means of reducing coronary risk. The fifth represents research guided by conceptualizations of Type A behavior that go beyond mere description. The sections that follow review each of these areas of research.

Convergent validity of Type A measures. The rate of agreement between SI- and JAS-derived A/B classifications has ranged from a low of 42% for a sample of 60 male undergraduates (Scherwitz, Berton, & Leventhal, 1978) to a high of 89.5% for 419 WCGS participants (Jenkins et al., 1979). More typical are data indicating about 70% agreement (Kittel et al., 1978; MacDougall et al., 1979; Matthews, Krantz, Dembroski, & MacDougall, 1982), which reflect a product-moment correlation of about .30 (Chesney, Black, Chadwick, & Rosenman, 1981). The degree of association between the SI and Framingham Type A Scale

appears comparable to that involving the SI and JAS (Haynes et al., 1980; MacDougall et al., 1979). Correlations between the JAS and Framingham Type A Scale are high. Smith, Houston, and Zurawski (1983) report an r of .58, and Smith (1984), an r of .69.

Matthews et al. (1982) conducted a penetrating analysis of the relationship between the SI and JAS. Their results indicate that variance shared by these two measures involves an association between the Speed and Impatience factor of the JAS and self-reports of similar behaviors derived from the SI. Both dimensions are more strongly correlated with JAS A/B scores than with overall SI classification. Also related to JAS A/B scores, though not to SI assessments, was self-reported competitiveness. Structured Interview ratings were quite substantially correlated with vigorous speech stylistics, a high energy level, and evidence of hostility, all as manifested during the SI itself. The latter set of Type A characteristics were only weakly associated with JAS A/B scores.

The findings outlined above indicate that the principal tools for assessing Type A behavior--the SI and JAS--show a considerable lack of convergent validity. While most of the reported associations are statistically reliable, the magnitude of the relationship is quite small. The Matthews et al. (1982) study suggests that the SI and JAS may emphasize different aspects of a multifaceted behavioral domain. It is not clear where the Framingham scale might fit into this picture, but the available data indicate a closer correspondence with the JAS than with the SI. In any event, the foregoing observations suggest that findings associated with one Pattern A measure cannot be assumed to hold for the others. Consequently, research involving

these instruments will be reviewed separately in the remainder of this paper.

Documentation of the descriptive elements of Pattern A. Studies described earlier indicate that analysis of the behavior of Type A subjects undergoing the SI reveals a vigorous style of speech, easily aroused hostility, and a high energy level (Dembroski et al., 1978; Matthews et al., 1982). The self-report of Type A characteristics during the SI was less strongly associated with overall behavioral classification. Similar findings have been obtained in other research (Glass, Ross, Contrada, Isecke, & Rosenman, 1982; Matthews, Glass, Rosenman, & Bortner, 1977; Scherwitz, Berton, & Leventhal, 1977; Schucker & Jacobs, 1977). Indeed, both Scherwitz et al. (1977) and Schucker and Jacobs (1977) found that measures of Type A content were statistically independent of behavior pattern assessments. Thus, an examination of information derived from the SI provides little support for the assumption that Type A individuals exhibit behavioral components of the descriptive definition of Pattern A other than hostility, i.e., competitiveness, impatience, and achievement-striving.

Studies involving direct observation of SI-defined Type A's and B's outside of the interview situation are few and have examined disparate behaviors, including vocal style (Friedman, Brown, & Rosenman, 1969), reaction time (Abrahams & Birren, 1973), parent-child interaction (Glass, 1977), and physical exercise (Schlegel, Wellwood, Copps, Gruchow, & Sharrat, 1980). This work sheds little light on the behavioral correlates of SI assessments.

Research correlating SI classifications with self-report measures indicate that SI-defined Type A's describe themselves as more aggressive, dominant, and achievement-oriented than do their Type B counterparts (Caffrey, 1968; Chesney et al., 1981; Rahe, Hervig, & Rosenman, 1978). There is also evidence that SI A/B ratings are associated with dissatisfaction with work, life achievements, and family relations (Howard, Cunningham, & Rechnitzer, 1976, 1977; Howard, Rechnitzer, & Cunningham, 1975; Keegan, Sinha, Merriman, & Shipley, 1979; Waldron, 1978). However, the magnitude of all these relationships appears quite modest (Matthews, 1982).

What emerges from the research outlined above is a substantial dissociation between vigorous speech stylistics, manifest hostility, and a high energy level, on the one hand, and the self-report of competitiveness, impatience, and achievement-striving, on the other. It also would appear that the first set of behaviors, or what may be thought of as the stylistic and expressive features of Pattern A, are much more strongly associated with overall behavioral classifications than the descriptive, or content variables.

In contrast to the SI, the JAS has been the focus of a large number of studies employing direct behavioral observation. The majority of these focus on A/B differences in performance on cognitive or psychomotor tasks and, therefore, are most relevant to the achievement-striving component of Type A behavior. In general, JAS-defined Type A's appear to outperform Type B's in situations involving moderately difficult tasks and activities that require persistence or endurance (e.g., Carver, Coleman, & Glass, 1976; Carver, DeGregorio, & Gillis, 1981; Stokols, Novaco, Stokols, & Campbell, 1978). Type A's

also outperform B's on simple tasks under conditions involving external distraction (Matthews & Brunson, 1979, Experiments 2 and 3), and work more quickly on simple tasks in the absence of a deadline, but not when an explicit deadline is given (Burnam, Pennebaker, & Glass, 1973, Experiment 2). Type A's also set higher goals than B's when performing simple tasks, and persist in doing so despite failure to attain those goals (Snow, 1978).

Type B's (JAS-defined) outperform A's on tasks that require a broad focus of attention (Matthews & Brunson, 1979, Experiment 1), which appears to reflect an attentional style in which Type A's focus on central activities and ignore both secondary tasks and their own physical symptoms (Weidner & Matthews, 1978). Type B's also tend to outperform A's on tasks requiring slow, careful responses (Glass, Snyder, & Hollis, 1974, Experiment 1; Price & Clarke, 1978, Experiment 2), apparently a reflection of the greater impatience of Type A's. Further documentation of the impatience component of Pattern A comes from a study in which JAS-defined Type A's were systematically slowed down by a coactor while working on a joint decision-making task (Glass et al., 1974, Experiment 2). A similar finding was obtained by Van Egeren, Fabrega, & Thornton (1983). It also has been shown that Type A's perceive time to be passing more slowly than Type B's (Burnam et al., 1973, Experiment 1) and arrive earlier to a scheduled research session (Gastorf, 1980).

In a study relevant to the hostility component of Pattern A, Carver and Glass (1978) found that JAS-defined Type A's who had been provoked by a confederate subsequently delivered more intense electric

shocks to that confederate than non-provoked A's and both provoked and non-provoked Type B's. Van Egeren (1979a, 1979b) has shown that Type A's express greater hostility, aggressiveness, and competitiveness than Type B's in the context of a modified Prisoner's Dilemma game.

Self-report data provide additional documentation of the achievement-striving component of Pattern A as measured by the JAS. This evidence derives from studies of occupational advancement and recognition (Matthews, Helmreich, Beans, & Lucker, 1980; Mettlin, 1976; Waldron, 1978), athletic and academic honors (Glass, 1977), study habits (Ditto, 1982; Hicks, Lingen, & Eastman, 1979; Hicks, Pellegrini, et al., 1979; Waldron et al., 1980), and educational status (Waldron, Zyzanski, Shekelle, Jenkins, & Tannenbaum, 1977). Research utilizing standardized personality measures indicates that JAS A/B scores are associated with fear of failure (Gastorf & Teevan, 1980) and high resultant achievement motivation (Matthews & Saal, 1978), which is consistent with the survey data just mentioned. Other psychometric instruments showing significant associations with the JAS include measures of dominance, impulsivity, and activity level (Glass, 1977). The JAS was related to anger, tension, and depression in a study of coronary patients (Dimsdale, Hackett, Block, & Hutter, 1978). However, other research, involving healthy subjects, has failed to show an association with measures of anger, hostility, anxiety, and psychological distress (Chesney et al., 1981; DeGregorio & Carver, 1980; Glass, 1977; Glass & Contrada, unpublished data; Nielson & Dobson, 1980; Suls, Becker, & Mullen, 1981).

The research outlined above provides considerable support for the assumption that JAS Type A scores are associated with the behavioral

characteristics that comprise the descriptive definition of Pattern A. The evidence is stronger here than is the case for the SI. However, this is due, in large part, to the limited amount of behavioral research that has been conducted using the SI.

The Framingham Type A Scale has received minimal study in behavioral research. The limited data available suggest associations with self-report measures of marital conflict, concerns about aging, worrying, tension, anxiety, activity level, and a tendency to experience bodily sensations when angry (Haynes et al., 1978; Smith et al., 1983).

Biological correlates of Pattern A. The rational for studying the relationship between Type A behavior and biological responsivity is threefold. First, the identification of physiological and biochemical correlates of Pattern A is an important step in elucidating the mechanisms linking Type A behavior to CHD. Second, specification of the types of person-situation interactions that give rise to pathogenic responses in Type A individuals should contribute to the understanding of the psychological antecedents of Pattern A behavior. Third, knowledge concerning pathogenic mechanisms and psychological antecedents should facilitate the development of interventions aimed at reducing coronary risk.

Friedman (1978) summarizes the results of early studies in which subjects manifesting Pattern A or B in the extreme, as determined by the SI, were compared with respect to a number of biological parameters. Relative to Type B's, Type A's showed higher levels of adrenocorticotropic hormone (ACTH), a sectretion of the anterior

pituitary which activates the adrenal cortex. It also was found that Type A's excreted less cortisol than B's following the infusion of exogenous ACTH. Taken together, these findings suggest that Type A's may experience chronic hypersecretion of adrenal cortical hormones, resulting in a lack of adrenal reserve. In comparison to Type B's, Type A's also exhibited a reduced serum level of growth hormone both prior to and after arginine challenge, a hyperinsulinemic response to glucose challenge, higher serum triglyceride levels both before and after the ingestion of a high-fat meal, elevated levels of serum cholesterol, faster clotting times, and increased sludging of erythrocytes after eating. This latter set of findings also indicate excessive pituitary-adrenocortical activity, and all of the responses mentioned above could be involved in the progression of atherosclerosis.

Two words of caution are in order in evaluating the foregoing results. First, the research was conducted using small, highly select samples, and there have been few attempts to replicate. Consequently, the statistical significance of the findings is not firmly established. On the other hand, these studies did not, for the most part, involve attempts to link biological responses to psychosocial factors (e.g., "appropriately challenging and/or stressful circumstances") that presumably give rise to Type A behavior and, therefore, might be expected to potentiate biological responsivity. Consequently, if the results are replicable, they may underestimate the true magnitude of the association between Pattern A and the biological responses studied.

A second set of studies are those in which biological responses

of Type A's and B's were measured while subjects were engaged in their usual occupational or academic activities. Using the Structured Interview, Friedman, St. George, Byers, and Rosenman (1960) found that male Type A's excrete significantly more norepinephrine (but not epinephrine) than Type B's during a working day. However, De Backer et al. (1979) and Schlegel et al. (1980) were unable to replicate this finding. Manuck, Corse, & Winkelman (1979) found evidence of an association between the JAS and both systolic and diastolic blood pressure levels during the working day of a group of male attorneys. However, studies relating JAS scores to blood pressure measurements taken during the working day of industrial employees (Stokols et al., 1978) and during the academic year in a sample of college students (Waldron et al., 1978), yielded equivocal results. Caplan and Jones (1975) employed a four-item measure of Type A behavior contructed by Vickers (1973) in an investigation of subjective distress and heart rate responses associated with an impending computer shut-down. Unfortunately, the data were not analyzed in a manner permitting inferences with respect to the differential responsivity of Type A and B subjects.

The field research reviewed above is limited by a number of factors. First, there are few studies of this kind, with no one measure of Type A behavior appearing in more than three investigations. Moreover, variations in the populations studied and in the environmental conditions under which measures were taken make it difficult to compare results across studies. For example, the DeBacker et al. (1979) study was conducted in Belgium, where the

language difference may have affected SI assessments. In view of these and related methological considerations (see Glass & Contrada, 1984, and Wright, Contrada, & Glass, in press), it would be unwise to draw firm conclusions until more field work is done.

Laboratory research on Type A behavior and biologic responsivity is fairly extensive. The results of these studies will be reviewed below. However, some preliminary comments are in order. First, only those studies permitting sound inferences with respect to physiological elevations above baseline levels will be considered. Findings are excluded from consideration where procedures for obtaining baseline data were inadequate, statistical analyses inappropriate, or the study was otherwise methodologically flawed. Second, results for a number of measures will not be discussed because they have been used to infrequently (e.g., heart rate variability, cortisol), or are not obviously implicated in the pathogenesis of coronary disease (e.g., electrodermal activity, finger pulse volume). Third, the data will be described in terms of three levels of support for a reliable effect. Full support indicates that relevant statistical tests achieved the 5% confidence level, or better, with a preponderance of evidence in the study favoring such a conclusion. If A/B effects were marginal ($.05 < \underline{p} \leq .08$), or were reliable in certain experimental conditions, but not in other, apparently comparable conditions, only partial support was inferred. No support indicates that all A/B comparisons failed to approach significance.

Table 1 (see Appendix A) depicts studies in which Pattern A was assessed using the SI. These findings document a consistent association with physiologic reactivity. The data are nearly uniform

in the case of systolic blood pressure (SBP), where 6 of 7 studies produced at least some evidence for an A/B effect. Studies measuring plasma epinephrine are also consistent in this regard, with 4 of 5 yielding partial support or better. Results for heart rate (HR) and plasma norepinephrine are somewhat less consistently supportive, with, respectively, 4 of 7 and 3 of 5 studies reporting A/B effects. Findings for diastoilc blood pressure (DBP) are weakest, with only 3 of 7 studies obtaining positive results.

Table 2 presents studies involving the JAS. In contrast to the SI findings, these data provide little evidence for A/B differences in reactivity. Systolic blood pressure results, while the most consistent, are, nonetheless, equivocal. Three studies yielded A/B effects, while an equal number failed to do so. Evidence for DBP and HR differences is minimal. Only 1 of 5 and 3 of 9 of the reported findings were even partially supportive.

Each of the studies summarized in Table 3 employed both the SI and the JAS. Consequently, results for the two measures may be contrasted directly, unconfounded by differeences in degree of challenge, type of subject population, and methodological rigor associated with studies employing the SI alone as compared to those involving only the JAS (see Wright, Contrada, & Glass, in press). These experiments confirm the relationship between the SI and physiological reactivity, but provide almost no evidence for A/B effects using the JAS. The SI detected clear differences in 6 of the 7 studies, whereas the JAS yielded positive results only twice. As in the data summarized in Tables 1 and 2, A/B effects were evident most

often for SBP.

Table 4 summarizes research involving a variety of assessment procedures. Manuck, Craft, & Gold (1978, Experiment 2) included only subjects classified as either Type A or B by both the JAS and a questionnaire constructed by Sales (1969) which never has been linked to the incidence of coronary heart disease. A similar, combinatorial procedure, involving the SI and JAS, was used by Williams et al. (1982). While evidence of A/B differences was obtained in both studies, the assessment procedures used do not permit a determination of the independent predictive contributions of the individual Pattern A measures.

It will be recalled that, of the measures used in the remaining studies, only the Thurstone, Framingham, and Bortner scales have been linked prospectively to coronary heart disease. The Activity scale generated positive findings for all three cardiovascular variables in the single study in which it was used. By contrast, the Framingham scale yielded null results in three experiments, two of which produced reliable findings for the SI (cf. Table 3). The Bortner measure failed to show a relationship with cardiovascular reactivity in a single study. The remaining studies report a number of reliable effects. However, the results are of questionable relevance, in view of the uncertain validity of the measures from which A/B classifications were derived.

The results summarized above suggest the following generalizations. First, it is critical to take into account the method used to assess Type A behavior. Structured Interview assessments show a more consistent association with biological

reactivity than those based on the JAS. Other measures have appeared in too few studies to warrant firm conclusions, and for the most part, are of questionable validity with respect to the Type A concept.

Second, where assessments are based on the SI, A/B effects are most consistently obtained on measures of SBP and plasma epinephrine, somewhat less consistently for HR and plasma norepinephrine, and fairly infrequently in the case of DBP. This pattern of findings strongly suggests that the enhanced physiological responsiveness of Type A's is a result of hyperreactivity of the sympathetic-adrenomedullary system. With few exceptions (e.g., Williams et al., 1982), early work linking Pattern A to hyperactivity of the hypothalamic-pituitary-adrenocortical system (Friedman, 1978) has received little subsequent attention in the A/B literature. Consequently, the status of this relationship is uncertain.

Note that support for an association between Type A behavior and sympathetic reactivity is not necessarily compromised by inconsistencies in the HR data. Under certain conditions, HR acceleration ordinarily induced by sympathetic activity may be inhibited by parasympathetic influences (Obrist, 1981, pp. 54-56). Simlarly, weak evidence for DBP differences may be expected, because of the counteracting effects of two opposing vascular effects produced by sympathetic stimulation. Vasodilation in skeletal muscles, induced by beta-adrenergic activity, can offset the pressor effect associated with alpha-adrenergically-mediated vasoconstriction occurring elsewhere in the vasculature. Diastolic blood pressure may, therefore, show little change during states of sympathetic activation.

At the same time, elevations in SBP are likely to be in evidence, as they are due, in part, to increases in cardiac output produced by beta-adrenergic effects on the heart that do not influence DBP (Obrist, 1981, pp. 143-144). Therefore, data for the SI are consistent with hypotheses concerning the role of sympathetic responsiveness in mediating the association between Pattern A and coronary disease (e.g., Herd, 1978). More specifically, the pattern of findings for cardiovascular variables suggests a primarily beta-adrenergic response.

Third, although results for the SI are fairly consistent, the magnitude of reported associations is quite small. Houston (1983) notes that correlations between Type A behavior and various indices of physiological reactivity have ranged from -.13 to +.52, with a median of about +.30. Holmes (1983) also has commented on the modest effect sizes obtained in these studies. Limitations inherent in laboratory research may account, at least in part, for weak effects (Contrada, Wright, & Glass, in press). However, other work has shown that measures of cardiovascular reactivity obtained in the laboratory are highly stable, both across time (Manuck & Garland, 1980) and in response to different experimental tasks (Glass, Lake, Contrada, Kehoe, & Erlanger, 1983). Therefore, Pattern A may leave unexplained a substantial amount of reliable variance. This suggests that a consideration of variables other than Type A behavior should lead to improvements in the prediction of biological responses which may culminate in coronary disease.

The research reviewed above sheds little light on the nature of the situational parameters that elicit A/B differences in biological

reactivity. This is partially a result of the fact that the vast majority of studies have involved a similar experimental situation--subjects typically are exhorted to do their best on some cognitive or psychomotor task. This strategy focuses on the achievement-striving aspect of Pattern A, to the relative neglect of other characteristics.

It appears that performance challenges are most likely to produce A/B differences in biological reactivity where (1) subjects are instructed in a challenging manner (Dembroski, MacDougall, Herd, & Shields, 1979); (2) experimental tasks are moderately difficult (Gastorf, 1981); (3) external incentives for good performance are not provided (Blumenthal et al., 1983); (4) the subject is harassed by a competitor (Glass, Krakoff, Contrada, et al., 1980, Experiment 1).

Intervention studies. Several studies report attempts to modify Type A behavior using various psychological interventions (Jenni & Wollersheim, 1979; Rahe, Ward, & Haynes, 1979; Roskies, Spevak, Surkis, Cohen, & Gilman, 1978; Roskies et al., 1979; Suinn, 1975; Suinn & Bloom 1977). Although all of these investigations report reductions in Type A behavior among subjects in treatment groups, these findings will not be reviewed in detail, since a variety of factors render the results equivocal. Chief among these are (1) exceedingly small sample sizes; (2) failure in many cases to report tests of statistical significance; (3) exclusive reliance on self-report measures, most of which have not been validated as predictive of CHD incidence; (4) follow-up periods so brief as to militate against drawing conclusions regarding clinical significance.

Conceptual approaches to the study of Type A behavior. It was noted earlier that the A/B area suffers from a lack of a theoretical framework that would permit an integration of empirical work. This section reviews preliminary efforts at conceptualization.

(i) Component analysis. The objective of Component Analysis is to differentiate Pattern A into its constituent dimensions and identify the "coronary-prone core" that accounts for enhanced CHD risk among Type A individuals. This strategy stems from a study involving reanalysis of data from the WCGS (Matthews et al., 1977). Matthews et al. factor analyzed 44 content and stylistic cues derived from the SI, and found that 5 factors accounted for a substantial portion of the common variance. These were labelled Competitive Drive, Past Achievement, Impatience, Non-Job Achievement, and Speed. However, only two factors--Competitive Drive and Impatience--were associated with CHD incidence. Further analysis revealed that three items loading on the first factor accounted for the significant relationship with CHD: two reflecting vigorous speech stylistics, and one reflecting signs of hostility exhibited during the SI. The only item loading strongly on the Impatience factor that was reliably associated with CHD was one measuring self-reported irritability at having to wait on lines. Three additional items were found to discriminate between CHD and non-CHD cases. These pertained to competitiveness, the tendency to express anger outwardly, and the frequency with which anger is experienced. All of these items loaded on either the Competitive Drive or Impatience factors, but at levels below a criterion ($\pm$0.475) set prior to analysis. A consideration of all items found to be predictive of CHD suggests that the critical

components of Type A behavior are a vigorous style of speech, and the tendency to express irritation, anger, and hostility.

Note that the Type A components shown to be predictive of CHD in the Matthews et al. (1977) study are quite similar to those which are more closely related to the SI than to the JAS (Matthews et al., 1982). Moreover, these same characteristics appear most strongly related to cardiovascular reactivity in psychophysiological studies of Pattern A (e.g., Dembroski et al., 1978). It would appear, therefore, that the ability of the SI to detect hostility and speech stylistics unrelated to JAS scores may account for its more robust relationship with sympathetic responsiveness. A stronger linkage with pathogenic processes associated with sympathetic reactivity might, in turn, explain the superiority of the SI over the JAS in predicting coronary heart disease (Brand et al., 1978).

While Components Analysis has generated some interesting findings, it clearly is better characterized as an empirical tool than as a conceptual approach. It has not been used in conjunction with a theoretical framework to guide attempts to elucidate the subdimensions of Pattern A, to specify which of these are most likely to be associated with enhanced coronary risk, or to identify the psychological antecedents of Type A behavior. Nevertheless, an exploration of the factorial structure of a behavioral domain is of basic importance in the process of construct validation (Wiggins, 1973). Moreover, the identification of those dimensions most strongly associated with CHD of practical value in identifying prime targets for interventions aimed at reducing coronary risk.

(ii) Self-Involvement. This approach derives from a study by Scherwitz, Berton, & Leventhal (1978), who reported that Type A's who use many self-references (I, me, mine, etc.) during the SI show higher levels of cardiovascular reactivity than those who do not. There is evidence that individuals with acute self-awareness are more likely to be aggressive when provoked (Scheier, 1976), and to compare their task performance to internal standards of excellence (Carver, Blaney, & Scheier, 1979). To the extent that these standards are high, salient discrepencies between performance and goals may lead to excessive achievement-striving, frustration, and anger, and to the physiological responses that accompany these reactions. Recently, Scherwitz et al. (1983) demonstrated that self-referencing was reliably associated with the severity of atherosclerosis among subjects undergoing coronary angiography.

Empirical support for the basis assumptions of this approach is weak. First, Scherwitz et al. (1978) offer no evidence for the construct interpretation of self-referencing in terms of self-involvement, and Glass and Contrada (unpublished data) found no reliable associations between self-referencing and scores on the Self-Consciousness Scale (Fenigstein, Scheier, & Buss, 1975). Second, the psychophysiological findings reported by Scherwitz et al. (1978) were obscured by a number of methodological factors (e.g., inadequate baseline procedure), and could not be replicated by Glass (unpublished data). Finally, Krantz (1980) reported an inverse association between self-referencing and severity of atherosclerosis, calling into question the significance of the Scherwitz et al. (1978) finding.

Matthews (1982) criticizes the Self-Involvement hypothesis on

conceptual grounds. This argument has to do with the fact that self-referencing is viewed as having a moderating effect on the relationship between Pattern A and physiological reactivity. That is, Scherwitz et al. (1978) hypothesize that the self-involvement dimension distinguishes those Type A's who show substantial elevations in sympathetic response from those who do not, while having little effect on the responsivity of Type B's. Therefore, Matthews argues, the Scherwitz et al. work does not attempt to specify the psychological dimensions that underly Type A behavior, but merely purports to identify a psychological factors that potentiates the effects of Pattern A upon sympathetic activation.

It may be argued that this feature of the Self-Involvement hypothesis represents an advantage, rather than a shortcoming. Recall that Pattern A appears to account for only a modest proportion of between-subjects variability in biological reactivity. It is possible, therefore, that theorizing along the lines proposed by Scherwitz et al. (1978) may lead to increased precision in the prediction of physiological and biochemical responses, as well as to the identification of those Type A individuals most likely to develop CHD. Moreover, research linking Pattern A with psychological processes that moderate its effects should contribute to an understanding of the construct validity of the Type A variable. Nevertheless, it should be reiterated that available empirical support for the Self-Involvement hypothesis is equivocal, at best.

(iii) Uncontrollability. Glass (1977) hypothesized that the accelerated pace, achievement-striving, impatience, and hostility of

the Type A individual may reflect a style of coping characterized by attempts to assert and maintain control over stressful events. Glass suggested further that, if efforts to master stressful events meet with failure, Type A's may be expected to give up and behave in a helpless manner (Seligman, 1975). Therefore, brief exposure to a psychological stressor accelerates the Type A individual's efforts to gain control, as manifested by behavioral hyperresponsiveness, whereas prolonged exposure leads to a decrement in such behavior, or hyporesponsiveness.

The Uncontrollability hypothesis also suggests a mechanism whereby Type A behavior may increase coronary risk. Glass (1977) proposed that behavioral hyperresponsivenss is accompanied by activation of the sympathetic-adrenomedullary system, which, as noted earlier, is associated with a variety of physiological and biochemical changes that may promote atherogenesis and precipitate clinical CHD. Glass also proposed that behavioral hyporesponsiveness is accompanied by a shift to parasympathetic dominance, and called attention to earlier speculations suggesting that abrupt shifts between sympathetic and parasympathetic influences may provoke ventricular arrhythmias and possibly sudden cardiac death (Engel, 1970; Richter, 1957).

Suppport for the Uncontrollability hypothesis derives from a number of sources. Results consistent with the hyperresponsiveness portion of the model were generated in a series of studies in subjects who had been classified as Type A or B on the basis of JAS scores were given brief exposure to either controllable or uncontrollable outcomes (Glass, 1977). Controllability was manipulated in a number of ways. For example, Krantz and Glass (reported in Glass, 1977)

exposed subjects to a series of noise bursts. Subjects in an escape condition could terminate or avoid each burst by manipulating a set of switches, whereas those in a No Escape coindition could not. In a second study, Krantz and Glass (reported in Glass, 1977) manipulated control by giving subjects either contingent or noncontingent reinforcement on a concept formation task. A third type of control manipulation (Pennebaker & Glass; Matthews & Glass; both reported in Glass, 1977) involved having subjects perform a button-pressing task under one of two different reinforcement schedules. Under a variable reinforcement schedule, there is no immediately discernable contingency between responding and reinforcement (in this case, activation of an apparatus that delivered a coin to the subject), whereas such a contingency is readily perceived under a fixed ration schedule.

In all four studies, enhanced performance among Type A subjects exposed briefy to uncontrollable outcomes was taken as evidence of hyperresponsiveness. In the first study conducted by Krantz and Glass, these data were generated in a test phase involving a reaction time task in which an emphasis was placed on speed of response. By contrast, the test phase of the second Krantz and Glass experiment involved a task which required a slow rate of responding. In studies involving reinforcement schedules, performance on the button-pressing used to manipulate controllability was employed to test predictions regarding hyperresponsiveness. In this manner, support for the model received conceptual replication, at least insofar as control manipulations and performance measures varied across the four studies.

Similar procedures were used to test the hyporesponsiveness portion of the Uncontrollability model (Krantz, Glass, & Snyder, 1974, Experiment 1; Hollis & Glass, reported in Glass, 1977). The chief difference was that exposure to uncontrollable outcomes was prolonged to a degree comparable to inductions employed in the learned helplessness literature (Seligman, 1975). Another difference was that variations were introduced in the degree of salience of uncontrollable outcomes (e.g., loudness of noise bursts, emphasis with which noncontingent reinforcement was delivered).

The results of these studies were complex. Where salience was high, the expected pattern of hyporesponsiveness was found among Type A's exposed to uncontrollable outcomes. However, under moderate salience, Type B's exhibited hyporesponsiveness, whereas Type A's did not. Subsequent research was conducted to clarify the role of salience in moderating the effects of uncontrollability among Type A and B subjects. These studies indicated that Type A's do, indeed, exhibit behavioral hyperresponsiveness, followed by hyporesponsiveness, when exposed to uncontrollable outcomes, but only where response-outcome noncontingency is highly salient. Under conditions of low salience, the picture is reversed, and Type B's exhibit the hyperresponsiveness-hyporesponsiveness sequence.

A second set of studies pertinent to the Uncontrollability notion involve paradigms used in the study of psychological reactance (Brehm, 1966). Reactance is aroused when an important behavioral freedom is threatened or lost. Therefore, it may be expected that Type A's, to the extent that they are more motivated to control their environment than Type B's, will show greater evidence of reactance under

appropriate eliciting conditions.

The foregoing predictions were supported in a series of studies reported by Carver (1980). Carver (1980, Experiment 1) found that JAS-defined Type A's perceived greater coerciveness in a persuasive communication than did their Type B counterparts. It also was found that male Type A's showed more reactance than male Type B's, in the form of greater attempts to resist persuasion, a result that was not observed among females (Carver, 1980, Experiments 2 & 3).

Rhodewalt and Comer (1982) employed the choice elimination paradigm (see Brehm, 1966) in a study of reactance in subjects classified as Type A or B on the basis of JAS scores. The experimental procedure involved having subjects evaluate a series of paintings, with subjects in a Choice Elimination condition led initially to believe they could have their preferred painting as a gift, only to learn later that one of them (the one rated third-best by the subject) would not be available. Reevaluations of the paintings revealed evidence of reactance, as reflected in an increase in ratings of the eliminated choice alternative, only among Type A's. This finding was replicated by Rhodewalt & Davison (1983), who employed nearly identical procedures.

Smith and Brehm (1981) examined the influence of the Type A individual's motivation to master potentially uncontrollable events upon attributional processes. After observing a target person participate in a Prisoner's Dilemma game with another individual, subjects either were led to expect that they would be engaging the target in a subsequent game, or were given no such expectation. It

was predicted that increased motivation to succeed would lead Type A's to exaggerate the amount of dispositional information they believed they could infer from observing the behavior of a future opponent. Such a belief, it was assumed, would produce increased confidence about predicting the target's behavior and thus increase perceived control over the outcome. The results supported this expectation when behavior pattern classification was based on the Hard-Driving subscale of the Student JAS. Data for the A/B scale were patterened similarly, but failed to achieve statistical significance.

Further evidence suggesting that Type A's are more concerned with controlling the environment than Type B's comes from two studies of factors affecting the relinquishment of control (Miller, Lack, & Asroff, 1983; Strube & Werner, in press). In these experiments, subjects received feedback concerning their own performance, as well as that of a partner, after working on an initial task. Subjects then were given the option to perform a second, similar task, or to allocate responsibility for performing the second task to their partners. Critical conditions in this paradigm are those in which initial feedback indicates that subjects' performance was inferior to that of their partners. In both experiments, Type A subjects (so-classified on the basis of JAS scores) showed a greater reluctance to relinquish control to a superior partner than was shown by their Type B counterparts.

Still another study bearing on the Uncontrollability hypothesis was reported by Dembroski, MacDougall, & Musante (1984). Subjects were administered the JAS, Rotter's Internal-External (I-E) Locus of Control Scale, and the Burger and Cooper (1979) Desirability of

Control Scale. They also were given the SI, from which was derived a 4-point overall A/B rating, as well as a score (labelled Clinical Ratings) reflecting signs of hostility, vigorous speech stylistics, and a high energy level (see Matthews et al., 1982). All three A/B measures were reliably associated with Desirability of Control scores (*r*'s = .37 for the JAS, .24 for theSI, and .25 for Clinical Ratings). Structured Interview assessments and Clinical Ratings were unrelated to I-E scores, whereas the JAS was (*r* = -.44), reflecting an association between internality and JAS scores in the Type A direction.

Thusfar, Glass' (1977) Uncontrollability model has been considered only in the context of behavioral research. There have been few studies in which attempts have been made to link uncontrollability to the physiological and biochemical hyperresponsiveness of Type A's. This work will not be reviewed in detail; suffice it to state here that the results have either been mixed (Contrada et al., 1982) or obscured by methodological problems (Cornelius & Averill, 1980; Lovallo & Pishkin, 1980). In any case, the data base is too limited to permit strong conclusions. There also has been a preliminary effort showing that Type A's are most likely to develop coronary heart disease following the occurrence of uncontrollable and stressful life events (the Houston Study, reported in Glass, 1977). However, the retrospective nature of the design of this study, and the need for replication, makes it unwise to make strong inferences.

The research reviewed in this section provides a reasonable

amount of support for Glass' Uncontrollability hypothesis. Some of the work is, of course, open to alternative explanations. For example, many of the findings reported in Glass (1977) can be taken to indicate that Type A's respond to task failure with enhanced efforts to do well on a subsequent task as a means of reconfirming their abilities. Viewed in this manner, behavioral hyperresponsiveness merely provides documentation of the hard-driving achievement-oriented quality of Type A behavior. However, the convergence of these findings with those generated in the reactance studies, and with the correlational data reported by Dembroski et al. (1984), is not readily explained in these terms.

Nevertheless, there is a clear need to address some limitations in the support for the Uncontrollability model. A major problem is that virtually all of the research has involved the JAS. With the exception of the Dembroski et al. (1984), there is little evidence that the SI measures a motivation to control the environment. Moreover, there are no data bearing upon a key assumption of the model, namely, that control motivation underlies the impatience, hostility, and time-urgency of Type A individuals, in addition to their hard-driving approach to cognitive and psychomotor tasks. Still another question concerns the meaning of results indicating that, depending upon the salience of response-outcome noncontingency, Type B's may exhibit behavior quite similar to that of Type A's. There is also a need for research relating uncontrollability to the biological hyperractivity of Type A's, and for replication of the Houston Study.

(iv) A Psychobiological approach. An implicit assumption in the A/B literature is that overt manifestation of Type A behavior arises

from a psychological substrate, with biological responsiveness occurring either as a direct consequence of the behavioral response, or as an additional manifestation of the underlying psychological process that is correlated with but causally independent of the behavioral response (Krantz & Durel, 1983; Matthews, 1982). An alternative, though not necessarily incompatible view is that physiological reactivity may be causally antecedent to Type A behavior. This possibility draws support from two studies in which Type A's showed greater blood pressure reactivity than B's while subjects were under anesthesia (Kahn, Kornfeld, Frank, Heller, & Hoar, 1980; Krantz, Arabian, Davia, & Parker, 1982), and from research suggesting that the intensity of Type A behavior may be reduced through pharmacological blockade of sympathetic beta-adrenergic activity (Krantz, Durel, et al., 1982; Schmeider, Freidrich, Neus, Ruddel, & Van Eiff, 1983). These findings have led Krantz and associates (Krantz & Durel, 1983; Krantz, Durel, et al., 1982) to propose a psychobiological model in which Pattern A is viewed as jointly determined by (1) sympathetic a reactivity possibly arising from an underlying constitutional factor, and (2) feedback mechanisms whereby peripheral changes are translated into Type A behavior via central nervous system processes. the implications of this reasoning for understanding Type A behavior are manifold. The model is noteworthy in that it specifies much more precisely than other approaches the nature of processes that may underly the association between Pattern A and biological reactivity.

CHAPTER IV

STATEMENT OF THE PROBLEM

A distillation of the research reviewed in the preceding chapter suggests the following empirical generalizations. The principal tools for assessing Pattern A exhibit some covariation, but seem to emphasize different aspects of a fairly broad behavioral domain. Associated with Type A behavior is a tendency to exhibit biological hyperreactivity under conditions where subjects are challenged to do well on cognitive and psychomotor tasks. This relationship is best established for Pattern A characteristics assessed by the SI, and for dependent measures reflecting heightened activity of the sympathetic-adrenomedullary system. Research concerned with modification of Type A behavior is in its infancy, and the results obtained thusfar are equivocal.

Empirical documentation of the descriptive elements of Pattern A yields support for the substantive validity of the Type A construct (Loevenger, 1957). Attempts to go beyond mere description have been limited. However, taken together, the four approaches outlined earlier provide a programmatic statement to guide future research. The Components-Analysis approach (Matthews et al., 1977) highlights the need to explore further the factorial structure of the domain of Type A behavior. Such an exploration bears upon what has been referred to as the structural component of construct validity (Loevenger, 1957). It is remarkable that, to date, there has not been a simultaneous, item-level factor analysis of the SI, JAS, and

Framingham Type A Scale. Multivariate work of this kind should facilitate the delineation of the unique and common components of the various instruments for assessing Pattern A (Matthews et al., 1982), and lead to more refined measurement of those components.

Research on Pattern A and Self-Involvement (Scherwitz et al., 1978) calls attention to the importance of studying Type A behavior in the context of other aspects of personality. In addition to elucidating psychological processes that may underly Pattern A, it is critical to specify dispositional variables that interact with Type A behavior. Elaboration of associations between a given measure and related behavioral variables, or what has been referred to as the nomological network, constitutes the external component of construct validity (Cronbach & Meehl, 1955).

The nomological network associated with a psychological construct also involves relationships with situational variables. This aspect of construct validity is addressed by the Uncontrollability model (Glass, 1977), which represents an attempt to specify the nature of those person-situation interactions that give rise to Pattern A. The Type A concept emphasizes the role of "appropriately challenging and/or stressful circumstances" in producing Type A behavior. Glass' work suggests that concepts employed in the study of psychological stress may permit a more precise specification of the meaning of these terms. For example, the reactions of Type A's when confronted by stressful events might be conceptualized in terms of the process of secondary appraisal (Lazarus, 1966) whereby the individual assesses his or her ability to cope with--or control--threatening situations.

In the case of a construct related to physical illness, research must also examine the nature of processes that link the variable to pathophysiological processes underlying disease. The Components-Analysis and Self-Involvement approaches are silent on this matter. Glass (1977) addresses this issue by suggesting that the biological correlates of behavioral hyperresponsiveness and hyporesponsiveness may reflect the operation of the same central nervous system mechanism. The peripheral feedback hypothesis of Krantz and Durel (1983) goes further by specifying how such a mechanism might operate to integrate behavioral and biological responses.

While the research directions outlined above are framed in terms of their implications for the theoretical understanding of Type A behavior, they also address an issue having to do with the epidemiologic importance of Pattern A. Despite statistically reliable associations with CHD incidence, the established measures of Type A behavior identify as coronary-prone many individuals who do not develop the disorder (Krantz et al., 1982). In other words, the magnitude of the relationship is quite modest. It should be noted that this lack of epidemiologic specificity is also characteristic of biomedical risk factors for CHD, no one of which, by itself, is notably superior to the Type A variable in this regard (Brand, Rosenman, Sholtz, & Friedman, 1976). Nevertheless, it would seem worthwhile to explore the possibility of improving the predictive powers of Pattern A.

It may be seen that these conceptual approaches to understanding Pattern A as a psychological construct also speak to the issue of epidemiological specificity. The Component-Analysis approach does so

by seeking to identify those facets of Pattern A that are most strongly associated with CHD. By refining the measurement of the "coronary-prone core" of Type A behaviors, it should be possible to identify with greater accuracy those individuals at risk for disease. Integration of Pattern A research with that concerned with other psychosocial variables, as exemplified by the work on Self-Involvement, also may facilitate the prediction of CHD. It may be found, for example, that the relationship between Type A behavior and disease is moderated by other aspects of personality. The investigation of possible situational determinants of Type A behavior, such as uncontrollable stressful events, also has epidemiological implications, since it may be the case that those Type A individuals most frequently exposed to such situations are at greatest risk for coronary disease. Finally, an understanding of the causal mechanisms underlying the association between Pattern A and biological reactivity may reveal factors other than Type A behavior, such as constitutionally-based sympathetic responsiveness, that contribute to cardiovascular dysfunction.

Ultimately, any proposed means of improving precision in the prediction of coronary disease must be tested in prospective, epidemiologic investigations. However, there are much less-costly ways of exploring the utility of new approaches. One strategy involves small-scale, cross-sectional studies in which patient groups are compared to controls with respect to the putative risk-enhancing variable. This was done in early research on Type A behavior (e.g., Caffrey, 1968). Another approach involves research concerned with

biologic responses that may be related to mechanisms underlying disease. For example, hypotheses concerning the interaction of genetic and environmental factors in essential hypertension gain support from psychophysiological studies in which subjects with a family history of the disorder have exhibited heightened cardiovascular responses when required to cope in an active manner with stressful stimuli (Obrist, 1981).

The research described below takes the latter approach in an initial investigation of two factors that may moderate the relationship between Type A behavior and biological hyperresponsivity. The first factor consists of subjective reactions, such as the performance strategies, attributions, and affective responses of individuals as they cope with demanding circumstances. The second is the Hardy personality, a composite of psychological attributes which appear to buffer against the illness-inducing effects of psychological stress (Kobasa, 1982b).

Pattern A and the subjective effects of psychological stress. A study by Brunson and Matthews (1981) addressed an issue raised by the controllability experiments by Glass and associates (Glass, 1977). It will be recalled that, under conditions where the uncontrollable stressor was only moderately salient, Type B's exhibited a pattern of behavior quite similar to that exhibited by Type A's under conditions of high salience. Brunson and Matthews sought to examine the possibility that the similar behavioral responses of A's and B's under the aforementioned conditions might represent qualitatively different psychological processes. Type A and B subjects, so-classified on the basis of JAS scores, were required to work on four solvable and then

four insoluble concept formation problems under conditions of either high or low salience. In addition, subjects were instructed to "think aloud" while working on the problems. Verbalizations generated in this manner were tape-recorded and transcribed. A content analysis was conducted in order to assess subjective reactions to uncontrollability.

The results indicated that, during exposure to salient uncontrollability, Type A's reported using problem-solving strategies that could not lead to a solution (were one possible), attributed their failure to lack of ability, and expressed frustration and annoyance with their plight. In contrast, Type B's in the moderate-salience condition reported using problem-solving strategies that were unsophisticated but could lead to a solution, and attributed failure more often to task difficulty than to lack of ability. Moreover, while they expressed some negative affect, Type B's in the moderate-salience group were more likely than high-salience A's to report boredom, as well as to express optimism about performing well. Thus, different psychological states may underly the similar performance of Type A's exposed to highly salient uncontrollability and Type B's exposed to moderately salient uncontrollability.

These results are at variance with Glass' (1977) research in which Type A's and B's showed no difference in their subjective reactions to stressful situations. However, other research, described earlier, indicates that such differences do occur (e.g., Carver, 1980, Experiment 1; Smith & Brehm, 1981). One implication of these findings is the possibility that differences in the coping behavior of Type A's

and B's may be a result of perceptual effects, rather than (or in addition to) being the manifestation of a response style (Glass, 1977).

The Brunson and Matthews (1981) research also has implications for the psychophysiological study of Type A behavior. It will be recalled that the association between Pattern A and sympathetic reactivity, while reliable (at least in the case of the SI), leaves unexplained a considerable portion of between-subjects variability (Houston, 1983). The manipulation of situational factors, in the context of procedures involving performance challenges, has proved a singularly unsuccessful means of addressing this problem (Wright et al., in press). An examination of the performance strategies, attributions, and affect of subjects as they perform a demanding task may lead to increased precision in the prediction of biological reactivity. Specifically, it might be expected that those Type A's (and possibly B's) who pursue ineffectual strategies in attempting to master uncontrollable circumstances, and who attribute their failure to control to lack of ability, are those most likely to exhibit behavioral hyperresponsiveness and concomitant elevations in sympathetic activity.

The foregoing line of thought suggests that it would be useful to conduct a conceptual replication of the Brunson and Matthews (1981) study in the context of a psychophysiological investigation of Type A behavior. Confirmation of the Brunson and Matthews findings would support the notion that the aggressive coping behavior of Type A individuals is related to a characteristic style of appraising stressful events. In addition, a concomitance between subjective

effects and cardiovascular response would suggest that A/B differences in the appraisal of demanding situations may contribute to the biological hyperreactivity of Type A individuals.

Pattern A and Hardiness. Kobasa (1982b) defines Hardiness as a personality composite consisting of commitment (versus alienation), control (versus powerlessness), and challenge (versus threat). Commitment implies a sense of positive involvement with oneself and one's social milieu. Control indicates the belief that one can influence the outcomes one experiences. Challenge refers to a tendency to perceive life changes in a positive way, that is, with interest, curiosity, and optimism.

Hardiness has been studied in a series of retrospective life-events studies (Kobasa, 1979; 1982a; Kobasa, Maddi, & Courington, 1981; Kobasa, Maddi, & Puccetti, 1982; Ouellette Kobasa & Puccetti, 1983), and in one prospective investigation (Kobasa, Maddi, & Kahn, 1982). This research provides substantial support for the notion that Hardiness buffers against the illness-inducing effects of life stress. Among those individuals reporting considerable recent life change, those with low Hardiness scores were most likely to develop somatic disease.

Recently, both Hardiness and Type A behavior were investigated in a retrospective study of life change (Kobasa, Maddi, & Zola, 1983). Pattern A, as measured by the JAS, was unrelated to scores on the Hardiness measures. More significantly, it was found that Type A behavior and Hardiness exerted a synergistic effect on health. Those subjects experiencing considerable life change who had high JAS scores

but were low in Hardiness reported the greatest amount of somatic illness.

The findings obtained by Kobasa et al. (1983), although preliminary and only marginally significant, are quite provocative. Taken together with other research cited above, they strongly suggest that Hardiness provides a source of resistance against the effects of psychological stress, perhaps especially among subjects who are otherwise most susceptible (e.g., Type A's). Moreover, the Kobasa et al. data are in accord with other findings (e.g., Stout & Bloom, 1982) suggesting that Pattern A may be associated with enhanced risk for somatic disorders other than coronary disease. The dependent measure employed in this study, the Seriousness of Illness survey (Wyler, Masuda, & Holmes, 1968), includes items referring to a variety of medical conditions. Evidence concerning the biological correlates of Pattern A also supports the plausibility of such associations (Review Panel, 1981).

Clearly, replication of the Kobasa et al. (1983) study is in order, preferably using a prospective design and controlling for any variations in initial health status that might be associated with Type A behavior and/or Hardiness. Nevertheless, if the results are assumed, tentatively, to be reliable, two additional research issues present themselves: (1) Through what biological mechanisms does Hardiness exert an ameliorating influence upon stress-induced illness? (2) Through what psychological processes does Hardiness influence these biological responses?

It will be recalled that two neuroendocrine systems appear to represent the most biologically plausible mechanisms whereby

psychosocial factors influence somatic health, these being the sympathetic-adrenomedullary system and the hypothalamic-pituitary-adrenocortical axis (Cohen, 1980). To date, there has been no published research attempting to link Hardiness to measures reflecting either of these response systems. An examination of Hardiness in the context of a psychophysiological study of performance challenge is one means of exploring mediating mechanisms.

With respect to psychological processes, Kobasa's (1982b) descriptions of the Hardy personality strongly suggest that cognitive-perceptual factors work to reduce affective and biological responsiveness to life stress. Kobasa's theoretical orientation emphasizes the role of "conscious psychological processes by which persons efficiently recognize and act on their situations" (Kobasa, 1982b, p. 6). Thus, the Hardy individual's internal locus of control provides a basis for the expectation that demanding situations are manageable. A sense of commitment to self and others should enable the Hardy person to regard even uncontrollable stressful experiences in proper perspective. A tendency to view adverse circumstances as challenging, rather than threatening, suggests the operation of a characteristic style of appraising stressful circumstances in a manner that should short-circuit the stress response--potential positive outcomes are given more attention than negative ones.

It would seem, therefore, that the empirical association between Hardiness and relative immunity to stress-related illness, and a consideration of the nature of the Hardy personality as conceived by Kobasa (1982b), argue for an examination of the effects of Hardiness

upon subjective and biological concomitants of psychological stress. Moreover, the need to improve epidemiological precision, and questions of basic importance in developing a more theoretical approach to the study of psychological factors affecting somatic health, suggest that further attempts to integrate the study of Pattern A and Hardiness may prove fruitful.

To address these issues, a psychophysiological investigation was conducted which assessed the effects of Hardiness and Type A behavior upon affective and cardiovascular responses to a demanding task situation. Subjects who had undergone the Structured Interview and completed the JAS and questionnaires measuring the Hardy personality composite performed a difficult psychomotor task while verbalizing their thoughts and feelings. Periodic measurements of systolic blood pressure, diastolic blood pressure, and heart rate were taken throughout the experimental session. Following procedures described by Brunson and Matthews (1981), verbalizations were transcribed and coded for the report of performance strategies, attributions, and affective responses. Supplementary measures of these variables were obtained following task performance through the adminstration of a post-task questionnaire.

Hypothesis 1: Type A's will show greater cardiovascular reactivity than Type B's. This expectation has an empirical basis in the psychophysiological research reviewed earlier. It is derived from theory concerning the role of sympathetic-adrenomedullary activity in mediating the association between pattern A and coronary disease. Previous work, and a consideration of the dynamics of cardiovascular psychophysiology, suggest that reliable effects are most likely to be

in evidence for systolic blood pressure. Past research also indicates that this prediction can be made with greater confidence for Type A assessments based on the SI as compared to those derived from the JAS.

Hypothesis 2: Type A's, in comparison to Type B's, will show (1) less frequent use of effective performance strategies; (2) a greater tendency to attribute failure to internal factors such as lack of ability, with fewer attributions to external factors such as task difficulty; (3) a greater tendency to express frustration and annoyance. These predictions are based on the results reported by Brunson and Matthews (1981). They also derive from expectations concerning the role of cognitive appraisal in mediating the effects of demanding environmental events upon affective, behavioral and biological components of the stress response (Lazarus, 1966).

Hypothesis 3: Among Type A subjects, those scoring low on the hardiness measures will show the greatest cardiovascular reactivity. This prediction is based on the Kobasa et al. (1983) study suggesting that Type A subjects who lack hardiness are most likely to develop stress-induced illness. An interactive relationship between Pattern A and Hardiness in the prediction of somatic disease should be paralleled by a similar synergistic effect in the prediction of physiological responses that may culminate in disease.

Hypothesis 4: Subjects with low scores on the Hardiness measures, compared to those with high scores, will show less frequent use of effective performance strategies, will attribute failure more often to internal factors, and less often to external ones, and will express greater negative affect. This expectation is based on the

notion that the Hardy individual will appraise potentially stressful events in a way that short-circuits the stress response (Kobasa, 1982b).

Hypothesis 5: Cardiovascular reactivity will be highest among subjects giving greatest evidence of ineffective performance strategies, internal attributions for task failure, and negative affect. These predictions derive from expectations concerning the role of cognitive appraisal in mediating the effects of demanding environmental events upon affective, behavioral, and biological components of the stress response (Lazarus, 1966).

CHAPTER V

METHOD

Overview

The study was conducted in two sessions. During the first, subjects were administered measures of Type A behavior and Hardiness. The second session, conducted about two weeks later, presented subjects with a difficult mirror-tracing task with instructions to verbalize whatever thoughts and feelings might occur to them. Verbalizations were tape-recorded and transcribed for coding of performance strategies, attributions, and affective responses. Periodic measurements of blood pressure and heart rate were taken throughout the second session. Subjects then were given a questionnaire containing additional measures of cognitive and affective responses. A post-experimental interview and debriefing completed the second session.

Subjects

Participants were recruited from the undergraduate subject pool at the State University of New York at Stony Brook. Subjects received course credit for participation. Only male volunteers were solicited, since sex appears related to sympathetic responsivity (Frankenhaeuser, 1983) and, therefore, would introduce variability unrelated to factors of interest in this investigation. A total of 68 subjects participated in the study, although, as described below, sample sizes for certain statistical analyses were smaller as a result of missing data. Subjects ranged in age from 18 to 22 years, with a mean of

21.1.

Measurement of Pattern A and Hardiness

The principal measure of Type A behavior was the Structured Interview (SI), which was administered by the author, who was trained in the technique by R. H. Rosenman. The interviews were tape-recorded and reviewed by a trained auditor. Subjects also completed Form T of the Jenkins Activity Survey (JAS). The SI and JAS are reproduced in Appendix B.

Following procedures described by Maddi and Kobasa (1982), Hardiness was assessed as a composite of scores on 6 questionnaires (see Appendix B). The Alienation from work and Alienation from Self Scales of the Alienation Test (Maddi, Kobasa, & Hoover, 1979) provide negative indicators of commitment. The External Locus of Control Scale (Rotter, Seeman, & Liverant, 1962) and Powerlessness Scale (Maddi et al., 1979) provide negative indicators of control. The Security Scale of the California Life Goals Evaluation Schedule (Hahn, 1966) and the Cognitive Structure Scale of the Personality Research Form (Jackson, 1974) provide negative indicators of challenge.

Measurement of Cardiovascular Responses

Measurements of systolic and diastolic blood pressure (SBP and DBP) were obtained with an Arteriosonde 1216 (Roche). The compressing cuff and transducer were placed over the brachial artery of the subjects non-dominant arm. The monitor was located in an observation room adjacent to the experimental chamber. Visual observation of the subject was made via closed-circuit TV. A special indicator on the Arteriosonde monitor signals when a displayed reading might be in

error; where possible, measurement was repeated under these circumstances. When measurements could not be repeated, suspect readings were deleted.

Heart rate (HR) was monitored as digital pulsation using a photocell plethysmograph attached to the second finger of the subject's non-dominant hand. Readings were taken during the 30-sec interval beginning immediately after the compressing blood pressure cuff had deflated. A digital display presents HR values for the 30-sec period in bpm.

Experimental Task

The mirror-tracing task consists of a channel measuring one-quarter inch wide and one-quarter inch deep cut into a 24-inch X 24-inch wooden platform in the shape of a six-pointed star. Distance from the apex of one point to its opposite measures 12 inches. The sides of the channel are lined with conductive material wired to a six-inch stylus. Contact between the stylus and the sides of the channel completes an electric circuit powered by a 12-volt DC source. Completion of the circuit activates a buzzer. Adjoining one edge of the platform at a 90-degree angle is a second 24-inch X 24-inch wooden panel, on which is mounted a 12-inch X 12-inch mirror. Direct visual inspection of the star is prevented by a third, 14-inch X 14-inch wooden panel resting on 4 wooden legs at a height of 8 inches over the platform. The reflection of the star in the mirror can readily be observed by looking over the third panel.

Successful performance requires that the subject use the stylus to trace the star, guided only by its reflection, and without touching the sides of the panel. This is virtually impossible to do without

considerable practice, much less in the 5 minutes allotted to subjects in the present study. Two factors contributing to difficulty are (1) narrowness of the channel, and (2) the fact that mirror-images are reversed. The first factor makes it difficult to negotiate even the straight edges of the star's outline without touching the sides; the second leads to problems in deciding which way to turn at the corners.

Task selection was based on a priori considerations as well as on pilot work in which several tasks were compared. The mirror-tracing task commended itself for a number of reasons. First, the patience required to work at the task for any length of time, in combination with a deadline for task completion, were expected to engage the impatience and time-urgency of Type A individuals. Moreover, the task has face-validity as a measure of spatial ability and hand-eye coordination, and instructions described it as such and noted (falsely) that, on average, other students had done reasonably well (see below). These factors were expected to engage the achievement-striving and competitiveness of Type A's. Second, interviews with pilot subjects indicated that they experienced a variety of reactions to the task, ranging from anger and frustration, to fascination, lively interest, and boredom. Thus, doing well seemed to be of importance to some subjects, but apparently was of little concern to others. It was expected that this feature of the task would be conducive to the detection of individual differences in the appraisal of poor performance. Third, pretesting showed that the task generated blood pressure and heart rate responses ranging from small decrements to substantial evevations. This was seen as a factor that would

facilitate the detection of associations between behavioral measures and cardiovascular reactivity.

Procedure.

Subjects participated individually in both sessions. At the first, the subject was greeted by the author, who introduced him to the laboratory facility, had him sit at a desk in a small office, and briefly described the (ostensible) purpose of the study: to examine the effects of personality and information-processing style upon psychological and physiological correlates of mental activity. At this point, the subject read and signed a consent agreement (see Appendix B). The experimenter then administered the Structured Interview following standard procedures (Rosenman, 1978). After the interview, the experimenter administered the JAS and Hardiness questionnaires, which were given in an order individually randomized for each subject. An appointment for the second session then was scheduled, and the subject was thanked and dismissed.

The second session took place an average of 16.3 days after the first (SD = 5.1). A different male experimenter greeted the subject, escorted him to a sound-attenuated experimental chamber, and had him sit at a table. The experimenter reiterated the purposes of the study and had the subject sign a second consent statement (see Appendix B). A baseline period ensued, during which time subjects were asked to sit quietly and relax. Several popular periodicals were provided for perusual. Measurements of SBP, DBP, and HR were taken every two minutes, until SBP values remained relatively stable (± 5 mmHg) across 2 successive sample periods, after a minimum of 8 minutes had elapsed. Means for the final two readings on each cardiovascular

measure were taken as baseline values.

Following the baseline period, the experimenter re-entered the experimental chamber, placed the mirror-tracing task on the table, and gave the subject a single sheet of paper containing instructions (see Appendix B). The experimenter then left the room, explaining that any further communication would take place over an intercom system. The instructions described the mirror-tracing task as a measure of spatial ability and hand-eye coordination, and indicated that the subject was to attempt to complete at least one tracing, without activating the buzzer, within a 5-minute period. It was stated that "about 50%" of the subjects participating in the project had been able to this, and that the main concern of the investigators was that subjects give their best effort. The instructions went on to request that the subject "think out loud" while working on the task. The subject was encouraged to verbalize whatever thoughts and feelings he might experience, whether or not they were related to the immediate situation. It was explained that these verbalizations would be used to determine the effects of different styles of information processing upon the performance of tasks involving hand-eye coordination. The instructions asked the subject to indicate when he had finished reading, and fully understood what he had to do, by saying "ready."

On hearing the subject's ready signal, the experimenter activated a tape-recorder connected to the hidden microphone serving the intercom system from the experimental chamber, and then instructed the subject to begin working. Blood pressure and HR measurements were taken 5 seconds later, and every 60 seconds thereafter, for the next 5

minutes. After recording the final measurements, the experimenter instructed the subject to stop working, re-entered the experimental chamber, and administered the post-experimental questionnaire. Following completion of the questionnaire, the first experimenter conducted a post-experimental interview and a thorough debriefing.

Post-Task Measures

The post-task questionnaire (see Appendix B) included the state version of Spielberger's (1982) State-Trait Personality Inventory (STPI-S), which contains items comprising three subscales: anger, anxiety, and curiosity. Instructions requested that the subject respond with reference to his feelings while working on the mirror-tracing task. The anger and anxiety scales were used to assess subjective distress. The curiosity scale was expected to detect positive appraisals of the task situation. It contains items reflecting interest, the desire to explore, inquisitiveness, and the like.

In addition to the STPI-S, the post-experimental questionnaire contained a set of items written for purposes of the present study. These included three sets of items: (1) questions regarding the subject's perceptions of the experimental situation, for example, the significance of the research and the importance of doing well on the mirror-tracing task; (2) items concerning reactions to task performance, for example, the degree of challenge, stress, and boredom experienced while working on the task; (3) ratings of the degree to which the subject believed his performance was attributable to ability, effort, chance, task difficulty, and the experimenter (see Appendix B).

Post-experimental Interview and Debriefing

The post-experimental interview developed in our laboratory consists of a series of questions concerning the subject's reactions to all aspects of experimental procedure, i.e., physiological recording, questionnaires, tasks, and so forth. Initial questions are general and open-ended and encourage the subject to state anything that is on his mind. The questions then become more specific, and probe for suspicion concerning the true purpose of the study, failure to understand or follow instructions, and any untoward psychological reactions. The experimenter then conducts a thorough debriefing, instructing the subject with respect to the actual goals of the study and providing background information pertaining to theoretical issues being addressed. The rationale for each aspect of the procedure, particularly the deception concerning the difficulty of the task, is explained fully. After answering any questions, the experimenter asks the subject not to discuss any aspect of the study with others who might later participate. The subject is then thanked and dismissed.

Data Reduction and Analysis

Type A measures. Interrater agreement of classification for the SI was 75%. There were 11 B/X disagreements, 5 A/X disagreements, 1 A1/A2 disagreement, and no A/B disagreements. Intercorrelation of the 4-point SI ratings (A1 = 4; A2 = 3; X = 2; B = 1) made by the interviewer and auditor produced an r of .87, indicating an acceptable level of interrater reliabliity. The 4-point ratings were averaged to construct a continuous SI Pattern A measure for use in correlational and regression analysis. Where statistical procedures called for a

dichotomous measure, discrepant ratings were combined following procedures recommended by MacDougall et al. (1979): A1/A2 and A/X = A; B/X = B.

The JAS was scored using unit item weights. The sample mean was 7.0 (SD = 3.7), and the median, 6.0. Cronbach's (1947) formula for estimating internal consistency (coefficient alpha) yielded a value of .73, reflecting a marginally acceptable degree of inter-item homogeneity. Raw scores were employed in analyses requiring a continuous measure, and a median split was used to generate a dichotomous classification where necessary.

Hardiness measures. Table 5 (see Appendix C) presents internal consistency coefficients for each of the component measures of Hardiness. Only the the Powerlessness and External Locus of Control scales show acceptable levels of internal consistency (Cronbach's alpha's = .76 and .82).

In the prospective study described earlier, Kobasa et al. (1982) found that scores on the Cognitive Structure scale were unrelated to the other Hardiness measures. It was, therefore, excluded from their analyses, and has not been used in subsequent research by Kobasa and associates (e.g., Kobasa et al., 1983). Consequently, in the present study, intercorrelations among the component measures of Hardiness were examined prior to constructing the composite.

The data are presented in Table 6. As can be seen, coefficients involving the Cognitive Structure scale range from -.15 to +.03, and are uniformly lower than intercorrelations among the remaining scales, which range from +.16 to +.56. These results are in accord with those of Kobasa et al. (1982) in suggesting that the

Cognitive Structure Scale cannot be viewed as a measure of Hardiness. Consequently, it will be not be given further consideration in the present study.

Standard scores were generated for scales providing negative indicators of Commitment (the Alienation from Self and Alienation from work scales), Control (the Powerlessness and External Locus of Control scales), and Challenge (the Security scale). Since both Commitment and Control are measured by two scales, while Challenge is measured by only one, Security scores were doubled prior to summing the 5 scores to construct the Hardiness composite. (Kobasa et al., 1982). This continuous measure of Hardiness (Cronbach's alpha = .86) was used in regression and correlational analysis. A median-split was used where a dichotomous variable was required.

Cardiovascular measures. Change-scores were computed for SBP, DBP, and HR by subtracting the appropriate baseline value from each of the five measurements taken during the task. It is desirable to residualize change-scores with respect to baseline levels since even nonsignificant associations between initial values and responses to treatment can increase the Type I or Type II error rate (Kinsman & Staudenmayer, 1978; Wilder, 1969). An important assumption of this procedure is that the regression of change-scores onto baseline values does not interact with predictor variables (Cohen & Cohen, 1984). A series of multiple regression analyses indicated that this condition was met in the present study (p's > .20). Therefore, change-scores were residualized for baseline measures in all analyses reported in this paper.

Verbalizations. Verbalization data were missing for nine subjects. In four cases, apparatus failure interferred with tape-recording. All four had been classified as Type A by both SI and JAS; two were in the High Hardiness group and two were in the Low Hardiness group. The remaining five cases said nothing during task performance. Two were Type B (SI and JAS) and low in Hardiness, two were Type B (SI and JAS) and high in hardiness, and one was Type A (SI and JAS) and low in Hardiness. Thus, verbalization data was lost to an equivalent degree among subjects high and low in hardiness (n's = 4 and 5), but to a greater degree among Type B's as compared to Type A's (n's = 8 and 1).

Verbalizations were categorized following procedures described by Brunson and Matthews (1981). This involved having two raters independently read the transcripts and classify each clause into one of the following categories: (1) Statements of useful task strategies; (2) Statements of inappropriate approaches to the task; (3) Difficulty attributions; (4) Self-instructions; (5) Statements of positive affect; (6) Laughter; (7) Statements of negative affect; (8) Swearing (9) Positive prognostic statements; (10) Negative Prognostic Statements; (11) Task-Irrelevant Statements; (12) Positive evaluations; (13) Negative evaluations; (14) General evaluative concern; (15) Statements of task difficulty; (16) Statements of task ease (17) Physical symptoms.

Categories 1, 3, 4, 5, 7, 9, and 11 were derived from the Brunson and Matthews (1981) study. The rest were added on the basis of pilot data suggesting that they might occur with sufficient frequency so as to be of interest in the present study. Detailed

descriptions of the categories and of the instructions followed in performing the content analysis may be found in Appendix B.

Table 7 (column 1) presents means (averaging across the two raters) for each of the content categories. Column 3 of Table 7 presents correlations reflecting interrater agreement for each of the verbalization categories. As can be seen, 14 of the 17 coefficients were quite high, ranging from .81, to .98, and three were low to intermediate, ranging from .44 to .71.

Raw frequencies were adjusted for total amount of verbalization with the use of the Gottschalk-Winget-Gleser correction factor (Viney, 1983):

$$CF = 100/n,$$

where n = the number of clauses in the subject's transcript. For each verbalization category, the adjusted score (AS) is computed as:

$$AS = \text{Raw Score} \times CF$$

This adjustment expresses the incidence of each verbalization category in terms of its frequency per 100 clauses. Means for the adjusted frequency scores may be found in column 2 of Table 7. A square-root transformation was performed on these adjusted frequencies to normalize their distributions (Viney, 1983).

Statistical Analysis. The appropriate analytic procedure for a study involving multiple independent variables as well as multiple dependent variables, where both sets of variables are assessed by continuous measures, is a multivariate multiple regression (Kerlinger & Pedhazur, 1973). This approach has the advantage of avoiding the loss of information and statistical power which results from forcing

dichotomies upon continuous predictor variables (Cohen & Cohen, 1984). At the same time, the multivariate model avoids the inflation of experiment-wise error which occurs where correlated dependent measures are tested in separate, univariate analyses (Harris, 1975).

The main hypotheses of this study were evaluated in two series of multivariate regressions. The first used the 4-point SI rating as a measure of Type A behavior, and the second employed JAS scores. Both series consisted of five separate analyses, each involving a different set of conceptually-related dependent variables. The first two sets involved measures taken during task performance: (1) residualized change-scores, representing baseline-free indices of reactivity for each of the three cardiovascular measures, and (2) verbalization categories, reflecting the report of performance strategies, affective responses, and attributions. The last three sets included measures obtained following task performance: (3) Post-experimental questionnaire items concerning perceptions of the task situation; (4) Post-experimental questionnaire items concerning reactions to task performance, plus the curiosity, anxiety, and anger scores from the State-Trait Personality Inventory; (5) Post-experimental questionnaire items concerning attributions for task performance.

The F-test employed to evaluate multivariate hypotheses was based on Wilks' lambda statistic (Harris, 1975). Significant univariate F-tests were considered reliable only where the corresponding multivariate test achieved the 5% confidence level or better. However, for heuristic purposes, all univariate tests were examined.

CHAPTER VI

RESULTS

Intercorrelations among Pattern A and Hardiness Measures

The SI and JAS showed a moderate degree of association, $r = .38$, $p < .01$. Intercorrelations between each Pattern A measure and scores on the the Hardiness questionnaires are presented in Table 8. Correlations between the SI and the component Hardiness measures are uniformly low and nonsignificant (r's ranging from -.19 to -.01), as is the coefficient involving the Hardiness composite ($r = -.15$, ns). The JAS shows a similar dissociation with Hardiness, except for a modest relationship with External Locus of Control ($r = -.31$, $p < .05$), indicating that subjects scoring in the Type A direction tend to be relatively internal in their generalized expectencies for control.

Cardiovascular Measures

Significance of task-induced elevations. It is of interest to determine whether the mirror-tracing task accomplished the purpose of eliciting significant elevations in physiological activity. For this reason, a series of one-way repeated-measures analyses of variance were conducted comparing baseline and task values for each of the cardiovascular measures. For purposes of this analysis, the 5 task readings were averaged to produce a single value for each measure. The relevant data are presented in Table 9. Task performance induced reliable increments in SBP, $F(1/67) = 145.37$, $p < .0001$. Subjects showed a mean change of +17.7 mmHg. Analysis of the DBP data yielded a similar effect, $F(1/67) = 158.48$, $p < .0001$). The average

DBP elevation was +12.7 mmHg. In contrast to the blood pressure data, HR showed no reliable elevation in response to task performance, $F < 1$. The mean increase was less than +1.0 bpm.

Intercorrelations among cardiovascular measures. Table 10 presents intercorrelations among change-scores (averaging across the 5 task readings) for SBP, DBP, and HR. As can be seen, SBP and DBP responses show a substantial association, $r = .51$, $p < .01$. By contrast, the correlation between SBP and HR, as well as that between DBP and HR, are low and nonsignificant (r's = .19 and .15, respectively.

Effects of Pattern A and Hardiness upon baseline data. Multivariate regression analysis of the baseline data yielded only a marginal term for the SI X Hardiness interaction, $F(3/62) = 1.92$, $p = .10$. Subsequent univariate tests revealed an SI X Hardiness interaction for SBP, $F(1/64) = 4.54$, $p < .04$. All other univariate effects were nonsignificant, p's > .07.

Table 11 presents baseline values for SBP, DBP, and HR for the four groups formed by crossing dichotomous SI ratings and Hardiness classification. As can be seen, SBP baselines among Type A's were higher for subjects high in Hardiness (M = 109.8 mmHg) than those with low Hardiness scores (M = 101.7 mmHg). By contrast, among Type B's, SBP baselines were higher among subjects with low as compared to high Hardiness scores (M's = 105.2 mmHg and 98.4 mmHg). Mean baseline values for DBP and HR were fairly homogeneous across the four groups.

Analysis of cardiovascular baselines employing the JAS revealed no reliable multivariate effects, p's > .20. The relevant data are

presented in Table 12. As can be seen, cell means for all three variables were quite simliar across the four groups.

Effects of Pattern A and Hardiness upon reactivity. Preliminary analysis indicated that reactivity on each of the cardiovascular measures showed no reliable changes over the five task readings, and that this pattern held irrespective of SI, JAS, and Hardiness scores (p's $> .20$). Consequently, a single index of reactivity was computed for each variable by averaging across the five change-scores after each had been residualized with respect to the appropriate baseline value. Multivariate regression analysis revealed significant terms for the SI main effect, $F(3/62) = 2.80$, $p < .05$, as well as for the Hardiness main effect, $F(3/62) = 3.11$, $p < .04$). The interaction term was not reliable, $F(3/62) = 1.59$, $p > .20$.

Subsequent analysis indicated that the SI effect was a result of significant univariate terms for SBP, $F(1/64) = 4.81$, $p < .04$, as well as for DBP, $F(1/64) = 7.61$, $p < .02$). The SI effect for HR fell short of significance, $F(1/64) = 2.84$, $p = .10$. Table 13 presents adjusted cell means. As can be seen, Type A's showed greater SBP elevations (marginal M's = +18.9 mmHg and +14.9 mmHg) and DBP elevations (marginal M's = +14.4 mmHg and +10.5 mmHg) than their Type B counterparts. The nonsignificant HR effect reflected a trend toward greater reactivity among Type A's compared to B's (marginal M's = +2.1 bpm and -1.6 bpm).

Univariate analysis revealed a significant Hardiness term only for DBP, $F(1/64) = 7.61$, p , .008. The data in Table 13 indicate that this result reflected greater change scores among scoring low in Hardiness as compared to those with high scores (marginal M's = +14.1

mmHg and +11.0 mmHg). The univariate Hardiness terms did not approach significance for either SBP or HR (*p*'s > .30), although cell means for both variables were in the expected direction (marginal *M*'s were 19.0 mmHg and 1.5 bpm for subjects low in Hardiness, and 15.0 mmHg and 0.9 bpm for subjects high in Hardiness).

Tables 14 through 16 present additional information from the univariate analyses. It can be seen that the reliable SI terms reflected modest effect sizes, accounting for 7.0% of the variance for SBP and 7.5% for DBP. The Hardiness effect for DBP was of comparable magnitude, involving 6.0% of the variance. It also can be seen that results for DBP included an SI X Hardiness interaction, $F(1/64) = 4.28$, $p < .05$, which accounted for an additional 5% of the variance. Inspection of the cell means presented in Table 14 indicates that this effect was a result of the relatively small DBP elevations of the Type B/High Hardiness group (+6.7 mmHg), which were lower than those for the other three groups (*M*'s ranging from +13.0 mmHg to +15.7 mmHg). None of the remaining univariate tests were reliable (*p*'s > .30).

Multivariate regressions involving the JAS yielded only a Hardiness effect, $F(3/62) = 3.06$, $p < .04$. This term duplicates the Hardiness effect described above, which reflected greater DBP elevations among subjects low as compared to high in Hardiness. In the univariate analyses, none of the terms involving the JAS approached significance (*p*'s > .10).

Verbalization Measures

Two 2 X 2 (Type A/B X High/Low Hardiness) analyses of variance

were conducted to determine whether Pattern A or Hardiness were associated with the amount of verbalization data produced by subjects. Results using the SI for A/B classification yielded a trend reflecting somewhat greater verbal output among Type A's (M = 15.5 clauses) as compared to B's (M = 11.0 clauses), $F(1/55) = 3.00$, $p < .09$). None of the remaining terms in the SI analysis, nor any of the effects in the analysis involving the JAS, approached statistical significance (p's > .20).

Multivariate regression analysis of the 17 verbalization categories revealed reliable terms for SI A/B assessment $F(17/39) = 3.66$, $p < .001$, Hardiness, $F(17/39) = 2.41$, $p < .02$, and the Type A/B X Hardiness interaction, $F(17/39) = 2.53$, $p < .01$). Results for the univariate tests are summarized in Tables 17 through 19.

Seven of the verbalization categories contributed to the Type A/B main effect. Cell means are presented in Table 17. Type A's exceeded B's in the frequency of self-instructions (M's = 12.7 and 5.6), task-irrelevant statements (M's = 3.6 and 0.1), and positive evaluations (M's = 8.5 and 4.6). Type B's exceeded A's in the frequency of symptoms (M's = 3.7 and 1.3), use of inappropriate approaches to the task (M's = 0.9 and 0.0), swearing (M's = 27.1 and 13.3), and laughter (M's = 4.4 and 0.6).

Three of the verbalization categories contributed to the Hardiness main effect. Cell means are presented in Table 18. Subjects with high Hardiness scores exceeded those with low scores in the use of inappropriate approaches to the task (M's = 0.7 and 0.0), difficulty attributions (M's = 1.0 and 0.4), and negative prognostic statements (M's = 3.4 and 1.2).

Five of the verbalization categories contributed to the Pattern A X Hardiness interaction. Relevant cell means are presented in Table 19. Results for two of the variables place qualifications on A/B main effects described above. The A/B difference for symptoms was carried mainly by Low Hardiness/Type B's, who reported more symptoms ($\underline{M}$ = 5.1) than subjects in the remaining groups ($\underline{M}$'s from 0.5 to 2.5). The A/B difference for inappropriate approaches to the task, on the other hand, was a result of a high frequency of verbalizations in this category among Type B's with high Hardiness scores ($\underline{M}$ = 2.3 versus $\underline{M}$'s from 0.0 to 0.1.

Three of the interactions qualify the Hardiness main effects. The interaction for inappropriate task approaches was just described. The greater number of difficulty attributions of Hardy subjects was particularly evident among those who were Type B ($\underline{M}$ = 1.4 versus $\underline{M}$'s from 0.4 to 0.8). Similarly, A high frequency of negative prognostic statements was observed chiefly among High Hardiness/Type B's ($\underline{M}$ = 8.6 versus $\underline{M}$'s from 0.6 to 1.9).

The remaining verbalization category showing a significant univariate interaction was that of negative affect. Among Type A's, verbalizations reflecting negative affect were in greater evidence among subjects who were high, as comparted to low, in Hardiness ($\underline{M}$'s = 6.6 and 1.1). The reverse was true among Type B's, where subjects low in Hardiness expressed negative affect more frequently ($\underline{M}$'s = 3.1 and 0.6).

Regression analysis involving the JAS yielded no significant multivariate ($\underline{F}$'s < 1) or univariate effects ($\underline{p}$'s > .20).

Post-Task Measures.

Perceptions of the task situation. Regression analysis of the first set of post-task measures, using the SI to measure Type A behavior, yielded no reliable multivariate (p's > .70) or univariate effects (p's > .08). In the analysis involving the JAS, the only multivatiate term to approach significance was that representing the Pattern A X Hardiness interaction, F(10/53) = 1.66, p = .11. Interactions involving three items account for this trend. Relevant means are presented in Table 20. Compared to Type A's with low Hardiness scores, A's with high Hardiness scores believed the experimenter was more fair (M's = 3.9 and 3.6). Means for the two Type B groups were more similar (3.9 and 3.8). The Type A/High Hardiness group also differed from their low Hardiness counterparts in feeling more confident in their initial expectations regarding task performance (M's = 3.5 and 2.8), and were more likely to believe that the task could be completed in five minutes (M's = 2.8 and 2.0). Among Type B's, differences between subjects scoring high and low in Hardiness were smaller (M's for initial expectations = 2.7 and 3.1; M's for the belief that the task could be completed in five minutes = 2.4 and 2.5).

Reactions to task performance. Regression analysis of the second set of post-task measures, using the SI to measure Type A behavior, revealed no reliable multivariate terms p's > .17. Two univariate effects emerged. Cell means are presented in Table 21. A reliable effect for the STPI Anger scale reflected higher scores among Type A's compared to B's (M's = 1.7 and 1.5). However, a near-reliable interaction indicated that the main effect was largely a result of low

anger scores among the Type B/High Hardiness group (M = 1.4 versus M's from 1.6 to 1.7).

Regression analysis of the second set of post-task measures, using the JAS to measure Type A behavior, also revealed no multivariate effects (p's > .18). Three of the measures did produce reliable or near-reliable univariate terms. Cell means are presented in Table 22. Type A/B main effects indicated that Type A's reported having less fun (M's = 2.4 and 2.6), feeling less challenged (M's = 3.4 and 3.7), and experiencing more anger (M's = 1.7 and 1.5) than their Type B counterparts.

Performance attributions. Regression analysis of the third set of post-task measures, using the SI to measure Type A behavior, yielded only one multivariate term approaching significance, a Type A/B main effect, F (5/60) = 1.96, p = .10. This was a result of a univariate A/B main effect (p < .05) indicating that Type A's attributed task failure to insufficient effort to a greater degree than Type B's (M's = 3.1 and 2.8).

Multivariate regression analysis of the third set of post-task measures, using the JAS to measure Type A behavior, also revealed a marginal Type A/B main effect, F(5/60) = 2.16, p = .07). This was a result of a marginal term (p = .11) indicating that Type A's attributed task failure to the experimenter to a greater degree than Type B's (M's = 1.3 and 1.1).

Relationship Between Cardiovascular and Verbalization Measures

Correlations between residualized change-scores reflecting SBP, DBP, and HR reactivity, and each of the verbalization measures, are

presented in Table 23. Only two of the 51 coefficients attained the 5% confidence level. A high frequency of self-instructions was positively associated with DBP responsivity, r = +.29, and A high frequency of negative evaluations was inversely related to HR responsivity, r = -.26.

Relationship Between Cardiovascular and Post-Task Measures

Correlations between cardiovascular change-scores and the post-experimental measures are presented in Table 24. Only five of the 75 coefficients achieved were reliable at the 5% confidence level. Diastolic blood pressure elevations were positively associated with ratings on a questionnaire item reflecting irritation experienced while working on the mirror-tracing task (r = +.27). Heart rate reactivity was positively associated with scores on the STPI State Curiosity scale (r = +.30), and ratings of the degree of interest experienced while working on the task (r = +.28). In addition, there were inverse relationships between HR change-scores and a single-item measure of boredom (r = -.27), and an item reflecting a tendency to attribute task failure to the experimenter (r = -.24).

Relationships Between Verbalization and Post-Task Measures

It is of interest to determine the nature of associations between the verbalization measures and responses to the post-experimental questionnaire. However, with a total of 17 verbalization categories, and 25 post-experimental measures (3 TPI scales plus 22 single-item measures), computation of all possible correlations for these variables would result in 821 unique coefficients.

A more efficient approach is to conduct a factor analysis. The subject-to-variables ratio (1:1) is unacceptably low for purposes of

generalizing beyond the present investigation--a problem which would be equally applicable were the correlation matrix itself to be examined. However, factor analysis has the advantage of providing a more efficient means of summarizing associations among a large set of variables.

The verbalization and post-task questionnaire measures were intercorrelated and the resulting matrix submitted to a non-iterative principal factor analysis after placing squared multiple correlation coefficients along the diagonal as communality estimates. Examination of the scree plot indicated that a two-factor solution would best fit the data. Therefore, two factors were retained and rotated to the varimax criterion.

Variables with loadings $\geq \pm .30$ were considered in interpreting the two factors. Loadings for these variables are presented in Table 25. Factor 1 was defined principally by high positive loadings for single-item ratings of frustration, irritation, and stress, as well as for the STPI anger and anxiety scale (loadings from +.71 to +.79). The negative affect measure derived from the verbalization data had a positive loading of moderate magnitude (+.31). High negative loadings were in evidence for single-item ratings ratings of being comfortable with the verbalization procedure (-.56) and feeling satisfied with task performance (-.50). Negative loadings of moderate magnitude were obtained for three verbalization measures: positive evaluations (-.32), and statements indicating that the task was easy (-.34).

Although it is defined in terms of variables with negative as well as positive loadings, the first factor appears unipolar in the

sense that one pole is anchored by variables indicating strong negative affect (e.g. irritation, frustration), whereas the other is anchored by variables representing affect which is, at best, mildly positive (e.g., verbalization was comfortable, performance was satisfying). Therefore, Factor 1 appears to reflect differences in the degree of negative affective response to task performance.

Factor 2 was defined principally by high positive loadings for single-item ratings of fun, challenge, and interest, as well as for the STPI curiosity scale (loadings from +.49 to +.79). Positive loadings of moderate magnitude were obtained for ratings reflecting (1) the belief that the experimenter was friendly (+.34) and fair (+.31), (2) initial confidence in the ability to perform the task (+.40), and (3) the belief that task performance was related to ability (+.33). The number of swear words in the verbalization data also received a moderate positive loading (+.37). High negative loadings were in evidence for a single-item rating of how boring the task was (-.59), and the number of negative evaluative statements in the verbalilzation data (-.49).

The pattern of loadings defining Factor 2 appears somewhat less coherent than that associated with the first factor. For example, it is not immediately clear why swearing and curiosity should load on the same factor. Nevertheless, examination of variables showing the highest loadings suggests a dimension reflecting positive affective responses to task performance. As with Factor 1, Factor 2 would appear to be unipolar in the sense that it is anchored on one pole by variables representing strong positive affect (fun, challenge) and on the other by variables representing mildly negative affective

(boredom). It is surprising, therefore, that the two factors did not coalesce to form a single, bipolar evaluative dimension. Rotation of the two factors to an oblique (promax) solution yielded virtually identical factor loadings, and an interfactor correlation of only .07, confirming that the two dimensions were, indeed, orthogonal.

Closer examination of the variables defining the two factors suggests a tentative means of distinguishing them. Those loading highest on Factor 1--ratings of negative affective responses such as stress, irritation, and anger--appear indicative of the respondent's internal state. On the other hand, variables loading highest on Factor 2--ratings of fun, challenge, and interest--seem more related to the respondent's degree of positive involvement in the task. While the validity of this distinction is unknown, the two factors were empirically unrelated. Therefore, they will be tentatively labelled Negative Affect and Positive Involvement.

Relationship Between Cardiovascular Responses and Factors Scores Reflecting Subjective Responses

Having determined that correlations among subjective responses to task performance may be adequately summarized in terms of two underlying dimensions, it would seem worthwhile to re-examine the relationship between subjective and physiological measures. Accordingly, factor scores were generated by unit-weighting and summing variables with loadings $\geq .30$ (after reversing signs where appropriate). Intercorrelations between factor scores and each of the cardiovascular change-scores are presented in Table 26. As can be seen, the only coefficient reliable at $p < .05$ reflects a positive

association between HR reactivity and high scores on the Positive-Involvement factor (r = .28).

Effects of Pattern A and Hardiness upon Factor Scores Reflecting Subjective Responses

The two factor scores were submitted to two multivariate Pattern A X Hardiness regression analyses, one using the SI to measure Type A behavior, and one using the JAS. None of the multivariate terms were reliable (p's > .50), nor were any of the univariate effects (p's > .20).

CHAPTER VII

DISCUSSION

As expected, results indicated that Pattern A and Hardiness represent substantially independent psychological variables. Also in accord with predictions were findings indicating that both Type A behavior and Hardiness were associated with cardiovascular reactivity to a difficult psychomotor task. For Pattern A, these associations reflected enhanced SBP and DBP responses among Type A's, and were in evidence only when assessments were based on the SI; the JAS was unrelated to reactivity. In the case of Hardiness, a significant relationship emerged for DBP, reflecting reduced responsiveness among subjects with high Hardiness scores. In addition to these main effects, there was marginally reliable evidence for an interaction between Pattern A and Hardiness in the DBP results. This effect indicated that the combination of Type B behavior and High Hardiness scores was associated with lowest DBP reactivity.

Results for subjective responses to task performance were less clear-cut. Verbalization data revealed significant effects for SI assessment and Hardiness, as well as for the interaction term. Data indicating that Type B's laughed more than Type A's were in accord with expectations. However, Type B's also showed more swearing, and Type A's made greater use of self-instruction, findings which run counter to predictions. Other verbalization results included Hardiness main effects and interactions between Pattern A and Hardiness, most of which were not consistent with predictions. Post-

task measures of subjective responses to task performance also revealed few relationships of interest. Type A SI assessments were associated with a tendency to attribute task failure to insufficient effort, while JAS scores in the Type A direction were associated with a tendency to attribute task failure to the experimenter, and to report greater anger and less fun and challenge.

These and other findings are discussed in greater detail in the sections that follow. A final section considers the significance of the present investigation and its implications for the study of Type A behavior and Hardiness

Relationship Between Pattern A and Hardiness

Both the SI and the JAS were unrelated to scores on the Hardiness composite (r's = -.15 and -.18). There are no published data concerning the relationship between SI assessments and the Hardiness variable. The null finding for the JAS is in accord with data reported by Kobasa et al. (1983). However, Rhodewalt and Agustsdottir (1984) found that subjects scoring in the Type A direction on the JAS were slightly but reliably more Hardy than those with scores in the Type B direction--an r of .16 attained significance because of a large sample size (N = 600). Recall, moreover, that in the present study, JAS scores were reliably associated with one of the component measures of Hardiness, the External Locus of Control Scale (r = -.31). This relationship has been reported elsewhere (Dembroski et al., 1984; Glass, 1977). It is possible that the Rhodewalt and Agustsdottir (1984) results reflect what would appear to be a statistically reliable association (albeit of modest magnitude) between JAS Type A

scores and an internal control orientation.

Pattern A, Hardiness, and Baseline Cardiovascular Data

There was no evidence of an A/B main effect, using either SI or JAS assessments, in the analysis of baseline cardiovascular data. This is consistent with results of over fifty psychophysiological studies which indicate no association between Type A behavior and cardiovascular measures taken at rest (Wright et al., in press). Structured Interview assessments did interact with Hardiness in the analysis of SBP baselines. Among Type A's, Hardiness was positively associated with SBP baseline, whereas this relationship was inverse among Type B's. There is no obvious explanation for this finding. It should be noted, however, that these differences were not of a magnitude that would suggest clinical significance. From a more practical standpoint, the baseline difference could not have influenced the reactivity data, since, as will be recalled, change-scores were residualized with respect to baselines prior to analysis.

Cardiovascular Reactivity to Task Performance

For the sample as a whole, the mirror-tracing task elicited significant and substantial elevations in SBP and DBP (*M*'s = +17.7 mmHg and +12.7 mmHg). However, the mean HR during task performance was virtually identical to that observed during the baseline period. This pattern indicates a primarily vascular response, in which blood pressure is elevated as a result of an increase in total peripheral resistance (Obrist, 1981). The myocardial contribution (i.e., increased cardiac output), if any, would be a consequence of enhanced stroke-volume (attributable to increased myocardial force), not cardiac rate.

Correlations among the cardiovascular change-scores are consistent with this interpretation. Systolic and diastolic blood pressure showed a reliable association of substantial magnitude (r = .51), while correlations between HR and blood pressure were small and nonsignificant (r's = .19 and .15). By contrast, where blood pressure elevations are primarily a result of enhanced cardiac output, SBP and HR changes show a sizeable positive relationship, while DBP elevations are only weakly associated with those for SBP (Obrist, 1981).

This pattern of resistance-induced blood pressure elevations probably reflects a sympathetic-adrenomedullary response primarily involving activation of alpha-adrenergic receptors to produce vasoconstriction (Obrist, 1981). Such a sympathetic response would be characterized by a proportionately greater release of norepinephrine than epinephrine (Innes & Nickerson, 1975). Although this is not an unreasonable interpretation, definitive determination of the hemodynamic and neurohumoral mechanisms underlying the blood pressure and heart rate changes induced by the mirror-tracing task would require direct measurement of cardiac output, peripheral resistance, and neuroendocrine activity.

While it is not possible to specify with certainty the nature of underlying physiological mechanisms, it is worthwhile to consider briefly what feature of the mirror-tracing task might be responsible for the observed pattern of cardiovascular response. Two explanations suggest themselves. One concerns Obrist's (1976, 1981) distinction between active and passive coping. Active coping involves situations where the individual is trying hard to attain some important goal. In

the typical research paradigm, the subject must give rapid and accurate responses on a reaction-time task in order to avoid aversive stimulation (e.g., Light & Obrist, 1980). The physiological concomitants of active coping include pronounced increases in HR and SBP, a result of sympathetic (beta-adrenergic) effects on the heart. At the same time, DBP may show little or no change, because any pressor response associated with alpha-adrenergic influences would be offset by beta-adrenergically mediated vasodilation in skeletal muscles.

Passive coping involves situations where the individual can only passively endure aversive stimulation. A typical operationalization is the cold-pressor task, which requires the subject to plunge a hand or foot into a bucket of extremely cold water. Under these conditions, a contrasting pattern of hemodynamic changes is in evidence. Beta-adrenergic influence on the heart is minimal, and HR comes under parasympathetic control, decelerating (or accelerating slightly) in response to the reduced metabolic requirements of minimal somatic activity. At the same time, both SBP and DBP will rise, as a consequence of alpha-adrenergically-mediated vasoconstriction in the skin and viscera (e.g., Obrist et al., 1978).

In terms of Obrist's (1981) active-passive coping distinction, minimal evidence of myocardial effects in the present study might indicate that subjects coped in a passive manner with the mirror-tracing task. There is some reason to believe that this was not the case. First, observation suggested that the large majority of subjects expended considerable effort attempting to trace the star. This anecdotal evidence is supplemented by responses to a post-task

questionnaire item asking the subject whether he had tried his best to complete the task. The mean response for the entire sample was 3.5, which is close to the highest possible score, 4.0. Nevertheless, the possibility cannot entirely be discounted that coping with the mirror-tracing task is best characterized in terms of passive endurance of an aversive situation.

A second possible interpretation of the pattern of cardiovascular response observed in the present study concerns the presummed effects of qualitatively different types of cognitive activity. Tasks involving mental work appear to elicit a strong beta-adrenergic effect, producing substantial increases in SBP and HR, and vasodilation in skeletal muscles, with little change in DBP (e.g., Williams, Bittker, Buchsbaumm, & Wynne, 1975). By contrast, activities requiring attention to environmental input--such as the mirror-tracing task--produce a primarily alpha-adrenergic effect, eliciting SBP and DBP elevations, with little increase (or a slight decrease) in HR (Williams et al., 1975).

A problem with both the active/passive coping and mental work/sensory intake distinctions is that they have been studied by comparing physiological changes to qualitatively different tasks (e.g., cold pressor versus reaction time; mental arithmetic versus vigilance). As a consequence, it cannot be determined whether some other task characteristic accounts for the production of primarily myocardial as opposed to vascular responses. Possibilities include difficulty level, evaluation apprehension, and task involvement. In any event, without additional data, it is impossible to ascertain

whether passive coping, sensory intake, or some other feature of the task situation accounts for the pattern of cardiovascular adjustments observed in the present study.

Effects of Pattern A and Hardiness upon Cardiovascular Reactivity

Structured Interview assessments were reliably associated with SBP and DBP reactivity, with Type A's showing greater elevations than Type B's. A trend toward a similar effect for HR fell short of significance. By contrast, Pattern A assessments based on the JAS were unrelated to cardiovascular change-scores. These results are in accord with initial expectations and are quite consistent with psychophysiological studies reviewed earlier (see Tables 1 through 3) which also indicate that the SI is more closely related to cardiovascular reactivity than the JAS.

The results reported here are also in accord with previous research in detecting A/B differences for SBP responsivity, the physiologic parameter which has most consistency been associated with Type A behavior. The present study is somewhat atypical, however in observing reliable effects for DBP, but not for HR, since the reverse pattern is more frequently obtained. This may well be a result of the primarily vascular response which was elicited by the mirror-tracing task (see above).

As predicted, Hardiness was associated with lower change-scores on all three cardiovascular measures. However, the effect was statistically reliable only in the case of DBP. It is not clear why this was the case, although, as was just suggested, the HR data may have been influenced by some property of the mirror-tracing task. There is no published research concerning the relationship between

Hardiness and psychophysiological reactivity. Should the association reported here prove replicable, it might reflect mechanisms underlying the role of Hardiness in buffering against stress-induced illness (Kobasa, 1982).

In addition to the main effects, Hardiness interacted with SI assessments in the prediction of DBP responses. This finding must be viewed guardedly, however, since the corresponding multivariate term was not reliable. The form of the interaction indicated that the lower DBP changes of Hardy subjects were in evidence only among Type B's. This suggests the possibility that Hardiness operates differently in Type A and B individuals, buffering against physiological reactivity only among the latter group. It will be recalled, however, that initial expectations called for Hardiness to exert a greater effect among Type A's. This prediction was based on previous work suggesting that Hardiness may buffer against the illness-inducing effects of life change mainly among Type A's (Kobasa et al., 1983) and other highly-stressed individuals (e.g., Kobasa, 1979).

To the extent that the present data indicate a greater effect for Hardiness among Type B's, as compared to Type A's, they do not conform to predictions. Nevertheless the observation of lowest DBP elevations among subjects who are Type B and High in Hardiness is not an unreasonable one, since both characteristics are associated with reduced risk for somatic illness. Determination of the psychophysiological mechanisms underlying this interaction--if it proves reliable--must await further research.

Effects of Pattern A and Hardiness upon Verbalization Measures

Experimental hypotheses called for stronger negative affect, greater use of inappropriate task strategies, and more frequent self-attribution for failure among Type A subjects, with stronger positive affect, greater use of effective task strategies, and more frequent attribution of failure to task difficulty among Type B's. A similar pattern was expected in the comparison of verbalizations generated by subjects with low as opposed to high scores on Hardiness. Neither set of predictions was borne out in the data.

Five of seven main effects for SI classification were unqualified by interactions with Hardiness. Only one of these was consistent with expectations: more frequent laughter among Type B's would appear to replicate the Matthews and Brunson (1981) finding suggesting greater positive affect among (JAS-defined) Type B's. The more frequent use of self-instruction among Type A's, compared to B's, runs against predictions. Although Brunson and Matthews reported no significant results for this variable, self-instruction would seem to represent an adaptive approach to the task; therefore, any reliable effect was expected to reflect greater self-instruction among Type B's. Similarly, the present finding of more frequent swearing among Type B's is inconsistent with that of Brunson and Matthews indicating greater negative affect among Type A's. Type A's generated more verbalizations which were irrelevant to the task at hand. Such a finding was expected to characterize the protocols of Type B subjects, since the pattern of data reported by Brunson and Matthews suggests that Type B's became progressively disengaged from the task over time. Finally, positive prognostic statements were in greater evidence among

Type A's, rather than among Type B's, as was initially anticipated.

Turning now to the Hardiness results, only one of the main effects was not qualified by an interaction with SI assessments. Subjects with high Hardiness scores gave reliably fewer positive prognostic statements than those with low Hardiness scores. This finding contradicts expectations for a greater frequency of such statements among Hardy Subjects.

Hardiness and SI assessment showed reliable interactions for five verbalization categories. For four of these effects, Hardiness appears to have had an impact upon the verbalizations of Type B subjects, but not upon those of Type A's. Among the Type B group, subjects high in Hardiness, compared to those low in Hardiness, showed a greater frequency of inappropriate approaches to the task, difficulty attributions, and negative prognostic statements. The effects for task approaches and negative prognostic statements stand in contradiction of the expected effects of Hardiness. The finding for difficulty attributions, on the other hand, is consistent with predictions. However, it is not clear why Hardiness operated in this manner only among Type B subjects. For Type B's, but not Type A's, Hardiness was associated with a lower frequency of symptoms, a finding which does accord with predictions. The remaining interaction was a cross-over: Hardiness was positively associated with negative affect among Type A's, and inversely related to negative affect among Type B's. Once again, the pattern is inconsistent with expectations.

It would appear that, overall, Type B's showed the subjective reactions which were expected to occur among Type A's (e.g., less

frequent use of self-instruction, fewer positive prognostic statements, and more swearing). Similarly, subjects low in Hardiness generated verbalizations which resembled those expected for the High Hardiness group (more positive prognostic statements), particularly among Type B's (e.g., less use of inappropriate approaches to the task, more negative prognostic statements). Only the greater amount of laughter among Type B's, and more frequent occurrence of difficulty attributions and reduced symptom reporting among Hardy/Type B's, may be construed as supportive of predictions.

There is no obvious explanation for these findings. Perhaps the most parsimonious interpretion would be to discount the verbalization data as reflecting sampling error. That is, it may be argued that the results do not represent reliable associations, but were produced by a small number of subjects who reacted the way they did for reasons unrelated to Type A behavior and Hardiness. Support for this view may be derived from data presented in Table 7. Values in column 1 indicate that the absolute frequency of verbalizations in all categories was very low--the average subject generated fewer than one verbalization for 11 of the 17 categories, and little more than one for the remaining categories. Clearly, the findings summarized above characterize the subjective responses of only a minority of subjects.

As an alternative, it might be suggested that the data do reflect real associations with Pattern A and Hardiness, but that the correct interpretation of these relationships is nonobvious. For example, Type A's might have generated positive prognostic statements in an effort to maintain false bravado in the face of imminent failure (Jenkins, 1975). A similar explanation might be offered to account

for the comparable behavior of subjects low in Hardiness. Problems with this line of thought are the rather straightforward results of Brunson and Matthews (1981), and the decidedly post hoc character of any reinterpretation of the verbalization variables.

The data may, of course, reflect reliable associations interpretable in terms of the manifest content of the verbalization categories. That is, individuals who are Type A and low in Hardiness may, under certain conditions, experience less adverse reactions to a difficult situation than their Type B/Hardy counterparts. After all, present results are not in direct conflict with previous findings. Brunson and Matthews (1981) used the JAS to measure Pattern A, while the reliable (but contradictory) findings reported here involved the SI. Moreover, experimental tasks employed in the two investigations differed, as did any number of other factors (e.g., personalities of the experimenters, laboratory ambience) which might have influenced verbalization data. In the case of Hardiness, the only directly relevant study indicated that Hardy individuals were more likely than those low in Hardiness to perceive life change as desirable and controllable (Rhodewalt & Agustsdottir, 1984). While this finding stands in apparent contrast to the present results, the discrepency may be superficial. It is by no means clear that perceptions of laboratory stressors capture those occuring in response to stressful life events (e.g., Coyne & Lazarus, 1980).

Without additional information, it would appear impossible to determine which of the foregoing explanations, if any, can account for the verbalization results. Whatever the interpretion, it is

undoubtedly the case that the methodology employed in the present can be improved. This issue is discussed in a later section.

Effects of Pattern A and Hardiness upon Post-Task Measures.

Structured Interview A/B assessments entered into only two effects for post-task measures. Although the corresponding multivariate term was not significant, univariate analysis indicated that Type A's showed higher STPI State-Anger scores than Type B's, a finding largely attributable to low anger among the Hardy/Type B group. Greater anger among Type A's is consistent with expectations based on the (JAS) finding for negative affect obtained by Brunson and Matthews (1981). Anger is, after all, part of the descriptive definition of Type A behavior, which includes an easily aroused temper (Friedman & Rosenman, 1974). Frequency of experience of anger and outward experession thereof were associated with SI assessments, as well as with CHD incidence, in a study reported by Matthews et al. (1977). While it is not clear why Hardiness should attenuate anger among Type B's, but not Type A's, such an effect would be consistent with the putative role of Hardiness in ameliorating responses to stressful situations (Kobasa, 1982b).

The second SI effect for a post-task variable reflected a tendency for Type A's, compared to Type B's, to attribute task failure to effort. This finding parallels results of studies using the JAS which have indicated that Type A's attribute negative outcomes to internal factors (Brunson & Matthews, 1981; Rhodewalt, 1984; Rhodewalt & Nahavandi, 1982). Note, however, that the appropriate multivariate test fell short of significance in the present study.

The JAS was associated with a greater number of post-task

measures than was the SI. Univariate analyses revealed that subjects with JAS scores in the Type A direction, compared to their Type B counterparts, reported having less fun, feeling less challenged, and experiencing more anger, while working on the task. These data appear consistent with the SI anger results, as well as with those reported by Brunson and Matthews (1981), and Dimsdale et al. (1978) in suggesting that Type A's and B's do experience different subjective reactions to stressful situations. Note, however, that other research has failed to detect such differences (e.g., Chesney et al., 1980).

There was also marginal evidence to indicate that JAS-defined Type A's were more likely than B's to attribute task failure to the experimenter. This finding appears inconsistent with evidence of more internal attributions among SI-defined Type A's, as well as with results of previous research (e.g., Brunson & Matthews, 1981). In any event, as with the SI, none of the multivariate terms corresponding to the JAS main effects achieved statistical significance.

There were univariate JAS X Hardiness interactions in the data for three post-task measures. Among Type A's, Hardy subjects gave higher ratings on an item asking how fair the experimenter was, an item asking whether the subject initially felt able to perform the task, and an item asking whether the subject believed the task could be completed in five minutes. Hardiness had relatively little impact on ratings for these items among Type B's. These results suggest that Hardiness was associated with a more favorable impression of the experimental situation among Type A subjects, a finding which might be

construed as congruent with the proposed tendency for Hardy individuals to become positively involved with their surroundings (Kobasa, 1982b). It is not clear, however, why such a relationship should hold only among Type A's and, once again, the appropriate multivariate effects were not reliable.

In the main, results for post-task questionnaire measures, though perhaps of marginal statistical significance, were in line with initial predictions. These measures yield a description of subjective responses to mirror-tracing that differs from the one suggested by the verbalization data. This may indicate that unexpected findings in the verbalization data were, indeed, a result of methodological artifact. On the other hand, measures obtained following cessation of stressful activity may reflect different psychological processes than those obtained while such activity is ongoing (Brunson & Matthews, 1981). It is not clear which of these possibilities accounts for discrepencies in the two sets of subjective data.

Relationships Among Dependent Measures.

Results of the present study were noteworthy in the degree of dissociation of physiologic and subjective responses to mirror-tracing. Verbalization data yielded only two nominally reliable correlations with cardiovascular change-scores. Frequency of self-instruction was positively associated with DBP increases, whereas number of negative evaluations was inversely related to HR responses. The DBP result is reminiscent of the findings of Scherwitz et al. (1978) which suggested that self-involvement was associated with enhanced cardiovascular reactivity. It will be recalled, however, that other workers were unable to replicate this finding (Krantz et

al., 1982). The significance of the relationship involving HR is also unclear. Given the large number of coefficients examined, it is quite likely that both DBP and HR correlations reflect random fluctuation.

As with verbalization variables, there were few associations between post-task questionnaire measures and cardiovascular responsivity. The relationship between irritation ratings and DBP attained nominal significance, and may reflect a concomitance of physiological and negative affective responses to performance challenge (e.g., Glass et al., 1983). Heart rate responses were related to four post-task measures. There were positive correlations with interest and STPI State-Curiosity scores, and negative correlations with boredom and the attribution of task failure to the experimenter. Associations for interest, curiosity, and boredom would appear to reflect covariation between task involvement and HR elevations. The correlation for the attribution item could be construed in these terms as well, to the extent that believing the experimenter controlled performance can be assummed to result in disengagement from the task. An association between HR increases and task involvement is consistent with research indicating that appetitive circumstances (e.g., presence of positive incentives for good task performance) produce cardiac acceleration (e.g., Fowles, Fisher, & Tranel, 1982; Tranel, Fisher, & Fowles, 1982).

There was evidence of meaningful covariation between verbalization and post-task measures. Factor analysis revealed dimensions tentatively labelled Negative Affect and Positive

Involvement. The Negative affect factor was defined primarily by high positive loadings for post-task measures of irritation, stress, anger, and the like, and by high negative loadings reflecting comfort with the verbalization procedure and satisfaction with performance. In addition, there was a positive loading of moderate magnitude for verbalizations reflecting negative affect, as well as negative loadings of moderate magnitude for verbalizations relecting positive evaluations of task performance and perceptions that the task was easy. These latter loadings lend validity to the verbalization procedure as a means of assessing subjective reactions to performance challenge.

The Positive Involvement factor was defined principally by high positive loadings for post-task measures of interest, fun, curiosity, and challenge, and by a high negative loading for a post-task boredom rating. There was, in addition, a negative loading of moderate magnitude for verbalizations reflecting negative performance evaluations, which gives credence to the interpretation of this verbalization category as an index of subjective responses to mirror-tracing. Curiously, amount of swearing in verbalization protocols loaded moderately in the positive direction, suggesting an association with task involvement. This may indicate that, under conditions of the present study, swearing reflected positively-toned involvement in task performance. It should be emphasized, however, that these results may not have wide generality. Generation of replicable factor structures requires a much higher subject-to-variables ratio, and more systematic sampling of the behavioral domain of interest (i.e., subjective responses to performance challenge) than was the

case in the present study (Kim & Mueller, 1978).

Although the factor analysis revealed two interpretable dimensions of covariation underlying subjective responses to mirror-tracing, analyses of factor scores provided no new information regarding relationships other variables. A correlation between HR responsivity and Positive Involvement essentially duplicated associations described earlier involving four of the variables defining the second factor. Moreover, multiple regression analysis indicated that neither Pattern A nor Hardiness, nor the interaction of the two, was reliably associated with scores on either factor, whereas analysis of individual subjective measures did produce sigificant effects.

CHAPTER III

SUMMARY AND IMPLICATIONS

The purpose of this investigation was to assess whether the statistically reliable but relatively weak associations typically obtained in psychophysiological studies of Type A behavior reflect a failure to take into account other factors contributing to individual differences in biological reactivity. Hardiness was selected for study because it appears to represent a dimension of individual differences in susceptibility to stress-induced illness (Kobasa, 1982b). The final pathway linking psychological variables to health outcomes must involve the pathophyiological processes underlying disease. Consequently, it is reasonable to hypothesize that Hardiness exerts a salutary effect upon health by attenuating physiological responsiveness to psychological stress.

The foregoing line of thought received support in the results for DBP reactivity. Hardiness accounted for a statistically significant portion of the variance in DBP responses beyond that attributable to Type A behavior. While consistent with expectations, it is important to view this finding guardedly. Its robustness should be assessed through replication, preferably with the use of experimental situations, subject populations, and relevant physiological measures other than those employed in the present study.

Aside from the issue of replicability, it must be recognized that psychophysiological reactivity has not been established as a risk factor for somatic disease (Krantz & Manuck, 1984), and cannot be viewed as a direct index of pathophysiological mechanisms culminating

in illness. Nevertheless, associations between psychological measures related to physical health, and physiological measures for which an etiologic role is theoretically plausible, constitute important evidence for the significance of bio-behavioral interactions in the disease process (Krantz et al., 1981).

The second factor expected to account for between-subjects variation in physiological reactivity was subjective reactions to performance challenge. Type A behavior was not originally conceived as incorporating a cognitive-perceptual component (Friedman & Rosenman, 1974), but empirical work suggests that this might be the case (Brunson & Matthews, 1981). The Hardiness construct, on the other hand, was derived from a theoretical perspective which emphasizes the role of cognitive-perceptual processes in shaping the stress response (Kobasa, 1982b), an orientation shared by most contemporary theorists in this area (e.g., Cox, 1978; Glass & Singer, 1972; Lazarus, 1966; Mason, 1972).

On the basis of this reasoning, it was expected that Type A subjects who were low in Hardiness would tend to perceive the mirror-tracing task as a threat, rather than a challenge, attribute poor performance to internal, rather than external factors, pursue ineffective rather than useful task strategies, and experience mostly negative affect. It was futher hypothesized that these subjective reactions would be strongly associated with heightened physiological reactivity.

Results for the verbalization data did not support these expectations. Indeed, the findings were in some ways opposite to

predictions, with Type A subjects and those High in Hardiness reporting subjective reactions similar to those anticipated for their Type B/High Hardiness counterparts. Three possible explanations were advanced to account for these findings: (1) the results reflect sampling error; (2) the effects are statistically reliable, but their understanding requires that the verbalization categories be interpreted in terms other than their manifest content; (3) under conditions of the present study, the subjective experience of Type A/Low Hardiness subjects did resemble that which was expected for Type B/High Hardiness subjects.

It was argued earlier that the first explanation is probably correct. This assertion was based on the observation that the absolute frequency of verbalizations was quite low, indicating that the data are not likely to be representative of the thoughts and feelings of most subjects. It also was suggested by the results for post-task measures, which provide some support for expectations regarding subjective responses to mirror-tracing. Of course, the validity of this argument can only be determined by further research. Nevertheless, it is worthwhle to consider aspects of the methodology used in the present study which may have worked against obtaining a more representative sampling of subjective responses to performance challenge.

Perhaps the major factor contributing to a relatively low verbal output was a decision not to allow subjects a preliminary experience with the verbalization procedure. In other research (e.g., Brunson & Matthews, 1981), practice may have permitted subjects to become comfortable with the technique, resulting in a more representative

sampling of actual subjective experience. A problem with this strategy is that performance challenges often have their greatest impact at the outset, with physiological reactivity diminishing over time (e.g., Obrist, 1981). It was for this reason that subjects were not given preliminary experience with the verbalization procedure in the present study. This problem might be circumvented, however, by having subjects practice verbalization while under relatively benign conditions, before introducing the task of interest.

Another contributing factor may have been the deliberate selection of a task which induced a wide range of reactions, ranging from interest and enjoyment to frustration and anger. It was thought that this quality of the mirror-tracing task might facilitate the detection of individual differences in subjects' appraisals of task performance, as well as in physiological reactivity. The task did serve this purpose to the extent that predictions for the cardiovascular data were upheld. For purposes of assessing subjective responses, however, use of the mirror-tracing task may have been ill-advised.

Two characteristics of the mirror-tracing task, in particular, may have been responsible for the diversity of reactions while working against the spontaneous production of performance attributions. In a recent review paper, Weiner (1985) concludes that spontaneous causal attributions are most often generated where outcomes are clearly negative and/or unexpected. The novelty of the mirror-tracing task probably minimized the degree to which subjects could form strong initial expectations for performance. Moreover, mirror-tracing was

described to subjects as a task which was succesfully completed by 50% of all prior participants. As a consequence, inability to trace the star may not have constituted a clear failure in the eyes of most subjects.

That the mirror-tracing task was conducive to the detection of relationships involving physiological reactivity, but not verbalization measures, raises the issue of independence between cardiovascular and subjective responses to performance challenge. Two factors may have contributed to this dissociation. First, as will be recalled, the data indicated a predominantly vascular response to mirror-tracing, with minimal evidence for myocardial effects. It is possible that changes in cardiac performance are more perceptible than the vascular responses detected in the present study (cf. Blascovich & Katkin, 1983) and, in consequence, contribute more strongly to the experience of emotion. This explanation assumes that affective states are determined, at least in part, by the perception of autonomic activity (Schachter & Singer, 1962).

A second explanation for the dissociation between subjective and physiological responses concerns the use of a post-measure-only between-subjects design. A study by Pennebaker and associates (Pennebaker, Gonder-Frederick, Stewart, Elfman, & Skeleton, 1982) reported substantial within-subjects correlations between blood pressure changes and subjective measures. Between-subjects analyses yielded no significant relationships. The Pennebaker et al. data suggest that changes in an individual's blood pressure are likely to covary with changes in his or her subjective state. The design of the present study did not permit assessment of this relationship,

since subjective measures were obtained only following performance challenge.

In summary, the present investigation met with partial success in attempting to examine conjointly the Type A behavior pattern and the Hardy personality composite in a study of the physiological and subjective responses to performance challenge. The cardiovascular data indicate that further attempts to integrate research on these two constructs may prove fruitful. Findings for the subjective measures were less encouraging. However, additional work utilizing the verbalization technique, with methodological adjustments along lines discussed above, may lead to the development of a useful paradigm for studying biobehavioral interactions of relevance to the understanding of somatic health and illness.

APPENDICES

APPENDIX A

Tables summarizing psychophysiological studies of Type A Behavior

Table 1

Results of Studies Using Only the SI

Experiment	SBP	DBP	HR	E	NE
Contrada et al. (1982)	Partial	No	Yes	Partial	Partial
Dembroski, MacDougall, & Lushene (1979)	Yes	Yes	No	-	-
Friedman, Byers, Diamant, & Rosenman (1975)	-	-	-	No	Yes
Glass, Krakoff, Contrada, et al. (1980)					
Experiment 1	Yes	No	Yes	Yes	No
Experiment 2	Yes	Yes	Partial	Partial	No
Glass, Krakoff, Finkelman, et al. (1980)	Yes	Partial	No	Yes	Partial
Jennings & Choi (1981)	?	?	?	-	-
Kahn, Kornfeld, Frank, Heller, & Hoar (1980)	Yes	No	-	-	-
Krantz et al. (1981)	No	No	Yes	-	-
Lovallo & Pishkin (1980)	?	?	No	-	-
Smyth, Call, Hansell, Sparacino, & Strodtbeck (1978)	?	?	-	-	-

Note: E = plasma epinephrine; NE = plasma norepinephrine; Yes = support for A's > B's [Yes(M) = support for A's > B's among males only]; No = no support for A's > B's; Partial = mixed or marginal support for A's > B's; "?" = unable to evaluate; "-" = not measured.

Table 2

Results of Studies Using Only the JAS

Experiment	SBP	DBP	HR	E	NE
Cornelius & Averill (1980)	-	-	?	-	-
Diamond & Carver (1980)	No	No	No	-	-
Gastorf (1981)	Yes	No	-	-	-
Goldband (1980)					
Experiment 1	-	-	No	-	-
Experiment 2	-	-	No	-	-
Jorgenson & Houston (1981)	No	Yes	Partial	-	-
Lawler, Rixse, & Allen (1983)	?	?	?	-	-
Lott & Gatchel (1978)	?	?	?	-	-
Manuck, Corse, & Winkelman (1979)	No	No	-	-	-
Manuck & Garland (1979)	Yes	No	Partial	-	-
Price & Clarke (1978)	-	-	No	-	-
Simpson et al. (1974)	-	-	-	?	?
Steptoe & Ross (1981)	?	?	-	-	-
Van Egeren (1979a)	-	-	Partial	-	-
Van Egeren (1979b)	-	-	No	-	-
Van Egeren, Sniderman, & Roggelin (1982)	-	-	No	-	-
Weidner & Matthews (1978)	Partial	?	-	-	-

Note: Symbols are defined in Table 1.

Table 3

Results of Studies Contrasting the SI and JAS

	Results for the SI			Results for the JAS		
	SBP	DBP	HR	SBP	DBP	HR
Blumenthal et al. (1983)	Yes	No	Yes	No	No	No
Corse, Manuck, Cantwell, & Matthews (1982)	Yes	Yes	No	No	No	No
Dembroski, MacDougall, Herd, & Shields (1979)	Yes	No	Yes	Partial	No	No
Dembroski, MacDougall, Shields, Petitto, & Lushene (1978)	Yes	No	Yes	Yes	Yes	No
Krantz, Arabian, Davia, & Parker (1982)	Yes	No	No	No	No	No
MacDougall, Dembroski, & Krantz (1981)						
Experiment 1	No	No	No	No	No	No
Experiment 2	Yes	No	No	No	No	No
Scherwitz, Berton, & Leventhal (1978)	?	?	?	?	?	?

Note: Symbols are defined in Table 1.

Table 4

Results of Studies Using A/B Measures Other Than the SI and JAS

Experiment	A/B Measure	SBP	DBP	HR	E	NE
Manuck, Craft, & Gold (1978)						
Experiment 1	Sales	Yes(M)	-	-	-	-
Experiment 2	JAS & Sales	Yes	No	No	-	-
Williams et al. (1982)	JAS & SI	No	No	No	Yes	Yes
Pittner, Houston, & Spiridigliozzi (1983)	Thurstone	Yes	Yes	Partial	-	-
Dembroski, MacDougall, Herd, & Shields (1979)	Framingham	No	No	No	-	-
MacDougall et al. (1981)						
Experiment 1	Framingham	No	No	No	-	-
Experiment 2	Framingham	No	No	No	-	-
Price & Clarke (1978)	Bortner Scale	-	-	No	-	-
Lawler, Allen, Critcher, & Standard (1981)	Bortner Battery	?	-	?	-	-
	Myth	?	-	?	-	-

Note: Symbols are defined in Table 1. Table continued on next page.

Table 4 (Continued)

Results of Studies Using A/B Measures Other Than the SI and JAS

Experiment	A/B Measure	SBP	DBP	HR	E	NE
Holmes, Solomon, & Rump (1982)	Shortened JAS	-	-	Yes(M)	-	-
Frankenhaeuser, Lundberg, & Forsman (1980a)	Swedish JAS	-	-	?	?	?
Frankenhaeuser, Lundberg, & Forsman (1980b)	Swedish JAS	-	-	No	No	No
Lundberg & Forsman (1979)	Swedish JAS	-	-	No	No	No
Pittner & Houston (1980)	Vickers	No	Yes	Yes	-	-

Note: Symbols are defined in Table 1. Catecholamine measures in Swedish studies were derived from urine samples.

APPENDIX B

Experimental materials

Structured Interview

(Student Version)

Introduction: "I would appreciate it if you would answer the following questions to the best of your ability. Your answers will be kept in the strictest confidence. Most of the questions are concerned with your superficial habits and none of them will embarass you."

1. May I ask your age?

2. Why did you sign up for this particular study?

3. What is your major area of study?

   A) Why did you select this major?

   B) What did you expect to major in?

4. Are you satisfied with your class performance, grade-wise?

   A) Why (not)?

5. Is your coursework very demanding?

   A) Is there any time when you feel particularly rushed or under pressure?

   B) When you are under pressure, does it bother you?

6. Would you describe yourself as hard-driving and ambitious in accomplishing the things you want, getting things done as quickly as possible, or would you describe yourself as relatively relaxed and easy-going?

   A) Are you married? Do you live with someone who knows you very well?

   B) How would she (he) describe you--as hard-driving and ambitious or as relaxed and easy-going?

   C) Has she (he) ever asked you to slow down in your work? Never? How would she (he) put it--in her (his) own words?

7. When you get angry or upset, do people around you know about it? How do you show it?--Would you change the expression on your face? Would you slam your fist on the table? Would you swear?

8. Do you think you drive harder to accomplish things than most other students?

9. When you don't have an exam coming up, do you ever do school work in the evening? How often?

10. Have you ever had the opportunity to play competitive games with children around the ages of 6 and 8? Like cards, checkers, or Monopoly?

    A) Did you always allow them to win on purpose?

    B) Why (not)?

    C) Do you think children should be taught to be competitive?

11. When you play games with people your own age, do you play for the fun of it, or are you in there to win?

12. Do you compete with your classmates for grades? Do you enjoy this?

13. Do you drive? Suppose some slowpoke in a car in your lane is going far too slowly for you--what do you do about it? Would you mutter and complain to yourself? Would anyone riding with you know that you were annoyed?

14. Most people have to get up fairly early in the morning--in your particular case, what time do you ordinarily like to get up?

15. If you make an appointment with someone for, oh, two o'clock in the afternoon, for example. Would you be there on time?

    A) If you are kept waiting, do you resent it?

    B) Would you say anything about it?

16. If you see someone doing a task rather slowly and you know that you could do it faster and better yourself, does it make you restless to watch?

    A) Would you be tempted to step in and do it yourself?

17. What irritates you most about college?

18. Do you eat rapidly? Do you walk rapidly? After you've finished eating, do you like to sit around the table and chat, or do you like to get up and get going?

19. If you were to go to a restaurant and you found eight or ten people waiting ahead of you for a table, would you wait?

20. How do you feel about waiting in lines--registration lines, bank lines, or supermarket lines?

21. Do you always feel anxious to get going and finish whatever you have to do?

22. Do you have the feeling that time is passing too rapidly for you to accomplish all the things you'd like to get done in one day?

A) Do you often feel a sense of time urgency?

23. Do you hurry in doing most things?

Alright, that completes the interview. Thank you very much.

The Jenkins Activity Survey

(Form T)

Instructions: Medical research is trying to track down the causes of several diseases which are attacking increasing numbers of people. This survey is part of such a research effort. Please answer the following questions 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 us 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. Your assistance will be greatly appreciated.

For each of the following items, please circle the number of the one best answer:

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 routine. 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 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 around 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 about 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 ten 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
    2. Probably hard-driving and competitive
    3. Probably more relaxed and easy-going
    4. Definitely more relaxed and easy-going

17. Nowadays, do you consider yourself to be

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

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

    1. Definitely hard-driving and competitive
    2. Probably hard-driving and competitive
    3. Probably more relaxed and easy-going
    4. Definitely more 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 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 feel really irritated because most such interruptions are unnecessary

29. How often are there deadlines in your courses?

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 you 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 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 university when it is officially closed (such as nights or weekends)? If this is not possible, circle here: 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 people tend to look to you to provide leadership?

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

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

1. Never
2. Occasionnally
3. Frequently

In each of the following questions, please compare yourself with the average student at your university. 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 lttle 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 litle less precise
    4. Much less precise

44. I approach life in general

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

Alienation from Work Scale

Instructions: The items below consist of attitudes with which you may or may not agree. As you will see, many of the items are worded very strongly. This is so you can decide the degree to which you agree or disagree. Please indicate your reaction to the following items by circling the number of the phrase which best describes the way you feel now. Please read the items carefully. Don't spend too much time on any one item.

1. I wonder why I work at all.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

2. Most of life is wasted in meaningless activity.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

3. If you have to work, you might as well choose a career where you deal with matters of life and death.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

4. I find it difficult to imagine enthusiasm concerning work.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

5. It doesn't matter if people work hard at their jobs; only a few bosses profit.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

6. Ordinary work is too boring to be worth doing.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

7. I don't like my job or enjoy my work; I just put in my time to get paid.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

8. I find it hard to believe people who actually feel that the work they perform is of value to society.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

9. If a job is dangerous, that makes it all the better.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

Alienation from Self Scale

Instructions: The items below consist of attitudes with which you may or may not agree. As you will see, many of the items are worded very strongly. This is so you can decide the degree to which you agree or disagree. Please indicate your reaction to the following items by circling the number of the phrase which best describes the way you feel now. Please read the items carefully. Don't spend too much time on any one item.

1. The human's fabled ability to think is not really such an advantage.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

2. The attempt to know yourself is a waste of effort.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

3. I am really interested in the possibility of expanding my consciousness through drugs.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

4. Life is empty and has no meaning in it, for me.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

5. The belief in individuality is only justifiable to impress others.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

6. I wish I could be carried away by a revelation, as apparently happened to some historically important persons.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

7. I long for a simple life in which body needs are the most important things and decisions don't have to be made.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

8. Unfortunately, people don't seem to know that they are only creatures after all.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

9. The most exciting thing for me is my own fantasies.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

Security Scale

Instructions: The items below consist of attitudes with which you may or may not agree. As you will see, many of the items are worded very strongly. This is so you can decide the degree to which you agree or disagree. Please indicate your reaction to the following items by circling the number of the phrase which best describes the way you feel now. Please read the items carefully. Don't spend too much time on any one item.

1. The more able person has a greater responsibility for the welfare of the less well able.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

2. Public supported medical care is the right of everyone.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

3. Violence never is justified because it harms the doer and the receiver.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

4. The young owe the old complete economic security.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

5. From each according to his ability; to each according to his need.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

6. A retired person should be free from all taxes.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

7. Ownership of property beyond providing for one's modest comfort and security should be illegal.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

8. Government should guarantee jobs for all.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

9. To achieve freedom from want is a large enough goal for anyone.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

10. One who does one's best should expect to receive complete economic support from one's society.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

11. New laws should not be passed if they damage one's income.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

12. There are no conditions which justify endangering the health, food, and sheltering of one's family or of one's self.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

13. Wealth and fame are less important than knowing one has an assured minimal social security.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

14. Pensions large enough to provide for dignified living are the right of all when age or illness prevents one from working.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

15. Steady saving is the best road to economic security.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

Powerlessness Scale

Instructions: The items below consist of attitudes with which you may or may not agree. As you will see, many of the items are worded very strongly. This is so you can decide the degree to which you agree or disagree. Please indicate your reaction to the following items by circling the number of the phrase which best describes the way you feel now. Please read the items carefully. Don't spend too much time on any one item.

1. Politicians control our lives.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

2. Most of my activities are determined by what society demands.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

3. There are only certain strict paths to follow if one is to be successful in our society.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

4. Everyone is out to manipulate you toward his own ends.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

5. Often when I interact with others, I feel insecure over the outcome.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

6. I try to avoid close relationships with people so that I will not be obligated to them.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

7. Those who work for a living are manipulated by the bosses.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

8. No matter how hard you work, you never really seem to reach your goals.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

9. I feel no need to try my best at work, for it makes no difference anyway.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

10. When you marry and have children you have lost your freedom of choice.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

11. My parents imposed their wishes and standards on me too much.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

12. I am not sure I want to stay married because I don't want to feel tied down.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

13. Thinking of yourself as a free person leads to great frustration and difficulty.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

14. No matter how hard I try, my efforts will accomplish nothing.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

15. Often I do not really know my own mind.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

Cognitive Structure Scale

Instructions: The items below consist of attitudes with which you may or may not agree. As you will see, many of the items are worded very strongly. This is so you can decide the degree to which you agree or disagree. Please indicate your reaction to the following items by circling the number of the phrase which best describes the way you feel now. Please read the items carefully. Don't spend too much time on any one item.

1. I live from day to day without trying to fit my activities into a pattern.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

2. When I talk to a doctor, I want him to give me a detailed explanation of any illness I have.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

3. It doesn't bother me to put aside what I've been doing without finishing it.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

4. I have no use for theories which are only good guesses and are not closely tied to facts.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

5. Each day I check the weather report so that I will know what to wear.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

6. I tend to start right in on a new task without spending much time thinking about the best way to proceed.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

7. My work is carefully planned and organized before it is begun.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

8. When I need one thing at the store, I get it without thinking what else I may need soon.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

9. I don't like situations that are uncertain.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

10. I like to be with people who are unpredictable.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

11. I won't answer a person's questions until I am very clear as to what he's asking.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

12. I don't keep an accurate account of my financial resources.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

13. It upsets me to go into a situation withiout knowing what I can expect from it.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

14. Before I ask a question, I figure out exactly what I know already and what it is I need to find out.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

15. I very seldom make detailed plans.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

16. When I take a vacation, I like to go without detailed plans or a time schedule.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

17. I don't enjoy confused conversations where people are unsure of what they mean to say.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

18. I like the adventure of going into a new situation without knowing what might happen.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

19. Once in a while I like to take a chance on something that isn't sure--like gambling.

0	1	2	3
Not at all true	A little true	Quite true	Completely true

External Locus of Control Scale

Instructions: Please indicate which of the two statements provided in each item listed below better represents your attitude. Please circle the letter (A or B) of the appropriate statement.

1. A. Many of the unhappy things in people's lives are partly due to bad luck.
   B. People's misfortunes result from the mistakes they make.

2. A. One of the major reasons why we have wars is because people don't take enough interest in politics.
   B. There will always be wars, no matter how hard people try to prevent them.

3. A. In the long run, people get the respect they deserve in this world.
   B. Unfortunately, an individual's work often passes unrecognized no matter how hard he tries.

4. A. The idea that most teachers are unfair to student is nonsense.
   B. Most students don't realize the extent to which their grades are influenced by accidental happenings.

5. A. Without the right breaks one cannot be an effective leader.
   B. Capable people who fail to become leaders have not taken advantage of their opportunities.

6. A. No matter how hard you try some people just don't like you.
   B. People who can't get others to like them don't understand how to get along with others.

7. A. I have often found that what is going to happen will happen.
   B. Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.

8. A. In the case of the well prepared student there is rarely if ever such a thing as an unfair test.
   B. Many times exam questions tend to be so unrelated to course work that studying is really useless.

9. A. Becoming a success is a matter of hard work; luck has little or nothing to do with it.
   B. Getting a good job depends mainly on being in the right place at the right time.

10. A. The average citizen can have an influence in government decisions.
    B. This world is run by the few people in power, and there is not much the little guy can do about it.

11. A. When I make plans I am almost certain that I can make them work.
    B. It is not always wise to plan too far ahead because many things turn out to be matter of good and bad fortune anyway.

12. A. In my case getting what I want has little or nothing to do with luck.
    B. Many times we might just as well decide what to do by flipping a coin.

13. A. Who gets to be the boss often depends on who was lucky enough to be in the right placve first.
    B. Getting people to do the right thing depends upon ability; luck has little to do with it.

14. A. As far as world affairs are concerned, most of us are the victims of forces we can neither understand nor control.
    B. By taking an active part in political and social affairs the people can control world events.

15. A. Most people don't realize the extent to which their lives are controlled by accidental happenings.
    B. There is really no such thing as luck.

16. A. It is hard to know whether or not a person really likes you.
    B. How many friends you have depends on how nice a person you are.

17. A. In the long run the bad things that happen to us are balanced by the good ones.
    B. Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.

18. A. With enough effort we can wipe out political corruption.
    B. It is difficult for people to have control over things politicians do in office.

19. A. Sometimes I can't understand how supervisors arrive at work evaluations.
    B. There is a direct connection between how hard I work and the evaluations I get.

20. A. Many times I feel that I have little influence over the things that happen to me.
    B. It is impossible for me to believe that chance or luck plays an important role in life.

21. A. People are lonely because they don't try to be friendly.
B. There's not much use in trying too hard to please people; if they like you, they like you.

22. A. What happens to me is my own doing.
B. Sometimes I feel that I don't have enough control over the direction my life is taking.

23. A. Most of the time I can't understand why politicians behave the way they do.
B. In the long run the people are responsible for bad government on a national as well as on a local basis.

Post-Task Questionnaire:

State Form of the State-Trait Personality Inventory

Instructions: A number of statements that people use to describe themselves are given below. Read each statement and then circle the appropriate number to indicate how you felt while performing the Mirror-Tracing task. There are no wrong or right answers. Do not spend too much time on any one statement.

		Not at all	Some-what	Moder-ately	Very Much
1.	I felt calm	1	2	3	4
2.	I felt like exploring the laboratory	1	2	3	4
3.	I was furious	1	2	3	4
4.	I was tense	1	2	3	4
5.	I felt curious	1	2	3	4
6.	I felt like banging on the table	1	2	3	4
7.	I felt at ease	1	2	3	4
8.	I felt interested	1	2	3	4
9.	I felt angry	1	2	3	4
10.	I was worrying about possible misfortunes	1	2	3	4
11.	I felt inquisitive	1	2	3	4
12.	I felt like yelling at somebody ..	1	2	3	4
13.	I felt nervous	1	2	3	4
14.	I was in a questioning mood	1	2	3	4
15.	I felt like breaking things	1	2	3	4
16.	I was jittery	1	2	3	4
17.	I felt stimulated	1	2	3	4
18.	I was mad	1	2	3	4
19.	I was relaxed	1	2	3	4

		Not at all	Some-what	Moder-ately	Very Much
20.	I felt mentally active	1	2	3	4
21.	I felt irritated	1	2	3	4
22.	I was worried	1	2	3	4
23.	I felt bored	1	2	3	4
24.	I felt like hitting someone	1	2	3	4
25.	I felt angry	1	2	3	4
26.	I felt eager	1	2	3	4
27.	I felt all burned up	1	2	3	4
28.	I felt frieghtened	1	2	3	4
29.	I felt disinterested	1	2	3	4
30.	I felt like swearing	1	2	3	4

Post-Task Questionnaire:

Ad Hoc Items

Instructions: Please read each of the following statements and indicate the degree to which you agree or disagree with it by circling the appropriate number.

		Not at all	Some-what	Moder-ately	Very Much
1.	This study is important	1	2	3	4
2.	It was important for me to do well on the Mirror-Tracing task	1	2	3	4
3.	The experimenter is friendly	1	2	3	4
4.	The experimenter has been fair with me	1	2	3	4
5.	I felt comfortable verbalizing my thoughts	1	2	3	4
6.	Initially, I felt I had the ability to perform the Mirror-Tracing task	1	2	3	4
7.	I believe it is possible to trace the star within 5 minutes	1	2	3	4
8.	Given sufficient practice, I could learn to trace the star once within 5 minutes	1	2	3	4
9.	I am satisfied with my performance on the task	1	2	3	4
10.	I tried my best to trace the star	1	2	3	4
11.	Working on the Mirror-Tracing task was:				
	a. Fun	1	2	3	4
	b. Challenging	1	2	3	4
	c. Frustrating	1	2	3	4
	d. Irritating	1	2	3	4

	Not at all	Some-what	Moder-ately	Very Much
e. Stressful	1	2	3	4
f. Boring	1	2	3	4
g. Interesting	1	2	3	4

13. My performance on the Mirror-Tracing task was determined by:

a. Chance	1	2	3	4
b. Ability	1	2	3	4
c. Task Difficulty	1	2	3	4
d. Effort	1	2	3	4
e. The Experimenter	1	2	3	4

Consent Statement: Session 1

State University of New York at Stony Brook
Stony Brook, New York 11794

Informed Consent Statement

The Department of Psychology supports the practice of protection for human subjects participating in research. The following information is provided so that you can decide whether you wish to participate in the present study. You should be aware that even though you may now agree to participate, you may drop out of the experiment at any time without penalty.

Today's session involves a brief interview following which you will be asked to fill out a few questionnaires. Both the interview and the questionnaire items deal with superficial aspects of your daily activities; none of the questions are of a sensitive nature.

Your participation is solicited, but is strictly voluntary. Be assured that your name will not be associated in any way with the research findings. Should you experience any adverse reaction to the study, the Psychological Center here on campus is available to you. If you have any questions about your rights as a subject, please contact Dr. Robert Schneider, Committee on Research Involving Human Subjects, phone # (516) 246-7935. We appreciate your cooperation.

Richard J. Contrada
(516) 246-7096

I have read the foregoing consent statement and agree to participate in this study.

_____
(Participant's signature)

Consent Statement: Session 2

State University of New York at Stony Brook
Stony Brook, New York 11794

Informed Consent Statement

The Department of Psychology supports the practice of protection for human subjects participating in research. The following information is provided so that you can decide whether you wish to participate in the present study. You should be aware that even though you may now agree to participate, you may drop out of the experiment at any time without penalty.

The study today is concerned with the physiological effects of mental effort. Your heart rate and blood pressure will be monitored while you perform different mental tasks. You will be asked at different points to complete some questionnaires.

Your participation is solicited, but is strictly voluntary. Be assured that your name will not be associated in any way with the research findings. Should you experience any adverse reaction to the study, the Psychological Center here on campus is available to you. If you have any questions about your rights as a subject, please contact Dr. Robert Schneider, Committee on Research Involving Human Subjects, phone # (516) 246-7935. We appreciate your cooperation.

Richard J. Contrada
(516) 246-7096

I have read the foregoing consent statement and agree to participate in this study.

_____
(Participant's signature)

Task Instructions

Researchers have long been interested in the way people respond to difficult cognitive and psychomotor tasks. Two types of response have been studied: Physiological and psychological. Typically, these responses have been examined separately, in research conducted by different laboratories. In today's study, we will look at both types of response at the same time, in order to examine the relationship between them.

The physiological responses we will be recording have already been described--heart rate and blood pressure. The psychological responses--your thoughts and feelings--will be assessed by having you think out loud while working on the task.

The task you will work on involves the apparatus you see before you. It is known as the Mirror-Tracing task, a measure of spatial ability and hand-eye coordination. Take the stylus from the top of the upper platform and place it in the star-shaped channel below the platform. Now try to trace the star. You will notice that, when the stylus touches either side of the channel, a buzzer goes off.

The object of this task is to trace the star while looking only at the mirror you see on the far panel--you will <u>not</u> be permitted to look directly at the star. If the stylus touches the side of the panel, and the buzzer goes off, you <u>must</u> start over again.

This task is difficult, but not impossible. We have found that about 50% of the students we test can perform one tracing during a five-minute period. We want you to do your best to perform one tracing. You may not be able to do this. The important thing for us is that you give your best effort.

As noted above, we would like you to think out loud while working on the task. Just say whatever comes into your mind. You may have thoughts about the task, concerning the strategies you are employing or the quality of your performance. Or you may be conscious of the inflating cuff and finger clip. Or you may think of things you've done today, or plan to do this weekend. Whatever your thoughts and feelings, feel free to say them out loud. Please speak clearly and a little more loudly than usual, and the microphone will pick up what you say without any problems.

When you have read these instructions and fully understand them, place the stylus back on the platform, and say "ready." Do <u>not</u> begin until the experimenter instructs you to do so.

APPENDIX C

Tables summarizing statistical analyses

Table 5

Internal Consistency of the Hardiness Measures

Measure	Cronbach's Alpha
Alienation from Work Scale	.60
Alienation from Self Scale	.65
Security Scale	.56
Powerlessness Scale	.76
Cognitive Structure Scale	.54
External Locus of Control Scale	.82
Hardiness Composite	.86

Note: Each coefficient is based on an N of 68.

Table 6

Intercorrelations Among the Hardiness Measures

	AFS	S	P	CS	ELC
Alienation from Work (AFW)	+.52*	+.32*	+.56*	-.10	+.20*
Alienation from Self (AFS)		+.16	+.46*	-.13	+.19
Security (S)			+.35*	+.03	+.20
Powerlessness (P)				-.15	+.36*
Cognitive Structure (CS)					-.14
External Locus of Control (ELC)					

* $p < .01$ (two-tailed)

Note: Each coefficient is based on an N of 68. Scoring of all questionnaires is such that lower values indicate greater Hardiness.

Table 7

Verbalization Categories: Means for Raw and Adjusted Frequencies, and Interjudge Reliability

Verbalization Category	Raw Frequency	Adjusted Frequency	Interjudge Reliability
Useful Task Strategies	1.09	6.41	.95
Inappropriate Approaches	.04	.38	.81
Difficulty Attributions	.15	.69	.44
Self-Instructions	1.91	9.71	.83
Positive Affect	.16	.80	.87
Laughter	.42	2.19	.98
Negative Affect	.57	1.06	.91
Swearing	1.58	19.19	.98
Positive Prognostic	.31	1.32	.92
Negative Prognostic	.31	2.31	.88
Task-Irrelevant	.31	2.11	.93
Positive Evaluations	1.25	6.87	.85
Negative Evaluations	1.25	14.71	.92
General Evaluation	.08	.63	.59
Task Difficulty	2.05	19.89	.94
Task Ease	.22	1.52	.71
Symptoms	1.58	2.30	.89

Note: $N = 59$. All correlations are reliable at $p < .01$ (two-tailed). See Appendix A for a description of each verbalization category.

Table 8

Intercorrelations between Pattern A Measures and Scores on the Hardiness Questionnaires

Hardiness Measure	4-Point SI Rating	JAS
Alienation from Work	-.19	-.13
Alienation from Self	-.12	-.11
Security	-.06	-.02
Powerlessness	-.17	-.16
External Locus of Control	-.01	-.31*
Hardiness Composite	-.15	-.18

* $p < .01$ (two-tailed)

Note: $N = 68$. Low scores on Hardiness measures indicates greater Hardiness. Higher scores on the Pattern A measures indicates greater Type A behavior.

Table 9

Mean Baseline and Task Values for

Each Cardiovascular Measure

Measure	Baseline	Task	Difference
SBP (mmHg)	104.6 (12.5)	122.3 (16.3)	+17.7 (8.4)
DBP (mmHg)	68.0 (9.5)	80.7 (10.3)	+12.7 (8.4)
HR (bpm)	72.7 (15.8)	73.0 (15.6)	+ 0.3 (9.4)

Note: N = 68. Standard deviations are indicated in parentheses following each mean.

Table 10

Intercorrelations Among Cardiovascular Change-Scores

	DBP	HR
SBP	.51*	.19
DBP	.15	

* $p < .01$ (two-tailed)

Note: $N = 68$.

Table 11

Mean Baseline Values for Each Cardiovascular Measure

By SI and Hardiness Classifications

Group	SBP (mmHg)	DBP (mmHg)	HR (bpm)
Type A/High Hardiness (n = 21)	109.8 (11.6)	68.3 (6.3)	72.8 (16.0)
Type A/Low Hardiness (n = 14)	101.7 (13.6)	70.6 (12.3)	70.3 (16.2)
Type B/High Hardiness (n = 13)	98.4 (9.4)	70.6 (12.3)	72.4 (9.5)
Type B/Low Hardiness (n = 20)	105.2 (12.6)	66.9 (10.1)	74.4 (19.1)

Note: Type A/B classification is based upon dichotomous SI ratings. High/Low Hardiness classification is based upon a median split of the distribution of Hardiness scores. Standard deviations are given in parentheses following cell means.

Table 12

Mean Baseline Values for Each Cardiovascular Measure

By JAS and Hardiness Classifications

Group	SBP (mmHg)	DBP (mmHg)	HR (bpm)
Type A/High Hardiness (n = 20)	107.1 (11.7)	69.4 (8.6)	69.8 (14.4)
Type A/Low Hardiness (n = 12)	102.1 (12.7)	66.5 (10.5)	70.4 (16.2)
Type B/High Hardiness (n = 14)	103.1 (12.7)	65.0 (6.1)	76.8 (9.5)
Type B/Low Hardiness (n = 22)	104.7 (13.2)	69.4 (11.4)	73.9 (19.1)

Note: Type A/B and Hardiness classifications are based on median splits of the distributions of JAS and Hardiness scores. Standard deviations are given in parentheses following cell means.

Table 13

Change-scores for each of the Cardiovascular Measures

By SI and Hardiness Classifications

Group	SBP (mmHg)	DBP (mmHg)	HR (bpm)
Type A/High Hardiness (n = 21)	+16.1 (11.5)	+13.6 (9.8)	+2.6 (12.8)
Type A/Low Hardiness (n = 14)	+23.1 (10.7)	+15.7 (11.5)	+1.2 (7.5)
Type B/High Hardiness (n = 13)	+13.1 (12.1)	+6.7 (10.3)	-0.2 (6.8)
Type B/Low Hardiness (n = 20)	+16.1 (15.5)	+13.0 (9.2)	-2.4 (10.9)

Note: Type A/B classification is based upon dichotomous SI ratings. High/Low Hardiness classification is based upon a median split of the distribution of Hardiness scores. Standard deviations are given in parentheses following cell means.

Table 14

Univariate Multiple Regression Analysis

For SBP Change-Scores

Predictor Variable	Regression Coefficient	% Variance Accounted for	Statistical Significance
SI	+3.5356	7.0	$p < .04$
Hardiness	+0.8635	1.0	NS
SI X Hardiness	-0.2692	1.0	NS

Note: Higher SI ratings indicate greater Type A behavior. Lower Hardiness scores indicate greater Hardiness.

Table 15

Univariate Multiple Regression Analysis

For DBP Change-Scores

Predictor Variable	Regression Coefficient	% Variance Accounted for	Statistical Significance
SI	+2.5189	7.5	$p < .02$
Hardiness	+1.6786	6.0	$p < .01$
SI X Hardiness	-0.5073	5.0	$p < .05$

Note: Higher SI ratings indicate greater Type A behavior. Lower Hardiness scores indicate greater Hardiness.

Table 16

Univariate Multiple Regression Analysis

For HR Change-Scores

Predictor Variable	Regression Coefficient	% Variance Accounted for	Statistical Significance
SI	+2.0246	3.6	$p = .10$
Hardiness	-0.5587	2.5	NS
SI X Hardiness	+0.0824	0.0	NS

Note: Higher SI ratings indicate greater Type A behavior. Lower Hardiness scores indicate greater Hardiness.

Table 17

Verbalization Categories: Mean Adjusted Frequencies for Subjects with Type A and B SI Classifications

Verbalization Category	Type A (n = 34)	Type B (n = 25)
Useful Task Strategies	5.4 (8.4)	7.9 (11.8)
Inappropriate Approaches*	0.0 (0.0)	0.9 (3.2)
Difficulty Attributions	0.7 (1.5)	0.8 (1.8)
Self-Instructions*	12.7 (13.1)	5.6 (8.2)
Positive Affect	1.1 (2.9)	0.4 (2.2)
Laughter*	0.6 (2.4)	4.4 (12.0)
Negative Affect	4.5 (7.3)	2.2 (4.2)
Swearing*	13.3 (17.3)	27.1 (33.3)
Positive Prognostic	1.6 (3.8)	1.0 (3.4)
Negative Prognostic	1.4 (2.7)	3.5 (13.3)
Task-Irrelevant*	3.6 (9.2)	0.1 (0.3)
Positive Evaluations*	8.5 (7.5)	4.6 (8.5)
Negative Evaluations	15.8 (18.9)	13.3 (19.6)
General Evaluation	1.0 (3.3)	0.1 (0.5)
Task Difficulty	19.8 (17.6)	20.0 (20.1)
Task Ease	2.2 (4.6)	0.5 (2.0)
Symptoms*	1.3 (3.3)	3.7 (10.4)

* Univariate regressions indicate a reliable A/B effect.

Note: Adjusted frequencies express the incidence of occurence of a given verbalization category per 100 clauses. Data analysis was conducted after a square-root transformation was performed on these values.

Table 18

Verbalization Categories: Mean Adjusted Frequencies for Subjects with High and Low Hardiness Scores

Verbalization Category	High Hardiness (n = 30)	Low Hardiness (n = 29)
Useful Task Strategies	5.3 (10.0)	7.6 (9.9)
Inappropriate Approaches*	0.7 (3.0)	0.0 (0.2)
Difficulty Attributions*	1.0 (2.0)	0.4 (1.0)
Self-Instructions	10.4 (12.0)	9.0 (11.9)
Positive Affect	0.6 (2.2)	1.0 (3.0)
Laughter	0.9 (3.0)	3.5 (11.1)
Negative Affect	4.8 (7.7)	2.2 (3.9)
Swearing	19.9 (26.8)	18.5 (25.6)
Positive Prognostic*	1.2 (3.7)	1.5 (3.6)
Negative Prognostic	3.4 (12.2)	1.2 (2.4)
Task-Irrelevant	3.3 (9.7)	0.8 (2.3)
Positive Evaluations	6.6 (7.4)	7.1 (8.9)
Negative Evaluations	13.2 (14.4)	16.2 (23.2)
General Evaluation	0.7 (2.4)	0.6 (2.8)
Task Difficulty	20.8 (19.1)	18.9 (18.2)
Task Ease	1.5 (4.1)	1.5 (3.5)
Symptoms	0.7 (1.9)	3.9 (10.0)

* Univariate regressions indicate a reliable Hardiness effect.

Note: Adjusted frequencies express the incidence of occurence of a given verbalization category per 100 clauses. Data analysis was conducted after a square-root transformation was performed on these values.

Table 19

Verbalization Categories: Mean Adjusted Frequencies for the SI Classification X Hardiness Interactions

Verbalization Category	Type A/High Hardiness (n = 21)	Type A/Low Hardiness (n = 13)	Type B/High Hardiness (n = 9)	Type B/Low Hardiness (n = 16)
Inappropriate Approaches	0.0 (0.0)	0.0 (0.0)	2.3 (5.2)	0.1 (0.3)
Difficulty Attributions	0.8 (1.8)	0.4 (0.9)	1.4 (2.6)	0.4 (1.1)
Negative Affect	6.6 (8.6)	1.1 (2.1)	0.6 (1.7)	3.1 (4.9)
Negative Prognostic	1.1 (2.5)	1.9 (3.1)	8.6 (21.9)	0.6 (1.5)
Symptoms	0.5 (1.4)	2.5 (4.9)	1.3 (2.6)	5.1 (12.9)

Note: Univariate regressions indicated a reliable SI X Hardiness interaction for each of the verbalization categories listed. Adjusted frequencies express the incidence of occurence of a given verbalization category per 100 clauses. Data analysis was conducted after a square-root transformation was performed on these values.

Table 20

Post-Task Measures Showing Reliable JAS X Hardiness Interactions: Perceptions of the Task Situation

Post-Task Measure	Type A/High Hardiness (n = 20)	Type A/Low Hardiness (n = 12)	Type B/High Hardiness (n = 14)	Type B/Low Hardiness (n = 22)
Experimenter Perceived as Fair**	3.9 (0.4)	3.6 (0.7)	3.9 (0.4)	3.8 (0.4)
Initially Felt Able to Perform Task*	3.5 (0.6)	2.8 (1.1)	2.7 (0.9)	3.1 (1.0)
Believed Task Could be Done in Five Minutes**	2.8 (1.0)	2.0 (1.3)	2.4 (1.2)	2.5 (1.1)

** JAS X Hardiness interaction reliable at $p = .05$.

* JAS X Hardiness interaction approached significance at $p < .07$.

Note: Standard deviations are given in parentheses following cell means.

Table 21

Cell Means for the SI X Hardiness Interaction for

STPI State Anger Scores

	Type A/High Hardiness (n = 21)	Type A/Low Hardiness (n = 14)	Type B/High Hardiness (n = 13)	Type B/Low Hardiness (n = 20)
STPI State-Anger Score	1.7 (0.7)	1.7 (0.6)	1.4 (0.4)	1.6 (0.5)

Note: The SI main effect was reliable at $p < .05$. The SI X Hardiness interaction fell short of significance at $p = .06$. Standard deviations are given in parentheses following cell means.

Table 22

Post-Task Measures Showing Reliable JAS Main effects:

Reactions to Task Performance

Post-Task Measure	Type A (n = 36)	Type B (n = 32)
Working on the Task was Fun*	2.4 (0.8)	2.6 (0.9)
Working on the Task was Challenging**	3.4 (0.7)	3.7 (3.7)
STPI State-Anger Score**	1.7 (0.6)	1.5 (0.5)

** JAS main effect was reliable at $p < .05$.

* JAS main effect fell short of significance at $p = .06$.

Note: Standard deviations are given in parentheses following cell means.

Table 23

Correlations between Verbalization Measures and

Residualized Change-scores for Each Cardiovascular Measure

Verbalization Category	SBP	DBP	HR
Useful Task Strategies	+.09	+.14	+.13
Inappropriate Approaches	+.03	-.09	+.07
Difficulty Attributions	-.04	-.16	+.08
Self-Instructions	+.17	+.29*	+.06
Positive Affect	-.12	-.09	+.01
Laughter	+.15	+.21	+.02
Negative Affect	+.11	+.13	+.07
Swearing	+.12	-.07	+.19
Positive Prognostic	+.15	+.04	+.03
Negative Prognostic	-.24	-.21	-.12
Task-Irrelevant	-.20	-.10	+.04
Positive Evaluations	+.06	+.14	+.03
Negative Evaluations	+.01	+.10	-.26*
General Evaluation	-.13	+.05	+.03
Task Difficulty	-.05	+.03	-.09
Task Ease	+.13	+.18	-.10
Symptoms	+.05	+.17	-.02

* Significant at $p < .05$ (two-tailed)

Note: N = 59

Table 24

Correlations between Post-Task Measures and

Residualized Change-scores for Each Cardiovascular Measure

Post-Task Measure	SBP	DBP	HR
Importance of Study	-.02	-.13	-.04
Importance of Doing Well	-.08	-.13	+.01
Experimenter was Friendly	-.03	+.02	+.09
Experimenter was Fair	+.02	.00	-.12
Felt Comfortable Verbalizing	+.21	+.07	+.03
Initially Felt Able To Perform Task	+.04	+.02	+.19
Believed Task Could Be Done in Five Minutes	-.08	-.17	+.01
Could Complete Task With More Practice	-.14	-.14	+.20
Was Satisfied with Performance	-.14	-.01	-.03
Tried His Best To Trace Star	+.23	+.18	+.18
Task Was Fun	+.08	-.21	+.13
Task Was Challenging	+.09	-.05	-.10
Task Was Frustrating	+.22	+.12	+.16
Task Was Irritating	+.15	+.27*	+.01

* $p < .05$ (two-tailed)

Note: N = 59. Table continued on next page.

Table 24 (Continued)

Correlations between Post-Task Measures and

Residualized Change-scores for Each Cardiovascular Measure

Post-Task Measure	SBP	DBP	HR
Task Was Stressful	+.19	+.18	+.08
Task Was Boring	-.21	-.02	-.27*
Task Was Interesting	+.15	.00	+.28*
STPI State-Curiosity	+.20	+.12	+.30*
STPI State-Anger	+.10	+.20	+.16
STPI State-Anxiety	+.06	+.20	+.03
Attributed Performance To Chance	-.02	-.05	-.03
Attributed Performance To Ability	+.20	+.19	-.07
Attributed Performance To Task Difficulty	-.06	+.03	-.13
Attributed Performance To Effort	-.06	-.08	+.04
Attributed Preformance To the Experimenter	-.12	-.14	-.24*

* $p < .05$ (two-tailed)

Note: N = 59

Table 25

Principal Factor Analysis of Subjective Responses Derived from Verbalizations (V) and from the Post-Task Questinnaire (PQ)

Subjective Measure	Factor 1	Factor 2
Task was Irritating (PQ)	+.79	
Task was Frustrating (PQ)	+.78	
Task was Stressful (PQ)	+.75	
STPI State-Anxiety (PQ)	+.72	
STPI State-Anger (PQ)	+.71	
Negative Affect (V)	+.31	
Positive Evaluations (V)	-.32	
Task Ease (V)	-.34	
Was Satisfied with Performance (PQ)	-.50	
Felt Comfortable Verbalizing (PQ)	-.56	
Task was Interesting (PQ)		+.79
Task was Fun (PQ)		+.72
STPI State-Curiosity (PQ)		+.61
Task was Challenging (PQ)		+.49
Initially Felt Able to Perform Task (PQ)		+.40
Swearing (V)		+.37
Experimenter was Friendly (PQ)		+.34
Attributed Performance to Ability (PQ)		+.32
Experimenter was Fair (PQ)		+.31
Attributed Performance to Chance (PQ)		-.31
Negative Evaluations (V)		-.49
Task was Boring (PQ)		-.59

Table 26

Correlations between Factor Scores and Residualized Change-Scores for Each Cardiovascular Measure

	SBP	DBP	HR
Negative Affect	+.10	+.05	+.10
Positive Involvement	+.09	-.06	+.28*

* $p < .05$ (two-tailed)

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