AN ABSTRACT OF THE THESIS OF

Sarah Ann Bremer for the Master of Science in Psychology presented in August, 1989

Title: Gender Differences in Systolic, Diastolic, and Mean Blood Pressures, Cardiac Output and Total Systemic Resistance During Stress and Recovery in Hypertensive Subjects.

Abstract Approved: T. A. Richmond

Striking differences in the acquisition of high blood pressure between men and women have been observed. Men have also shown significantly higher risk of developing coronary heart disease and related deaths than women. No clear explanation exists for these gender differences. This study evaluated possible gender-related differences in cardiac reactivity to acute stress. Variables studied were cardiac output (CO), blood pressure (BP) and total systemic resistance (TSR) during two types of stress, and during each recovery period. It was hypothesized that women would evidence less reactivity than men.

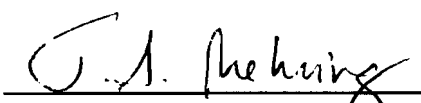
Sixty-nine hypertensive patients (44 men and 25 women) served as subjects. Following medication withdrawal, psychophysiologic reactivity was assessed employing cardiac impedance and automated BP measurement. Reactivity testing included: 20-minute self-relaxation baseline, serial 7's subtraction task, six-minute recovery, and 90-second cold pressor task with recovery.

This study utilized a three-factor MANOVA design with repeated measures on 2 factors. No differences were seen with regard to gender for any variable. For all subjects, a highly significant difference between tasks was seen in each analysis ($p < .001$). A highly significant difference was observed between stressor and recovery periods in all analyses ($p < .001$). Interactions were significant between gender and task ($p < .074$), gender and period ($p < .148$), and task and period ($p < .001$).

These results suggest that, among hypertensive patients, in regard to the specific tasks of mental arithmetic and cold pressor, gender related differences in cardiac reactivity are not significant. This conclusion must, however, be qualified in that (1) all subjects were referred for self-regulation training (2) the tasks selected may not be gender sensitive, (3) data on menstrual cycle phase are unavailable and (4) the homogeneity of the sample (all hypertensives) may limit the possibility of observing differences. Despite the absence of significant gender differences observed in this study, reactivity assessment appears to provide an exciting and objective foundation for further exploration into the uncharted waters of human psychophysiology.

ACKNOWLEDGMENT

I am grateful to Dr. Steven Fahrion and Peter Parks for their constant support and encouragement throughout every phase of this project. And I am grateful to the members of my thesis committee, Dr. Cooper B. Holmes, Dr. Tess Mehring and Dr. Phil Wurtz, for their assistance and guidance. My special thanks goes to Dr. Steven Davis, and the many staff and students at Emporia State University, who participated in my learning process which this document reflects in a concrete way. I also thank Alyce and Elmer Green, and the entire staff of the Voluntary Controls Program at the Menninger Clinic who supported and encouraged this work.



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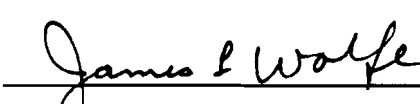

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GENDER DIFFERENCES IN SYSTOLIC, DIASTOLIC, AND MEAN BLOOD PRESSURES, CARDIAC OUTPUT, AND TOTAL SYSTEMIC RESISTANCE DURING STRESS AND RECOVERY IN HYPERTENSIVE SUBJECTS.

A Thesis Presented to The Division
of Psychology and Special Education
Emporia State University

In Partial Fulfillment of the Requirements
for the Degree Master of Science

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by

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August 1989

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CHAPTER 1

INTRODUCTION

Arterial hypertension contributes significantly to the development of a number of serious cardiovascular diseases, including heart failure, coronary heart disease and stroke. Among these disorders, cardiovascular disease ranks as the nation's leading cause of death, claiming nearly one million lives per year. Coronary heart disease, the most common form of cardiovascular disease, is the result of inadequate blood flow through the arteries supplying the muscles of the heart. It is estimated that in the United States as many as 58 million or more of the adult population have blood pressures above 140/90 mm Hg. or are taking antihypertensive medication (National Institutes of Health [NIH], 1988). The majority of these cases are patients with elevated blood pressure of undetermined origin. This particular type of high blood pressure is called "essential hypertension".

Special populations have been identified to be at greater risk for essential hypertension. Included in this group are blacks, older patients, offspring of hypertensives, and those with high normal blood pressure. The severity of hypertension in blacks is likely to be

higher than that of whites, and may develop at an earlier age. Interestingly, regional variations in blood pressure have also been observed. In the southeastern United States, blacks have a greater prevalence rate and greater stroke death rate than do blacks in other areas of the country (NIH, 1988).

In industrialized countries, another striking difference has been observed in the risk for coronary disease between men and women. It has been well documented that men have significantly higher risk of death from coronary heart disease than women (Rice, Hing, Kovar & Prager, 1983). Men also have two to three times greater risk of developing coronary heart disease than women, even when account is taken of recognized risk factors such as level of blood pressure, cigarette smoking, serum cholesterol level, relative weight, and glucose intolerance (Jenkins, 1976). Myocardial infarction and sudden death occur 10-20 years later in women than men (Dawber, 1980). It must be noted however, that the incidence of hypertension in women is significantly lower than men from puberty to age 45-50, after which time they surpass men (Holroyd & Gorkin, 1983). Despite the many known behavioral and biological risk factors currently measured, no conclusive explanation of the gender differences in coronary heart disease

morbidity and mortality exists (Wingard, Suarez, & Barrett-Connor, 1983). In an effort to explore the variables involved in gender differences in essential hypertension, this study is focused on the role of specific behavioral patterns, namely psychophysiologic reactivity to acute stress.

An emerging field of research focuses on psychophysiologic reactivity and the role it plays in the disease process. The term psychophysiologic refers to behaviorally induced responses and their associated physiologic correlates.

> Reactivity is defined as the deviation of a physiologic response parameter(s) from a comparison or control value that results from an individual's response to a discrete, environmental stimulus. The stimulus can be primarily physical or psychological in nature for example, strenuous exercise or performing a boring task, respectively (Matthews, 1986, 461-2).

Psychophysiologic reactivity measurement involves the assessment of changes in physiologic parameters when an individual is exposed to or involved in some type of psychologic or physical challenge. More recently, cardiovascular pathology has been commonly hypothesized to arise from repeated large magnitude responses to

psychological stressors (Herd, 1983; Kranz & Manuck, 1984; Matthews, Weiss, Detre, Dembroski, Faulkner, Manuck, & William, 1986; Schneiderman, 1983). Various methods are being developed to objectively measure reactivity. This new field is exploring psychophysiologic reactivity as an significant primary risk factor for the development of cardiovascular disorders.

Eliot (1982) identified two emerging areas of research related to behavioral influences on the development of coronary heart disease and essential hypertension. The first area of research included behaviors believed to increase risk such as improper diet, smoking, caffeine and immoderate alcohol consumption, and non-compliance with a prescribed medication regime. The second category investigated psychophysiologic responses (behaviorally induced responses and their associated physiologic correlates) to physical and psychological stress.

Traditionally, blood pressure level has served as the most notable factor in the clinical determination of established risk. The National Institutes of Health strongly encourages health care professionals to measure blood pressure at each patient visit (NIH, 1988). Most clinical assessments of blood pressure are based on resting (casual) office pressures. However, it is well

known that blood pressure is a variable phenomenon and is dependent on situational influences, emotional state, and anticipatory set (Schneiderman & Pickering, 1986) . Given this lability, the representative nature of blood pressure readings in the doctor's office is questionable. Some researchers have concluded that acute reactions observed in the laboratory are more useful indicators of pathophysiologic functioning than are measurements recorded under casual conditions (Krantz & Manuck, 1984). The pattern of change in psychophysiologic variables during periods of activation cannot usually be predicted or inferred from baseline measures (Manuck & Krantz, 1986). Taken together these facts point out the need to observe psychophysiologic responses in a variety of situations to empower the diagnostic, and potentially therapeutic value of the physiologic measurements. Psychophysiologic reactivity measurement is an area that provides measurable, observable, objective data to further the exploration of the influence behavior (mental, emotional, physical) plays in physiologic changes and disease.

Early investigations made by Walter Cannon (1936) revealed dramatic activation of the sympathetic nervous system associated with behavioral states such as fear and anger. However, only in the last 5-10 years has stress

received in-depth investigation as a serious and important coronary heart disease risk-related variable. Much of the literature on stress that defines stress follows a stimulus model. The stimulus model focuses on stress as any action or situation that places special physical or psychological demands upon a person that unbalance his or her equilibrium. In contrast, Hans Selye (1974), a Canadian scientist and the father of modern stress research, proposed that "stress is the nonspecific response of the body to any demand made upon it" (p. 27). This identifies stress not as a precipitating agent or stimulus but instead as the response to such agents. Included in his response definition of stress was the concept of a basic stress response pattern which included changes such as increased blood pressure and heart rate. More recently researchers have observed highly individualized response patterns to challenging stimuli. Many of these researchers attribute these individual response patterns to the notion that the way the stimulus is perceived, the setting, and the individual's personal resources all affect psychophysiologic responses (Lazarus, 1966; Kasal, 1984).

Lazarus and Folkman (1984) provided a definition of stress that is best characterized as relational rather

than stimulus or response oriented. In this model, stress is seen as a particular relationship between the person and his or her perception of the environment. More specifically, they define psychological stress as "a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (Lazarus and Folkman, 1984, p. 19). Both the stimulus and the response are included in this definition, but a new concept has been introduced, in that it is the person's appraisal of the stimulus which mediates the response.

A wide range of experimental tasks have been used in reactivity measurement research. Three general categories of tasks were effectively described by Krantz, Manuck and Wing (1986). These three task categories are determined by the way the task demands are structured. The first category, "situational" and "interactive" eliciting tasks are those which include interpersonal spontaneous role-playing, structured interview, public speaking, and games involving cooperation or competition. These tasks provide a wealth of information because of the relative naturalistic format. However, these eliciting tasks are often difficult to standardize and administer. A second category of experimental tasks are "mental intake" tasks

which incorporate the use of mental challenge such as arithmetic, vigilance, reaction time, cognitive problems and others. The last type of procedure, "passive participation", such as viewing a movie, or being exposed to physical stimuli, limits the subjects' perceived opportunity to cope. These passive tasks require sensory intake with limited cognitive activity. These three reactivity task categories are concerned with the procedural aspects of the experimental situation.

Beyond the procedural factors of response eliciting tasks, there are many other important aspects that can affect the magnitude and pattern of the reactivity response. The presentation of task instructions can impact on the quantitative form of the physiologic response. For example, the response can be markedly increased or decreased by the level of challenge employed, ranging from repetitive low demand to highly demanding tasks (Obrist, et al., 1978). Others have concluded that among young women, direct interpersonal challenge represents a more effective stimulus for the elicitation of psychophysiologic reactivity (Polefrone & Manuck, 1987). At this stage there are no standardized reactivity protocols or standardized measurement variables

established. Increases in blood pressure are elicited in the laboratory by an array of tasks, such as those described above, combined with a variety of instructions.

The two basic mechanisms involved in arterial pressure control are cardiac output (CO) and total systemic resistance (TSR). CO is related to the volume of blood leaving the heart with each contraction (stroke volume) and the heart rate. Hole (1978) noted "These actions are affected by mechanical, neural and chemical factors.... the more blood that enters the heart from the veins, the stronger the ventricular contraction, the greater the stroke volume, and the greater the cardiac output" (p. 590). TSR is regulated primarily by neurally and hormonally regulated changes affecting the diameter of arterioles. The smaller the diameter of the blood vessels of the arterial tree, the greater the resistance to blood flow. There is much supportive evidence for the view that the autonomic nervous system greatly influences both the development and the maintenance of essential hypertension, and in particular that psychologic factors may influence blood pressure changes by increasing the CO, and by constricting arterial diameter.

A close look at the mechanisms responsible for blood pressure change reveals three primary hemodynamic

patterns, alpha-adrenergic, beta-adrenergic and the combined reactor pattern involving both alpha and beta responses. Specific tasks, such as cold pressor, are known to elicit alpha-adrenergic activity (Buhler, Bolli, Hulthen, Amann, & Kiowski, 1983). Mental arithmetic appears to activate beta-adrenergic arousal (Obrist, 1982). Andren and Hansson (1980) found the increase in blood pressure during the alpha-adrenergic cold pressor task was due to significant increases in TSR accompanied by minimal increases in CO. Conversely, during the beta-adrenergic mental arithmetic task, the CO significantly increases and TPR is slightly elevated.

Keys et al. (1971) observed that the magnitude of a subject's diastolic BP responses to the cold pressor test correlated significantly with the development of coronary heart disease at a 23-year follow-up. More recently, a research group investigating mental stress found that the magnitude of myocardial ischemia induced by mental stress was similar to that induced by physical exercise (Rozanski, et al., 1988). In that study it was concluded that "since mental stress may occur more frequently than stress from exercise in daily life, it could represent an important and largely unrecognized factor in the precipitation of more severe clinical coronary events" (p. 1011). Evidence supporting the role of <u>behavior</u> in

the etiology of coronary heart disease is also derived from research concerning the Type-A coronary-prone behavior pattern (Eliot, 1982). Included here are variables such as elevated blood pressure, and increases in heart rate, CO and TSR. It is these psychophysiologic responses that are the main focus of this investigation.

Very few studies have primarily investigated gender as a variable in cardiac responsiveness to various stressors. Of those that do exist, most have only used male subjects and have primarily focused on the Type-A coronary prone characteristics. The small number of these studies that have included females have tended to report on differences and similarities within the group of females, with varied findings. Some studies report Type-A females to be more physiologically reactive to various stimuli than their Type-B counterparts (Weidner & Matthews 1978; Lundberg & Forsman, 1979; Lawler, Rixse & Allen, 1983). No differences in reactivity in women have been reported by others (Manuck, Craft & Gold, 1978; Waldron, Hickey, et al. 1980; Lane, White & Williams, 1984).

Currently, controversy exists in the literature concerning the measurement of the Type-A pattern. Matthews (1983) suggested that the biggest problem inhibiting progress in understanding Type-A behavior and its associated coronary proneness has arisen because of

the way Type-A characteristics have been measured. This measurement issue clouds the significance of the research and leads some researchers to find variables that can be more objectively measured.

Animal studies using male cynomolgus monkeys found "high" physiologic reactivity animals to have twice the coronary artery atherosclerosis than their "low" reactive counterparts (Manuck, Kaplan & Clarkson, 1983). Another study by the same research group found the same results when female cynomolgus monkey were studied (Manuck, Kaplan, Adams, & Clarkson, 1989). Recently, a carefully executed study investigating gender differences in lipids and lipoproteins in response to acute stress noted significant differences between healthy young males and females (Stoney, Matthews, McDonald, & Johnson, 1988). They found men to consistently show larger increases in low density lipoprotein-cholesterol than women during each of three diverse stressors. Also observed were cardiovascular changes with males exibiting higher blood pressures during stress relative to females. During a video taped speech, females responded with higher heart rates than males, but showed less response than males during the self-evaluation of the video task.

An extensive meta-analytic review of gender differences in physiological response to stress in

coronary heart disease recently appeared in Psychophysiology by Stoney, Davis and Matthews (1987). They reported three major findings. First, females had higher resting heart rates than males. Second, females had lower resting systolic blood pressure than males. Third, males had larger urinary epinephrine responses during stress than females. These researchers concluded that more investigation of gender differences in physiological responses to acute stress is needed to begin to understand more fully the enormous gender differences in coronary heart disease morbidity and mortality.

No thorough examination has yet been conducted of gender differences in coronary heart disease morbidity and mortality as a factor of gender differences in cardiovascular responses to behavioral/psychological challenge (stress). To the degree that consistent, large magnitude physiologic reactivity during challenge elevate's risk for coronary heart disease, it is first important to investigate the extent and quality of gender differences in stress-induced physiological responses (Stony, et al., 1987).

The purpose of this research is to study possible gender differences in physiologic reactivity as reflected in blood pressures, CO, and TSR during two types of stress and during the recovery period following each stressor. It

is hypothesized that women, as compared to men, will show less reactivity both on a task designed to enhance output-driven increases in blood pressure (serial 7's) as well as on a task previously observed to enhance systemic resistance (cold pressor).

CHAPTER 2

METHOD

Subjects

The subjects were 69 patients with diagnosed hypertension who volunteered to participate in a hospital-based research project investigating biobehavioral treatment of essential hypertension. Fourty-four men and twenty-five women were selected and matched for age and blood pressures. The study protocol was approved by the Menninger Ethical Review committee, and informed consent was obtained from each patient after thorough explanation of the protocol.

Apparatus

Twice weekly office blood pressures were obtained from the subjects using a Hawksley random-zero sphygmomanometer. The reactivity lab consisted of two rooms connected by an audio system. The first room housed the materials used to prepare the subject for physiologic monitoring and an IBM-XT used to save data obtained from the physiologic monitors. The second, the testing room, was supplied with a BOMED Noninvasive Continuous Cardiac Output Monitor (NCCOM) and a blood pressure monitor. Blood pressures were obtained with the Vita-Stat 900-S

which is an automated, non-invasive, microprocessor controlled blood pressure monitor. The testing room was furnished with a recliner chair for the subject, a table, a lamp, and a chair for the examiner.

During reactivity testing, systolic blood pressure (SBP) and diastolic blood pressure (DBP), mean arterial blood pressure (MAP), CO, and TSR were measured. SBP is the maximum pressure achieved during ventricular contraction. DBP reflects the lowest pressure in the arteries before the next ventricular contraction. MAP is the average pressure tending to push blood through the systemic circulatory system. The MAP is the average pressure throughout the pressure pulse cycle and is an important variable related to tissue blood flow (tissue perfusion). CO, measured in liters per minute by the Bomed NCCOM, is the product of stroke volume and heart rate and expresses the perfusion capability of the heart. The first and major component of TSR is the tone of the blood vessels, or the friction between the blood and the walls of the blood vessels. The second and less variable factor is the viscosity of the blood. TSR is a calculated value obtained by dividing the MAP by the CO.

Procedure

After orientation and acceptance, all subjects were placed in a stepped medication withdrawal phase by the

project physician in cooperation with the subject's physician. The subjects were taught to measure their own blood pressures, and these measures were validated twice weekly by the blood pressure technician using a random-zero sphygmomanometer. Subjects were considered suitable for the study after successful withdrawal from all anti-hypertensive medication. Success was based on the ability to come off medication without exceeding systolic pressures of 160 mm Hg or diastolic pressures of 105 mm Hg on three successive measures. A four week baseline period followed the medication withdrawal phase.

Psychophysiologic reactivity testing was assessed following the four week baseline period. All subjects were medication free for a minimum of four weeks prior to testing. Resting baseline values were established from the average of blood pressures obtained by the blood pressure technician using a ramdom-zero sphygmomanometer. Psychophysiologic reactivity was then evaluated during two conditions routinely used for simulating life-stresses alternating with recovery periods. A low challenge format was used in the presentation of the tasks. Serial 7's, a mental arithmetic task was administered. This procedure involved subtracting by 7, continuously, quickly and accurately for three minutes, starting at a 3 digit number greater than 700. During the cold pressor test, the

subject was asked to immerse his/her hand up to the wrist for 90 seconds. (See Appendix A for complete Reactivity Assessment Protocol)

The reactivity protocol began with a 20 minute physiologic adaptation and baseline period with the examiner out of the room. The examiner then returned to the testing room and administered the serial 7's subtraction task for three minutes, followed by a 6 minute recovery period, then a 90 second cold pressor (hand in ice water) test followed by a 6 minute recovery period. The session concluded with another 6 minute recovery period with the examiner out of the room. During the baseline and all recovery periods the subject was asked to sit quietly and relax.

Reactivity test protocol summary:

Baseline - 20 min. (examiner out)

Serial 7's - 3 min.

Recovery - 6 min.

Cold Pressor - 90 sec.

Recovery - 6 min.

Recovery - 6 min. (examiner out)

CHAPTER 3

RESULTS

This study utilized a 3 factor MANOVA with repeated measures on 2 factors. The 3 factors were:

1) GENDER (Male/Female)

2) TASK (Serial 7's/Cold Pressor)

3) PERIOD (Stress/Recovery).

The Task and Period factors involve repeated measures on the same subjects. The variables studied were:

1) Cardiac Output (CO),

2) Total Systemic Resistance (TSR),

3) Systolic Blood Pressure (SBP),

4) Diastolic Blood Pressure (DBP),

5) Mean Arterial Pressure (MAP).

Using CSS, a statistical software package, three separate MANOVA'S were performed on the data grouped in the following manner:

1)CO and TSR,

2)SBP and DBP and

3)MAP.

SBP and DBP, as separate measures collected at the same time, were analyzed together. A second MANOVA was

performed on MAP, a calculated variable based on SBP and DBP, and also a factor in calculating TSR; thus it was analyzed separately. CO and TSR were analyzed together because data points on these variables were matched in time. For the multivariate analyses, significance level was defined according to convention as $p < .15$. The MANOVA'S were performed to compare:

1) GENDER - physiological reactivity of women to men
2) TASK - serial 7's to cold pressor
3) PERIOD - stress to recovery.

With regard to gender, no significant differences were observed for any variable (SBP & DBP, MAP, and CO & TSR). However, a highly significant difference between the two tasks (serial 7's & cold pressor) was seen in each analysis for the entire group (SBP/DBP $F(2/66)=28.29$, $p < .001$; MAP $F(1/67)=37.59$, $p < .001$); CO/TSR $F(2/66)=16.21$, $p < .001$). These effects were due primarily to higher DBP, and higher TSR, on cold pressor as compared to serial 7's. For the entire sample, a highly significant difference was observed between stressor and recovery periods in all analyses (SBP/DBP $F(2/66)=126.89$ $p < .001$; MAP $F(1/67)=235.13$ $p < .001$; CO/TSR $F(2/66)=49.84$ $p < .001$), with SBP and DBP variables playing a determining role in the stress periods, and CO playing the primary role in the recovery periods.

Several significant interactions were revealed in these MANOVA's. The interaction between gender and task was significant ($F(2/66)=2.71$ $p <.074$) due primarily to SBP, with women somewhat lower during serial 7's, and showing better recovery than men during cold pressor recovery. Men showed comparable SBP on the two tasks but somewhat better recovery from cold pressor than from serial 7's. The interaction between gender and period was not significant for SBP/DBP and for CO/TSR, but was significant at the .15 level for MAP $F(1/67)=2.14$ $p <$ .148. For the entire sample a highly significant interaction was seen in each analysis between task and period (SBP/DBP $F(2/66)=13.43$ $p < .001$; MAP $F(1/67)=16.85$ $p < .001$; CO/TSR $F(2/66)=8.79$ $p < .001$). In the first analysis this effect was due primarily to DBP, which was higher for cold pressor but showed better recovery as compared to serial 7's; in the last analysis the effect was due primarily to CO, which was higher for serial sevens than cold pressor, but showed better recovery. For all three analyses, the interaction between gender, task and period was not significant.

CHAPTER 4

DISCUSSION

In summary, these results suggest that, among hypertensive patients, in regard to the specific tasks of mental arithmetic (serial 7's) and cold pressor, gender-related differences in cardiac reactivity are not significant, since no difference in reactivity was observed. This conclusion must, however, be qualified in that (1) all subjects were physician referred or self-referred for self-regulation training and may not be representative of hypertensive patients at large, (2) the types of tasks selected may be unique in that they are not gender sensitive, (3) data on menstrual phase, known to affect cardiac reactivity in women, are unavailable for these subjects and could not be taken into account, and (4) the homogeneity of the sample (all diagnosed hypertensives) may limit the possibility of observing differences compared to those seen with men and women at large. The fact that these women have been diagnosed with hypertension, may account for the lack of gender differences in reactivity. The data collected in this

study reflects a strong tendency of these diagnosed hypertensive subjects to respond physiologically in similar ways.

With regard to sampling concerns, there is need to consider that a given sample of essential hypertension patients who volunteer for a biobehavioral psychophysiologic program may not represent the general population of hypertensive patients (Leigh, Ungerer, Ostfield, Drake & Reiser, 1976/77). These sampling considerations must be taken into account in qualifying any generalizations to be made from this and any other research in this area.

The effects of differences in task characteristics are complex and often overlap with the influence of the setting and instruction. For this reason, several investigators have explored a variety of tasks as elicitors of different physiologic patterns. Certain tests such as the cold pressor test are known to elicit alpha-adrenergic activity wich vasoconstriction dominating (Buhler, Bolli, Hulthen, Amann, & Kiowski, 1983). Other tasks involving some type of challenge are believed to exert their influence through beta-sympathetic arousal (Obrist, 1982). However, if the cold pressor test is combined with highly challenging instruction, a beta-adrenergic component may elicit a combination of

effects. In an effort to enhance treatment and diagnostic applications of the reactivity data, researchers must recognize that task selection, the setting and the type of instruction may influence outcome. In the current study it is possible that the specific tasks used to elicit a response are not gender sensitive. The extent of gender differences, or lack of, in both the current and previous studies may be due less to gender and more to an interaction of gender and stimulus (task) characteristics.

Hormonal factors have been assumed to be important players in the lower rate of coronary heart disease incidence in women (Kannel, Hjortland, McNamara, & Gordon, 1976). However, the mechanisms involved have not been clearly established. Hastrup and Light (1984) conducted a study to test the effect of the menstrual cycle phase on physiological stress. They used reaction time and cold pressor as stressors on young healthy women and men. The women tested during the follicular phase (preovulatory) of their menstrual cycle showed significantly reduced cardiovascular responsivity to a time reaction test than as compared with those in the luteal phase or with males. No differences were reported during a cold pressor test. Unfortunately, menstrual cycle information was not obtained from the subjects in the current study.

Given that all of the subjects in the current study were diagnosed hypertensives, one may speculate that perhaps female hypertensives respond physiologically similar to male hypertensives. In the current study similarities in physiologic responses were observed to be unexpectedly analogous. (See Appendix B).

More and more, decisions in clinical medicine are increasingly based on published scientific studies. Interestingly, gender differences are often disregarded in the application of many such research findings. A recent example of this followed a preliminary report from the Physicians' Health Study which is a randomized double-blind, controlled trial testing the beneficial effect of aspirin on reduction of mortality from cardiovascular disease in healthy male physicians (Physicians' Health Study, 1988). Shortly following the publication of this preliminary report, the print and electronic media carried advertising directed toward the lay public encouraging the use of aspirin to prevent heart attack. In most advertisements no mention was made of the special nature of the population studied, the increased risk of cereberal & intercranial bleeding or the problem that arises when the study results are applied broadly, as in this example, to women as well as men (Young, Nightingale & Temple, 1988).

Nonetheless, these results suggest that, among these hypertensive patients, gender-related differences in reactivity are minimal on these particular tasks. For this group of subjects, the reactivity-related risk appears to be equal for both sexes, since no difference in reactivity was observed. The evident lack of difference in cardiac reactivity between the sexes points to a need to further examine gender differences in coronary heart disease morbidity and mortality as a factor of individual differences in cardiovascular responses to behavioral and/or psychological challenge (stress).

The link between reactivity and disease is not yet clear. Further refinement and standardization of reactivity protocols will result in a more complete understanding of the relationship between mind and body. The emerging data from the current reactivity work will contribute to the development of reactivity testing procedures for use in the lab as well as the doctors office. Reactivity assessment provides an objective foundation for further exploration into the uncharted waters of human psychophysiology.

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APPENDIX A

REACTIVITY LAB PROTOCOL:

The subject will be greeted by the examiner in the lobby and escorted to the Cardiac Reactivity Laboratory. To facilitate subject accommodation to the testing environment the examiner shall conduct a short tour of the lab area and provide a general explanation of the recording equipment. A description of skin preparation, electrode placement and the application procedure of other devices to be attached to the subjects body will be given using a drawing that illustrates the electrode and sensor placements.

Subject Preparation:

Provide gown and prepare skin with an alcohol scrub. Locate and mark electrode positions and apply electrodes. Answer questions the subject has at that time.

Instrument Hookup:

Connect subject to the monitoring equipment. Check the comfort of the participant and offer blanket, pillow, and adjust wires. Observe physiologic monitoring equipment and confirm that everything is set up properly. Give final instructions, start

computer recording of physiological data and leave room.

Instructions:

"All of this equipment will be taking measurements and monitoring processes going on in your body. It has been thoroughly checked out to be sure there is no hazard to you from any of it. Overall we will be recording data for about an hour. We can stop if you need to, but you can get a drink or use the rest room now if you like, before we begin."

"Throughout this recording session the equipment will automatically take your blood pressure as well as collect other data. While your pressure is being taken, just breathe normally. As much as you can, sit quietly throughout the session so the data will be accurate. To begin with I want you to allow yourself to relax as well as you can on your own for about 20 minutes. There will be two different tasks that vary in length, and then each task is followed by a short period of about six minutes to allow you to relax".

"I will be in the other room for about 20 minutes to check the recording equipment, and to give you a chance to relax. This room is set up so I can hear you from next door, so if you need me just speak in a normal voice and I will be able to hear you. When I come back to the room just keep relaxing and I'll tell you when we are ready to begin.

Data Period #1:

BASELINE: "Everything is set to go, so all I ask you to do is to sit quietly and allow yourself to relax, and remember you can contact me through the intercom system."

(In 20 minutes return to the testing room to begin task/recovery phase.)

Data Period #2:

SERIAL SEVENS: "To begin with, I have a mental arithmetic task. I will ask you to subtract 7 from 777 in continuous order. Please do it as accurately and rapidly as possible. See how far you can get! You have three minutes. Begin now."

Data period #3:

SEVENS RECOVERY: "Now take six minutes to allow yourself to relax. I will tell you when the time is up"

Data period #4:

COLD PRESSOR TEST: "All right! "Now I'm going to ask you to put your hand up to the wrist in this container of ice-water and hold it there for the next 90 seconds with your fingers spread apart. Although the water will be cold and uncomfortable, it will not damage your hand. It is important that your hand remain in the water for the full 90 seconds. If it becomes too uncomfortable, you may remove it."

Data period #5:

COLD PRESSOR RECOVERY: "Ok that's it! Now take another six minutes to allow yourself to relax. I will tell you when the time is up."

Data period #6:

FINAL RECOVERY: "Now I'd like you to continue relaxing on your own while I'm in the next room.

I'll be able to hear you as before if you need anything, but take another six minutes to see if you can get even more relaxed." Examiner leaves room for six minutes.

Return to SUBJECT room. "We are almost all done. I will disconnect the wires, remove the sensors and we will be finished with this session."

APPENDIX B

GROUP MEANS FOR STRESS AND RECOVERY PERIODS

SYSTOLIC BLOOD PRESSURE				DIASTOLIC BLOOD PRESSURE			
7'S STRESS		7'S RECOVERY		7'S STRESS		7'S RECOVERY	
M	F	M	F	M	F	M	F
144.9	139.2	134.6	127.3	96.1	95.4	88.0	87.0
COLD STRESS		COLD RECOVERY		COLD STRESS		COLD RECOVERY	
M	F	M	F	M	F	M	F
147.3	145.5	132.7	130.3	103.7	107.3	89.4	88.7

CARDIAC OUTPUT				TOTAL SYSTEMIC RESISTANCE			
7'S STRESS		7'S RECOVERY		7'S STRESS		7'S RECOVERY	
M	F	M	F	M	F	M	F
7.3	7.1	6.57	6.58	1323.9	1326.5	1390.1	1318.0
COLD STRESS		COLD RECOVERY		COLD STRESS		COLD RECOVERY	
M	F	M	F	M	F	M	F
6.8	6.8	6.5	6.5	1467.9	1527.0	1415.3	1405.5

MEAN BLOOD PRESSURE			
7'S STRESS		7'S RECOVERY	
M	F	M	F
111.2	107.0	116.3	117.7
COLD STRESS		COLD RECOVERY	
M	F	M	F
101.7	97.0	102.1	99.0