Inter-Personal Stress, Hostility and Salt-Intake

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A Thesis

in

The Department

of

Psychology

Presented in Partial Fulfilment of the Requirements
for the Degree of Master of Arts at
Concordia University
Montreal, Quebec, Canada

ISBN 0-315-87?63-2

Abstract

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The present study examined the role of inter-personal stress in elevating salt-intake in human male subjects with a particular focus on the effects of hostility in moderating this relationship. Salt-intake was assessed in 79 young male undergraduates following completion of a mathematical subtraction task. Half of the subjects engaged in the math-task while being harassed through anger-provoking statements. Following the math-task all subjects had to ingest a sodium-free soup. The soup was presented to the subject together with a salt-shaker without any comments. Subjects were categorized into low and high hostile individuals based on the Buss-Durkee Hostility Inventory scores. A significant hostility group effect for salt intake indicated that high hostile subjects consumed significantly more salt than low hostile individuals irrespective of the harassment condition. High hostile harassed individuals, however, did exhibit significantly greater cardiac output, forearm blood flow and forearm vascular resistance when compared to high hostile non-harassed individuals or low hostile individuals. Results suggest two pathways by which hostility may confer risk for cardiovascular disease, i.e., elevated cardiovascular stress

responses, and high sodium intake. These factors may also interact to further elevate disease risk.

Acknowledgements

Firstly, I would like to thank Dr. Sydney B. Miller for his supervision, encouragement and good suggestions. Furthermore, without the involvement and active participation of Lisa Dolgoy and Aurelio Sita this project would not have been possible. Thus many thanks go to them. I also would like to acknowledge my committee member Dr. Barbara Woodside for her terrific soup idea and her invaluable comments. And last but not least I would like to thank my friend Sylvie Laflèche for caring and encouraging me throughout the years.

The thesis is dedicated to my mother Ursula Friese

Table of Contents

List of Tables

List of Figures

List of Appendices

Inter-Personal Stress, Hostility and Salt-Intake

Many researchers agree that essential hypertension is heterogenous, more a syndrome than a disease, that it is multifactorial in its initiation and its maintenance and that it possesses a complex pathogenesis (Weiner & Sapira, 1987; Weiss, 1987). That is, not one factor alone but many environmental as well as personality factors seem to be responsible for the development of essential hypertension.

The excessive intake of dietary sodium is one well documented risk factor that has been associated with an increased risk for developing essential hypertension. On first sight, there seems to be a direct positive relationship between excessive salt intake over an extended period of time and the development of essential hypertension. This relationship was first suggested by epidemiological studies which observed that variations in the prevalence of essential hypertension among different societies and cultures were at least partly due to their various levels of salt intake (Dahl, 1977; Freis, 1976; Tobian, 1975; Denton, 1982). For example, almost no hypertension is observed in societies where the average dietary sodium intake is less than one-gram per day. Increases in blood pressure with age however can be observed in countries where salt intake exceeds 10-grams a day. In addition, the prevalence of hypertension is even higher in societies like Japan, where salt ingestion is more than 20-

grams a day (Dahl, 1977; Denton, 1982; Freis, 1976; Tobian, 1975).

Despite such evidence many researchers claim that one cannot infer from epidemiological studies that a direct relationship between hypertension and salt intake exists (Anderson, 1986; Henry, 1988; Tobian, 1975). In fact, societies do not only differ in the amount of salt they ingest but also in other variables, that may have an influence on blood pressure. One such variable, for example, is stress. As well, in experimental studies where researchers have increased or decreased sodium intake in a systematic, controlled manner one cannot always observe a positive correlation between high salt intake and blood pressure (Mark, Lawton, Abboud & Fitz, 1975). That is, salt restriction lowers blood pressure and high salt intake increases blood pressures in some individuals but many individuals show no blood pressure change and some people even exhibit changes in the opposite direction (Falkner & Light, 1986; Falkner, Onesti & Angelakos, 1981; Mark et al., 1975). These results demonstrate that people respond differentially to excessive salt intake and suggest that some individuals may be more salt sensitive than others (Dahl, 1977; Weiner, 1979).

Stress has also been associated with increased risk for developing essential hypertension. Clinical observations and epidemiological studies have shown that environmental stress, operationalized as: a demanding occupation, job loss, migration, exposure to poverty and crime, war and natural disasters, contribute to the development of essential hypertension (Anderson, Mahony, Lauer & Clarke, 1987; Falkner, 1987; Harburg, Erfurt, Hauenstein, Chape, Schull & Schork, 1973).

Laboratory studies, have found that induced stress can elicit elevation in blood pressure and heart rate (Falkner, Onesti, Angelakos, Fernandes & Lagerman, 1979; Light & Obrist, 1980, Manuck & Proiette, 1982). Although such studies cannot establish a causal relation between stress and the development of hypertension Falkner, Kushner, Onesti & Angelakos (1981) found that blood pressure responses to a 10-minute mental arithmetic stressor could predict future hypertension in adolescents. As with research on sodium, however, not all individuals exhibit an enhanced cardiovascular reactivity to laboratory and environmental stressors. Krantz and Lazar (1987) state, that in addition to prolonged stress other factors, e.g. a genetic predisposition or a specific personality profile, must be present in order for hypertension resulting from stress to develop.

One personality factor that has been linked to cardiovascular diseases and other life-threatening illness is hostility (Smith,1992). Hostility has been defined as a tendency to want to inflict harm on others and/or the proclivity to feel angry towards others (Smith, 1992). It has been suggested that hostility is linked to disease processes mainly via its psychophysiological effects. Heightened cardiovascular and neuroendocrine responses to stress have been observed in hostile individuals (Engebretson & Matthews, 1992; Hardy & Smith, 1988; Pope & Smith, 1991; Smith & Allarad, 1989; Smith & Christensen, 1992; Houston, Matthew & Cates, 1989; Williams, Barefoot & Shekelle, 1985; Weidner, Friend, Ficaretto & Mendell, 1989). Furthermore, because it is suggested that hostile individuals experience anger more often and more intensively than non-hostile individuals it is hypothesized that they also more often experience increased psychophysiological reactivity (Friedman, 1992). Heightened reactivity, in turn, may be linked to the development of cardiovascular disease.

Again, however, the results of studies that have investigated associations between hostility and physiological reactivity have not always been consistent (Williams, Barefoot, Shekelle, 1985; Diamond et al., 1984; Glass, Lake, Contrada, Kehoe & Erlanger; 1983). In general, studies that used non-social stressors, such as, solvable anagrams and mental arithmetic tasks have not found an association between hostility as measured by the Hostility (HO) Scale (Cook & Medley, 1954) or the Buss Durkee Hostility Inventory (BDHI) (Buss & Durkee, 1957) and physiological reactivity (Kamarck, Manuck, & Jennings, 1990; Sallis, Johnson, Trevorrow, Kaplan, & Melbourne, 1987; Smith & Houston, 1987). Studies that have used inter-personal stressors, on the other hand, have in general found a positive relationship between hostility and cardiovascular reactivity. For example, Suarez and Williams (1989) found that compared to performing an anagram task alone, the anagram plus harassment task led to increased cardiovascular reactivity that was more elevated for high HO subjects than low HO subjects. In addition, Hardy & Smith (1988) found that a high hostile group exhibited greater diastolic blood pressure reactivity during inter-personal conflict when compared to a low hostile group. Furthermore, Smith & Allred (1989) found that high hostile individuals exhibited greater systolic and diastolic blood pressure to inter-personal stressors than low hostile individuals. Baggio, Supplee and Curtis (1981), using a stressor that involved anger-provoking situations, however, found that hostility as measured by the Buss Durkee Hostility Inventory was not associated with increased cardiovascular reactivity.

There is also evidence that psychological stress may interact with sodium intake to elevate cardiovascular reactivity which may subsequently lead to the development of essential hypertension (Anderson, 1986; Mark et al., 1975; Rankin, Luft, Henry, Gibbs & Weinberger, 1981). Such an interaction has been reported by Anderson, Kearns & Better (1983). For a period of two weeks dogs were exposed to high salt intake and daily stress. This salt-stress combination led to a prolonged elevation of blood pressure in the animals. Of interest here is that neither sodium nor stress alone could raise blood pressure. In an experiment with human subjects, Haythornthwaite, Prately & Anderson (1992) examined blood pressure responses to high sodium intake during two types of behavioral stress. Thirty-two students were randomly assigned to either a high sodium (1-600 mg/tablet per 4.5 kg body weight) or normal-sodium (placebo tablets) condition. Resting blood pressure responses were taken across a 14-day period preceding either a high stress period (examinations) or a low stress period (low academic demands). Haythornthwaite et al. (1992) found that high sodium intake during the high stress period resulted in greater elevations in resting systolic blood pressure and mean arterial pressure than either the normal sodium intake during the high stress period or the high sodium intake during the low stress period. The researchers suggested that behavioral stress can potentiate the effects of salt on resting blood pressure.

Denton (1982) suggests that societies vary in their habitual salt intake and in their exposure to psychosocial stress. Thus, life in some societies is more stressful than in others and Denton (1982) suggests that high salt consuming societies experience more stress than low salt consuming societies. Evidence in support of this comes from a study by Prior, Grimley, Harvey, Davidson & Lindsey (1968) who compared two Polynesian populations and found that blood pressure in Roratongans increased substantially with age but that blood pressure in Pukapukans did not change throughout their life span. These investigators suggested that a differential habitual salt-intake was responsible for the phenomenon observed. That is, Roratonga individuals ingested on average about 8 grams of salt per day while individuals in Pukapuka only ingested approximately half as much.

Henry (1988), however, proposed that differential exposure to stress may have been responsible for the observed difference in blood pressures in the two Polynesian populations. That is, individuals in Pukapuka live peaceful lives without any clocks and time constraints. Roratongans on the other hand after 60 years of a repressive government live in a more westernized society with all its pressures.

Animal research has shown more directly that exposure to stress induces salt appetite in mice and wild rabbits (Denton & Nelson, 1980; Kuta, Bryant, Zabik, & Yim, 1984). Denton & Nelson (1980), for example, found that stressing wild rabbits by the application of restraining jackets increased significantly their intake of 0.5 m NaCl solution.

Other studies have found that the systematic administration of stress hormones, such as adrenocorticotropin (ACTH), cortisol, corticosterone, or deoxycorticosterone acetate (DOCA), increased the sodium ingestion of rabbits and rats (Blaine, Covelli, Denton, Nelson & Shulkes, 1975; Denton & Nelson, 1970; Tarjan & Denton, 1990; Weisinger, Denton, McKinley & Nelson, 1978). Folkow et al. (1985), suggested that the observed 10-15 grams daily intake of NaCl in stressful societies might reflect a "psycho-physiological resetting to the environment" similar to the increase in salt appetite observed in stressed animals.

The goal of the present study was to examine the role of inter-personal stress in elevating salt-intake in human male subjects with a particular focus on the effects of hostility in moderating this relationship. Salt-intake was assessed in young male undergraduates after a nine-minute mathematical subtraction task (math-task). Half of the subjects engaged in the math-task while being harassed through anger-provoking statements (harassment condition; see Appendix A). Hostility was assessed using the Buss-Durkee Hostility Inventory (BDHI). It was hypothesized that individuals in the harassment condition would ingest significantly more salt than individuals in the non-harassment condition. Research suggests that individual differences in hostility may moderate the cardiovascular response to stress, particularly during inter-personal stress situations (Kamarck, Manuck, & Jennings, 1990; Sallis, Johnson, Trevorrow, Kaplan, & Melbourne, 1987; Smith & Houston, 1987). It was therefore further hypothesized that high hostile individuals would ingest significantly more salt than low hostile individuals again during the harassment condition.

Method

<u>Subjects:</u>

A total of 89 healthy, normotensive male undergraduate students between 18 and 35 years of age were recruited from the student population of Concordia University in the following way. Each interested subject had to complete a Food Preference Questionnaire to rate their customary salt consumption on a scale from 1 (not at all) to 7 (very much) (see Appendix B) and a Health Questionnaire, stating their own and their parents health and blood pressure status (see Appendix C). Individuals were excluded from participating in the actual laboratory project: if they had any serious physical or psychological health problems and/or if they used medication on a regular basis that could influence blood pressure. Forty subjects were randomly assigned to a non-harassment condition and 49 individuals were randomly assigned to a harassment condition. Ten subjects had to be eliminated from the harassment condition; nine because they did not believe the anger-provoking scenario and one because he demanded the experiment to be stopped. Thus, a total of seventy-nine subjects, 39 in the harassed condition and 40 in the non-harassed condition entered the final data analysis. Subjects did not differ significantly in age, weight and customary salt-intake as a function of harassment condition or hostility group (see Appendix D).

Measures and Apparatus:

Measurements of systolic and diastolic blood pressure (in mm Hg) were obtained at one minute intervals using the IBS Automated Blood Pressure and Pulse Rate Monitor SD-700 A. The blood pressure cuff was placed on the subject's left thigh. Blood pressure values were corrected for the distance from the heart level according to the manufacturer's instruction.

Heart rate (in bpm), cardiac output (in ml\min.) and pre-ejection period (in msec) values were obtained non-invasively using the Minnesota Impendence Cardiograph Model 304 A, an EMPAC IBM compatible personal computer, a tetrapolar electrode-band configuration, EKG spot electrodes and the COP program created by BIO-Impendence Technology Chapel Hill, North Carolina. Within every minute 30 seconds of recordings were obtained and averaged across 1-minute periods.

Pre-ejection period was used as an index of sympathetic nervous system influences on the myocardium. Pre-ejection period unlike heart rate is relatively unaffected by parasympathetic activity (Sherwood & Turner, 1992).

The inner two recording electrode-bands were placed around the base of the subject's neck and around the thorax over the tip of the xiphoid process. The outer two electrode-bands were placed around the neck and thorax at least 3 cm apart from each of the inner electrode-bands.

The EKG recording used 3 spot electrodes. Two electrodes were placed on opposite sides of the rib cage at approximately the level of the seventh rib. The ground electrode was placed on the right hip bone. The EKG signal was filtered through the Coulbourn Instrument bypass filter and then transferred to the Minnesota Impendance Cardiograph.

Forearm blood flow (in ml/min/100ml of forearm volume) was measured using venous occlusion plethysmography in the left forearm and recorded using Coulbourn Instruments, amplifiers, transducers, the Coulbourn Videograph system and an AT computer. The forearm rested on a rigid but comfortable support slightly above heart level. A mercury-in-silastic two-strain gauge was placed around the subject's left forearm approximately 5 cm below the antecubital crease. The gauge was held in place with the help of a clasp that allowed for calibration by adjusting the length of the gauge. Two blood pressure cuffs were also placed on the arm. One blood pressure cuff was placed distal to the gauge and around the wrist and the second one was placed on the upper arm.

During the recording of forearm blood flow the circulation to the hand was eliminated by inflating the wrist cuff above the subject's maximum systolic blood pressure. Venous occlusion was achieved by inflating the upper arm cuff to a pressure of 40-45 mm Hg. The wrist cuff inflation was done manually and the upper arm cuff inflation was done with the help of the Hokanson AG 101 Automated Cuff Inflator by the experimenter who was housed in another room. Blood flow measures were derived from changes in the forearm circumference resulting from the inflow of blood while venous return was blocked. Forearm blood flow, is based on the assumption that percentage change in arm circumference may be doubled to yield a percentage change in arm volume (Whitney, 1953).

Forearm vascular resistance (in units) values were calculated by dividing forearm blood flow measurements by the corresponding mean arterial blood pressure values.

The mathematical substraction task stressor (math-task) consisted of the Computerized Subtraction Version 1.21 computer program by Turner, Sherwood & Lutz, an IBM compatible PC computer and a Truemouse Model TX 300 computer mouse. The Computerized Subtraction Version consists of a series of mathematical subtraction equations with either correct or incorrect solutions. During each three minute trial 180 three second presentations of equations are presented on the computer monitor. The subject responds by pressing the right computer mouse button if he thinks the answer on the screen is correct or by pressing the left button if he thinks the answer on the screen is incorrect. If the subject's answer is correct the computer emits a high pitched tone indicating that the subject has responded accurately. If the subject's answer is incorrect the computer emits a low pitched tone indicating that the subject has responded inaccurately. If the subject does not respond within the three seconds no tone is emitted. The math-task is designed in such a way that each subject will attain a 50 to 60 percent correct response rate. That is, equations become more difficult or easier depending on the performance of each subject.

To assess trait-hostility, each subject completed the Buss-Durkee Hostility Inventory (BDHI). The BDHI is one of the most extensive self-report hostility instruments. It consists of 75 true-false items and yields information on the individual's self-reported level of general hostility. The reliability coefficients for the total score is 0.82.

Salt-intake was measured as follows: A salt-shaker filled with table salt was weighed on a Sartorius CANLAB Balance Type 2703. The salt-shaker was presented together with a hot Health Valley Sodium-Free Chicken Broth soup (407 ml) to the subject without any comments. After the subject had ingested the soup, the salt-shaker was again weighed on the Sartorius Balance. The difference in pre-soup-ingestion weight to post-soup-ingestion weight equalled the amount of salt ingested.

The experiment was conducted in a quite room with a comfortable armchair.

<u>Procedure:</u>

Each subject participated in a 1 1/2 hour session. Subjects were asked to refrain from drinking coffee and from smoking for four hours prior to the session.

Prior to the beginning of the experimental session, subjects were told that they would engage in a computerized mathematical substraction-task consisting of 3-three minute trials (math-task), then ingest a chicken broth soup and then again engage in the math-task. They were told that the purpose of the study was to investigate the influence of a nutritious meal and the ingestion of amino acids on their math-task performance and their physiological responses. All subjects were kept blind as to the real purpose of the study.

Subjects were randomly assigned to the harassment or non-harassment conditions. After the subjects were informed about the purpose of the study they were attached to the physiological apparatus by researcher A (female). Following the calibration of the physiological apparatus the subject rested for 13 minutes. During the last three minutes of rest cardiovascular baseline responses were recorded. The subjects then completed a Mood Questionnaire where they had to rate their current anxiousness, depression, irritation, anger and upsetness, on a scale from 1 (not at all) to 7 (extremely) (see Appendix E).

For subjects in the harassment condition the following procedure was then implemented. While researcher A explained the math-task to the subject, researcher B (male) entered the testing room and told researcher A that Dr. Miller wants to speak to her on the phone. Researcher A continued explaining the math-task to the subject. Once explained she excused herself and entered the adjoining room. In a voice loud enough so that the subject could overhear, researcher A pretended to engage in a telephone conversation in which Dr. Miller asked researcher A to see her right away. Researcher A then asked researcher B if he could continue testing the subject. Researcher B became angry and told researcher A, that he would not be responsible if anything goes wrong. Researcher A then entered the testing room, explained that researcher B will take over for her and left the room. Researcher B pretended to be angry while entering the testing room (see Appendix F for a more detailed description).

For subjects in the non-harassment condition the following procedure was used: Researcher B entered the testing room and told researcher A, that Dr. Miller wants to see her. Researcher A continued explaining the math-task. Once explained, she excused herself, informed the subject that researcher B will take over for her and left the testing room. A friendly researcher B entered the testing room. All subjects then engaged in the nine minute math-task consisting of 3 three minute trials.

In the harassment condition the following procedure was used during the math-task: Researcher B delivered six anger-provoking statements at predetermined fixed times. Sample statements are "Did you understand the instructions ?!", "Can't you do better than this!?" (see Appendix A). All responses by the subjects were ignored unless the subject wanted the experiment to be stopped.

In the non-harassment condition researcher B was friendly and courteous towards the subjects throughout the math-task. To assess if affect ratings had changed for subjects following harassment and non-harassment all subjects again completed the Mood Questionnaire (Appendix F) after the math-task.

Following this, the subject rested for five minutes and was then served the sodium-free chicken soup together with a salt-shaker filled with salt. The subject was requested to ingest all of the soup though no mention was made of the salt shaker. At the completion of the experimental session all subjects were debriefed about the deception and the purpose of the harassment and the true nature of the experiment was explained.

Experimenters were kept blind as to the subject's hostility score.

The study was approved by the Human Ethics Committee of Concordia University. All Subjects gave informed and written consent (see Appendix G).

<u>Data Reduction and Analyses</u>

The cardiovascular responses for all measures recorded during the experimental sessions were reduced in the following way. The three values obtained during baseline were averaged to obtain a mean baseline value. Similarly, all values acquired during the harassment and non-harassment math-task were averaged across each 3-minute period to obtain mean math-task values for each 3-minute trial. To facilitate stress analyses baseline-stress change scores were calculated as % of the mean baseline value.

Subjects were categorized into low and high hostile individuals using a tercile split on the BDHI. Individuals obtaining a score < 26 on the BDHI were considered low hostile (n = 27) and subjects obtaining > 36 scores were considered high hostile individuals (n = 24).

All data was analyzed using ANOVAs. The decision to use univariate analyses was done because the majority of research in this area uses univariate instead of multivariate analyses (McCanney & Matthews, 1988; Poleferone & Manuck, 1988; Smith & Allred, 1989; Suarez and Williams, 1989).

Results

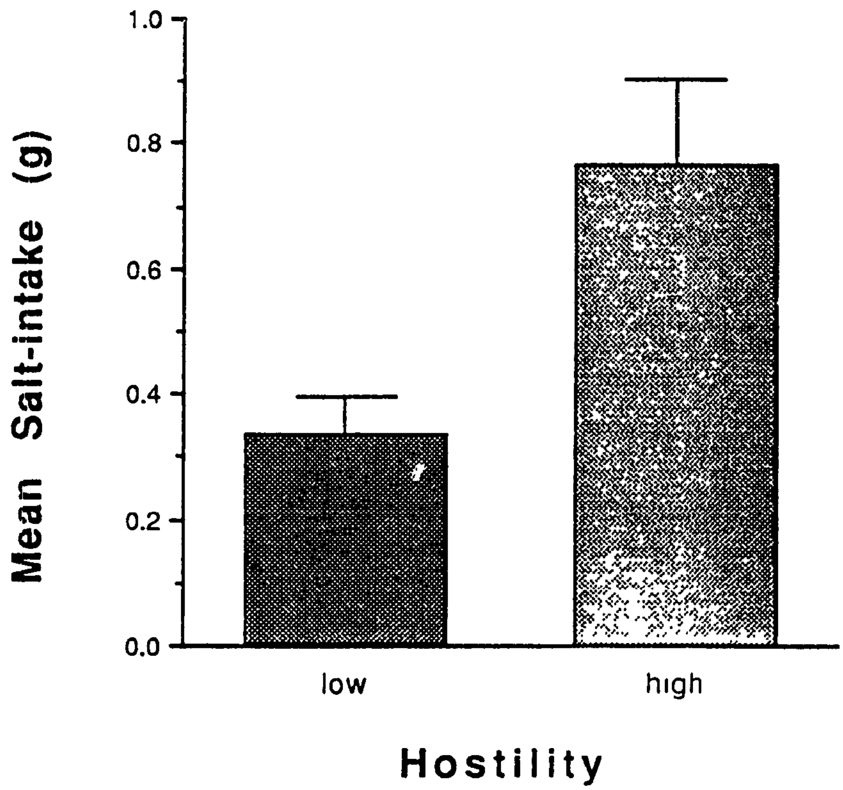
Salt-Intake

To assess whether high hostile (HiHo) and low hostile (LoHo) individuals differed in their salt intake as a function of harassment a 2 (Harassment vs Non-Harassment) X 2 (Hostility group) ANCOVA on salt-intake was conducted with subject's self-rating of typical salt-intake serving as the covariate. The analysis revealed a significant hostility group effect ($F\ 1/43 = 6.11$; $p < .017$). The effect of harassment, however, was not significant nor was the harassment x hostility interaction. These results indicate that the HiHo subjects consumed significantly more salt than the LoHo subjects (see Figure 1) irrespective of whether or not they were harassed. See Appendix H for ANCOVA summary table. Degrees of freedom are reduced in this and other analyses due to missing data.

Baseline Analyses

To assess the effects and interactions of hostility group and harassment condition on baseline values. 2 (Harassment vs Non-harassment) X 2 (Hostility group) analyses of variance (ANOVAs) were conducted on each of the following cardiovascular measures: HR, CO, PEP, FBF, FVR, SBP, DBP. Means and standard errors of resting cardiovascular values by hostility group and harassment condition are presented in Table 1.

Figure 1 : Mean salt-intake values and standard errors for low and high hostile subjects.



1.0
0.8
0.6
0.4
0.2
0.0
Mean Salt-intake (g)
low
high
Hostility

Table 1

Mean Cardiovascular Baseline Values and Standard Errors for Harassed (Har) and Non-Harassed (Non-Har) Conditions as a Function of Hostility Group

	SBP		DBP		HR	
Hostility Group	Har	Non-Har	Har	Non-Har	Har	Non-Har
low	114.4 (2.6)	112.9 (2.0)	64.0 (1.7)	60.0 (2.9)	64.9 (1.8)	58.1 (2.1)
high	112.2 (2.9)	111.1 (3.8)	59.7 (3.0)	62.5 (3.2)	63.0 (2.5)	66.3 (2.4)

	CO		PEP		FBF	
	Har	Non-Har	Har	Non-Har	Har	Non-Har
low	6.8 (0.4)	7.1 (0.4)	117.2 (3.6)	116.3 (2.8)	2.7 (0.2)	2.9 (0.3)
high	8.2 (0.4)	6.9 (0.4)	108.6 (3.1)	115.7 (3.6)	3.2 (0.4)	3.7 (0.3)

	FVR	
	Har	Non-Har
low	31.3 (2.1)	30.0 (2.9)
high	32.2 (3.8)	22.4 (1.5)

A significant hostility by harassment interaction was found for heart rate (F (1,47) = 4.72, p < .035). Simple effect analyses revealed that the HiHo subjects exhibited higher resting heart rate than the LoHo group only in the non-harassment condition (F (1,23) = 6.11 p < .022). In addition, LoHo subjects exhibited significantly greater HR baseline values in the harassed condition (F (1/26) = 5.72, p < .025). No other resting effects were significant. See Appendix I for ANOVA summary table.

Stress-Analyses

To assess the effects and interactions of harassment, hostility group and math-task trials, 2 (Harassment vs Non-harassment) X 2 (Hostility group) X 3 (3-min math-task trials) repeated measures analyses of variance (ANOVAs), were conducted on baseline-stress percentage-change scores for each of the cardiovascular measures. To address the problem of homogeneity of covariance, significant levels were determined using Greenhouse-Geisser corrected degrees of freedom for all within-factor effects (Keppel, 1991). Means and standard errors of the baseline-stress percentage change scores by hostility group, harassment condition, and math-task trials are presented in Table 2.

Table 2

Mean Cardiovascular % Baseline-Stress Change Scores and Standard Errors for Low (Lo-Ho) and High Hostile (Hi-Ho) Groups in the Harassment (Har) and Non-Harassment (Non-Har) Condition over Math-Task Trials.

	SBP			
Math-task	Lo-Ho		Hi-Ho	
	Har	Non Har	Har	Non-Har
Trial 1	13.1 (2.3)	7.9 (1.4)	14.3 (2.0)	9.3 (1.2)
Trial 2	16.3 (2.8)	10.2 (1.3)	20.0 (2.4)	8.8 (1.5)
Trial 3	17.3 (2.2)	9.9 (1.0)	23.6 (2.8)	8.3 (1.5)
	DBP			
	Lo-Ho		Hi-Ho	
	Har	Non Har	Har	Non-Har
Trial 1	13.4 (2.7)	11.9 (2.4)	21.0 (3.7)	16.7 (4.2)
Trial 2	14.7 (3.0)	15.3 (2.7)	23.1 (5.2)	14.2 (4.2)
Trial 3	11.6 (3.0)	10.6 (2.4)	16.7 (3.6)	9.6 (5.1)
	HR			
	Lo-Ho		Hi-Ho	
	Har	Non Har	Har	Non-Har
Trial 1	20.9 (5.3)	16.5 (2.6)	20.6 (3.6)	10.7(3.0)
Trial 2	19.9 (4.7)	13.2 (2.0)	23.7 (4.4)	12.0(2.8)
Trial 3	24.1 (5.2)	13.4 (1.7)	32.1 (5.2)	11.4(2.4)

Table 2 (continued)

	CO			
Math-task	Lo-Ho		Hi-Ho	
	Har	Non Har	Har	Non-Har
Trial 1	15.0 (5.9)	8.5 (2.5)	14.7 (3.2)	4.4 (2.7)
Trial 2	13.8 (7.3)	8.5 (2.4)	19.0 (4.0)	5.1 (2.1)
Trial 3	14.2 (7.1)	6.7 (2.2)	27.9 (5.7)	2.8 (2.0)
	PEP			
	Lo-Ho		Hi-Ho	
	Har	Non Har	Har	Non-Har
Trial 1	-8.0 (3.5)	-3.1 (1.5)	-8.2 (1.5)	-1.6 (1.2)
Trial 2	-5.7 (4.0)	-2.6 (1.3)	-9.6 (2.3)	-0.8 (0.9)
Trial 3	-5.9 (4.0)	-0.7(1.4)	-13.9 (3.8)	0.5 (1.4)
	FBF			
	Lo-Ho		Hi-Ho	
	Har	Non Har	Har	Non-Har
Trial 1	85.7 (20.7)	36.3 (13.6)	103.4 (22.8)	19.3 (12.7)
Trial 2	75.0 (20.7)	31.4 (11.1)	109.0 (17.1)	17.2 (11.3)
Trial 3	78.2 (19.9)	40.7 (12.4)	174.2 (35.9)	7.8 (5.3)

Table 2 (continued)

FVR

	Lo-Ho		Hi-Ho	
	Har	Non Har	Har	Non-Har
Trial 1	-32.7 (7.1)	-10.0 (7.6)	-41.0 (6.0)	5.6 (11.1)
Trial 2	-21.2 (11.2)	-9.0 (6.2)	-44.0 (4.2)	0.1 (11.3)
Trial 3	-26.7 (8.9)	-15.8 (6.0)	-53.5 (4.0)	4.8 (7.3)

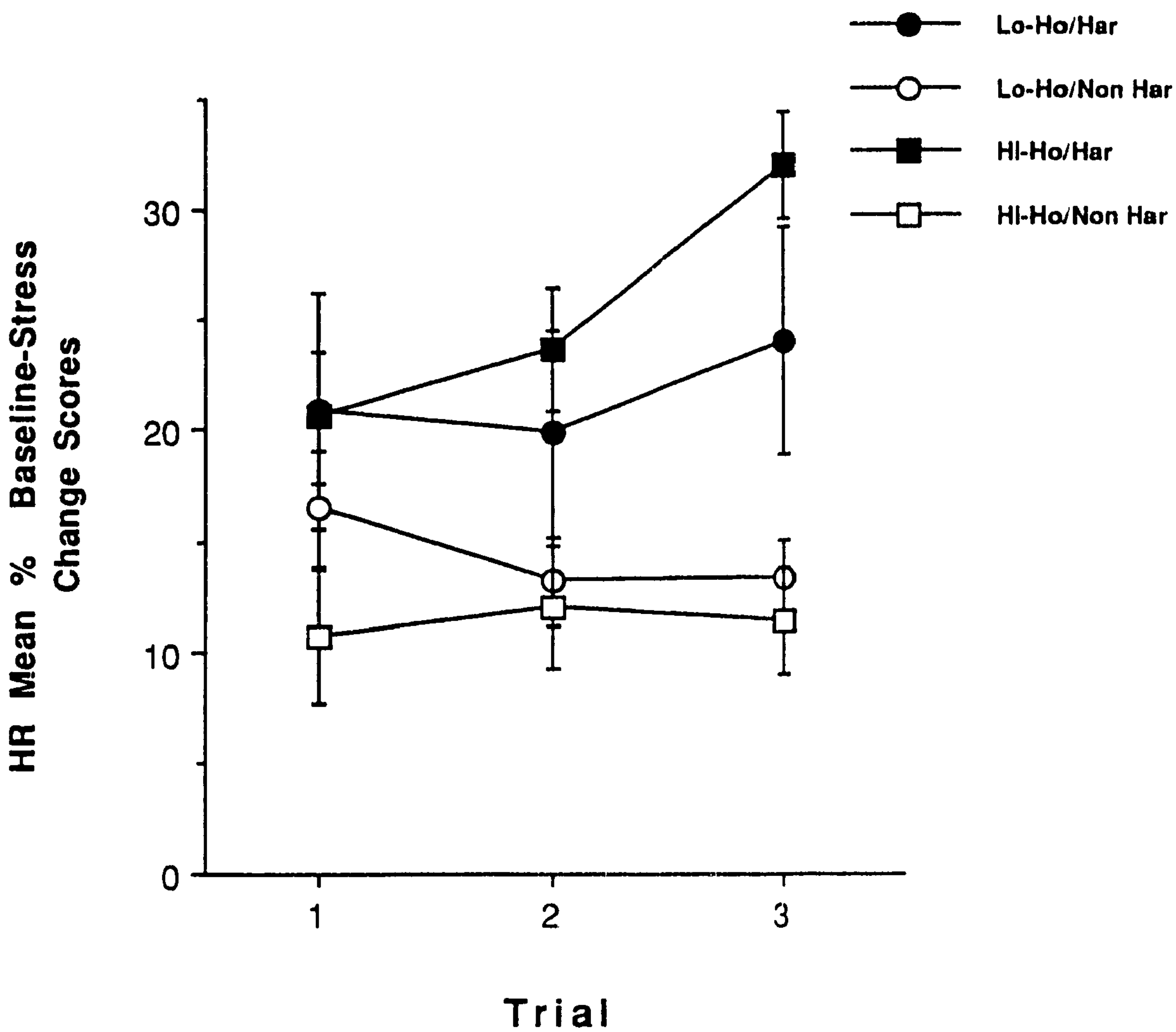
Heart Rate

Significant main effects of harassment (F (1,47) = 7.92, p < .007) and trial (F (2,94) = 6.27, p<.003) were obtained as well as significant harassment x trial (F(2,94) = 9.84, p < .000) and hostility group x trial interactions (F(2,94 = 4.75, p < .011). Analysis of simple main effects for the harassment x trial interaction indicated that heart rate responses increased as the math-task trials progressed in the harassment (F(2,76 = 19.18, p < .000) but not the non-harassment condition. Analysis of simple main effects for the hostility group x trial interaction indicated that for HiHo subjects heart rate increased throughout the 3 math-task trials (F(2,46)=8.98, p<.001) while for LoHo subjects heart rate did not increase. Taken together, these results indicate an increasing heart rate for the HiHo/harassed subjects during the course of the stressor, but no such effect for the remaining groups (see Figure 2). See Appendix J for ANOVA summary table.

Cardiac Output

A significant harassment main effect (F(1,47) = 6.75, p < .012), and significant hostility group x trial (F(2,94) = 4.18, p < .018), harassment x trial interactions (F(2,94) = 6.07, p < .003) were obtained. The 3-way interaction of hostility group x harassment x trial was also significant (F(2,94) = 4.10, p < .020). Analysis of simple main effects

Figure 2: Mean HR % baseline-stress change scores and standard errors for high (Hi-Ho) and low hostile (Lo-Ho) harassed (Har) and non-harassed (Non Har) groups as a function of trial.


Lo-Ho/Har
Lo-Ho/Non Har
HI-Ho/Har
HI-Ho/Non Har
HR Mean % Baseline-Stress
Change Scores
0
10
20
30
1
2
3
Trial

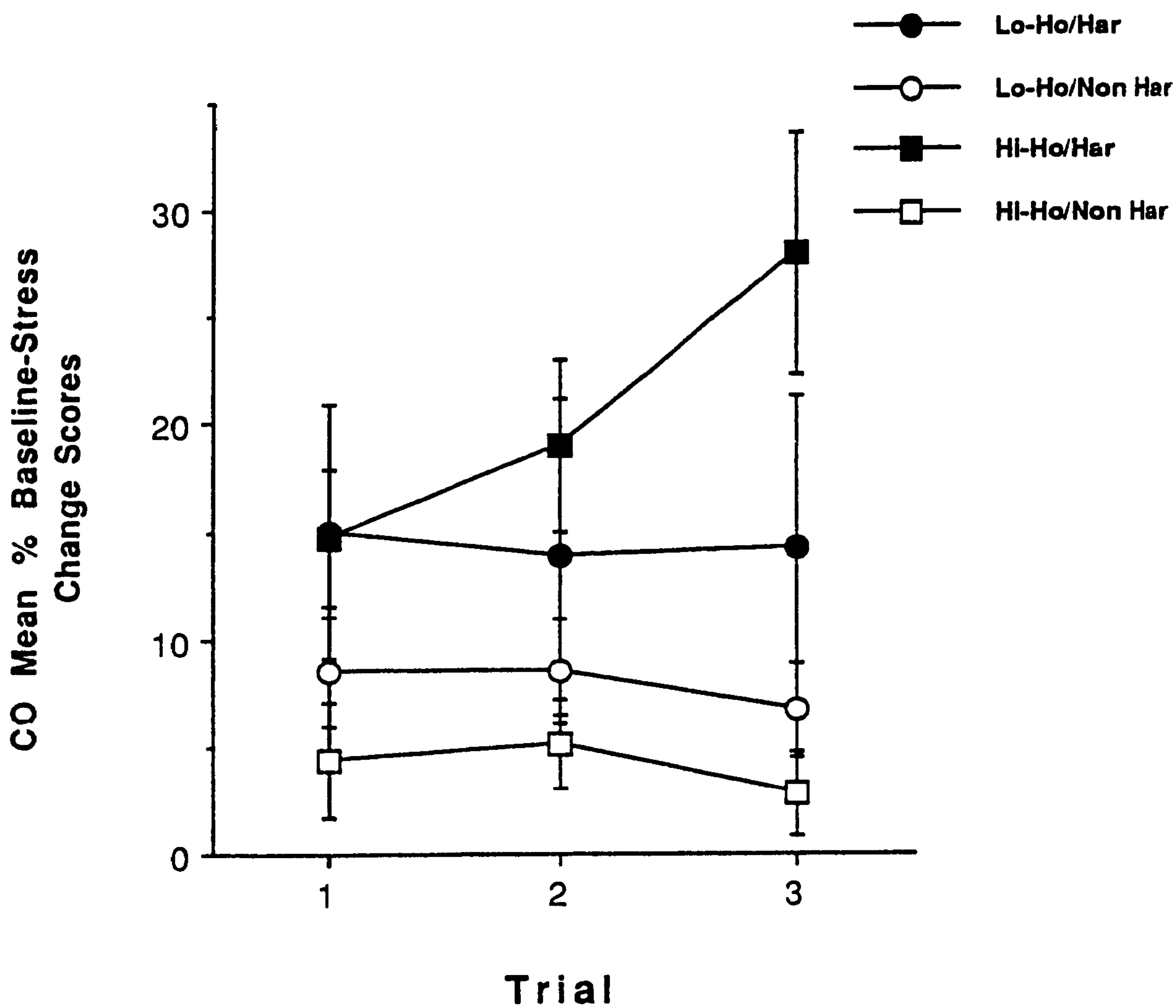
for the 3-way interaction were then conducted. Examining the effect of harassment x trial for the HiHo and LoHo groups separately revealed a significant interaction for HiHo ($F(2,44)=5.81$, $p<.006$), but not LoHo subjects. Analysis of this effect by trial indicated that HiHo/harassed subjects exhibited greater ~~heart rate~~ responses as compared to HiHo/non-harassed subjects throughout the 3 trials, but that this difference increased as the trials progressed. Examination of the hostility group x trial interaction for harassment and non-harassment conditions separately revealed a significant effect during the harassment ($F(2,50)=5.28$, $p<.008$). Analysis of this effect by trial indicated that HiHo/harassed subjects exhibited higher cardiac outputs than LoHo/harassed subjects by the third math-task trial ($p<.05$). In the non-harassed condition, HiHo and LoHo subjects did not differ in their cardiac output responses (see Figure 3). See Appendix K for ANOVA summary table.

Pre-Ejection Period

A significant harassment effect was found ($F(1,47) = 8.97$, $p < .004$), indicating that PEP was significantly reduced in the harassment as compared to the non-harassment condition. See Appendix L for ANOVA summary table.

No other main or interaction effects were observed.

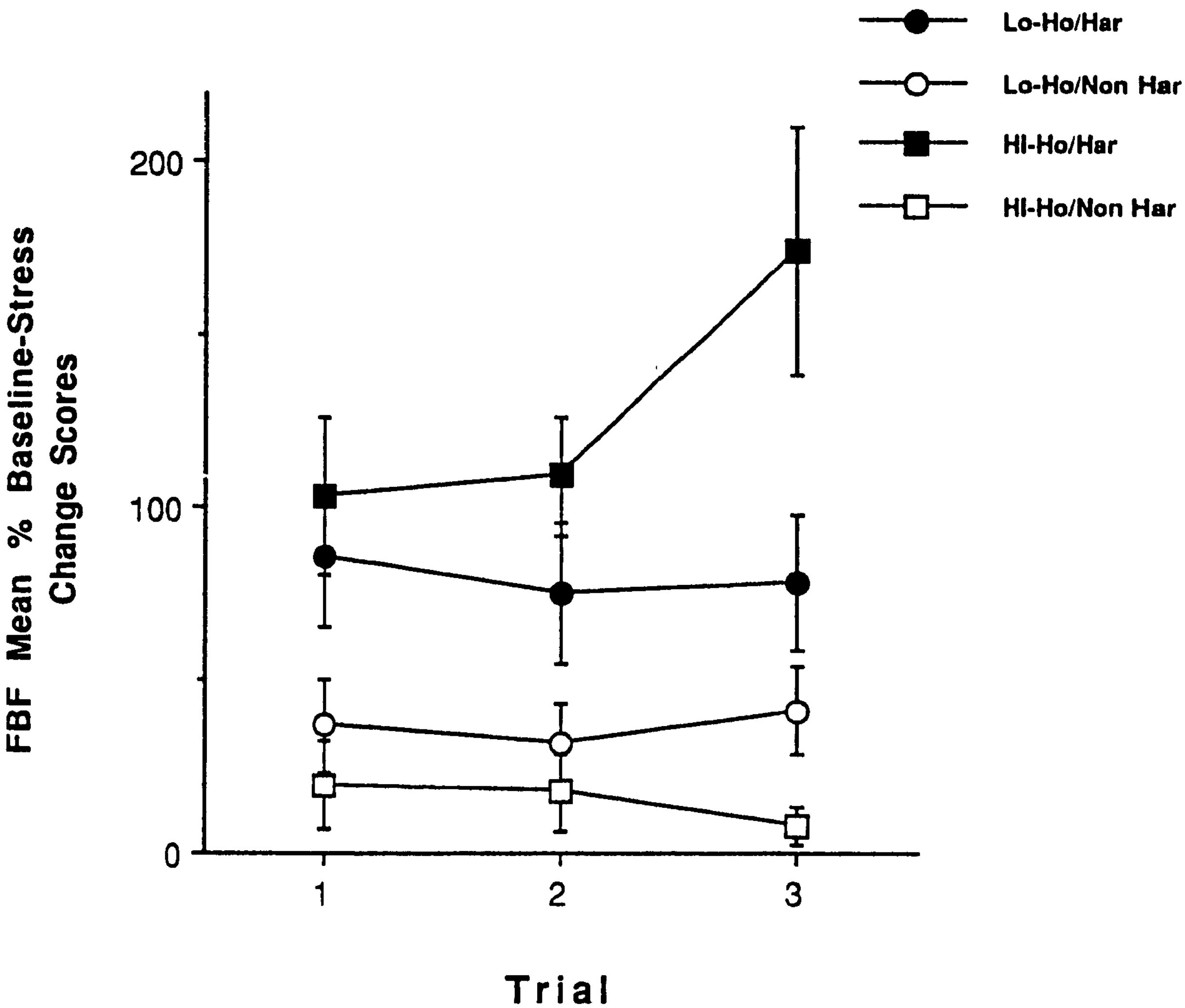
Figure 3: Mean CO % baseline-stress change scores and standard errors for high (Hi-Ho) and low hostile (Lo-Ho) harassed (Har) and non-harassed (Non Har) groups as a function of trial.


Lo-Ho/Har
Lo-Ho/Non Har
Hi-Ho/Har
Hi-Ho/Non Har
CO Mean % Baseline-Stress Change Scores
30
20
10
0
1
2
3
Trial

Forearm Blood Flow

Significant harassment (F(1,47) = 17.79, p < .000), harassment x trial (F(2,94) = 3.62, p < .03) and hostility group x harassment x trial effects (F(2,94) = 5.84, p < .004) were observed. Analysis of simple main effects for the 3-way interaction examining the effect of harassment x trial for the HiHo and LoHo groups separately indicated a significant interaction for the HiHo (F(2,44)=5.34, p<.022). Analysis of this effect by trial indicated that HiHo/harassed subjects exhibited consistently and increasingly higher forearm blood flow responses than HiHo/non-harassed subjects as the stressor progressed. For LoHo subjects the effect of harassment was marginally significant (F(1,25)=4.14, p<.053) indicating greater FBF responses in the LoHo/harassed versus the LoHo/non-harassed subjects. Examination of the hostility group x trial interaction for harassment and non-harassment conditions separately revealed a significant effect during the harassment condition (F(2,50)=4.82, p<.012). HiHo/harassed subjects exhibited a significant elevation of forearm blood flow as compared to LoHo/harassed subjects by the third math-task trial (p <.02). In the non-harassed condition, HiHo and LoHo subjects did not differ in their forearm blood flow responses (see Figure 4). See Appendix M for ANOVA summary table.

Figure 4: Mean FBF % baseline-stress change scores and standard errors for high (Hi-Ho) and low hostile (Lo-Ho) harassed (Har) and non-harassed (Non Har) groups as a function of trial.



Lo-Ho/Har
Lo-Ho/Non Har
HI-Ho/Har
HI-Ho/Non Har
200
100
0
FBF Mean % Baseline-Stress Change Scores
1
2
3
Trial

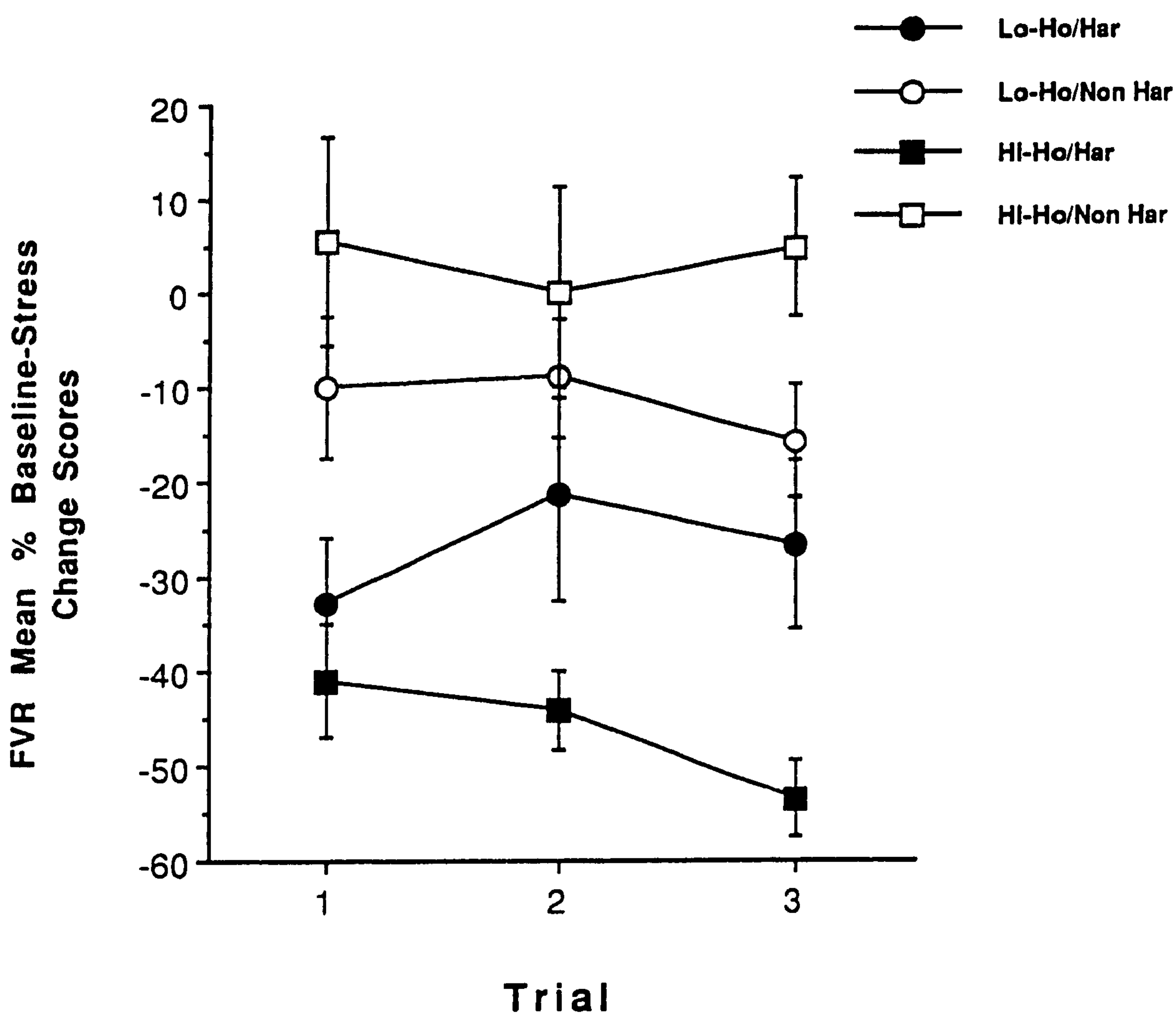
Forearm Vascular Resistance

A significant harassment main-effect ($F(1,46) = 23.36$, $p < .000$) and a significant hostility group x harassment interaction ($F(1,46) = 6.54$, $p < .014$) were obtained. Subsequent simple effect analyses of the effect of harassment on HiHo and LoHo subject groups examined separately revealed that HiHo/harassed subjects exhibited significantly reduced FVR values as compared to HiHo/non-harassed subjects ($F(1,21) = 34.56$, $p < .000$). The effect of harassment on LoHo subjects was not significant. Examination of hostility group differences for harassment and non-harassment conditions separately revealed that HiHo/harassed subjects exhibited a greater reduction in FVR as compared to LoHo/harassed subjects ($F(1,24) = 5.16$, $p < .032$). In the non-harassed condition, HiHo and LoHo subjects did not differ in their response (see Figure 5). See Appendix N for ANOVA summary table.

Systolic Blood Pressure

Significant main effects of harassment ($F(1,47) = 19.52$, $p < .000$), and trial ($F(2,94) = 12.52$, $p < .000$) were obtained. The 2-way harassment x trial ($F(2,94) = 8.91$, $p < .000$) and 3-way hostility group x harassment x trial interactions ($F(2,94) = 3.61$, $p < .024$) were also significant. Subsequent simple main effects analyses of harassment x trial for the HiHo and LoHo groups separately, indicated a significant interaction for the HiHo ($F(2,44)=8.49$, $p<.001$).

Figure 5: Mean FVR % baseline-stress change scores and standard errors for high (Hi-Ho) and low hostile (Lo-Ho) harassed (Har) and non-harassed (Non Har) groups as a function of trial.


Lo-Ho/Har
Lo-Ho/Non Har
Hi-Ho/Har
Hi-Ho/Non Har
20
10
0
-10
-20
-30
-40
-50
-60
FVR Mean % Baseline-Stress Change Scores
1
2
3
Trial

Examination of this effect by trial indicated that for HiHo subjects, those experiencing harassment exhibited higher systolic blood pressure responses in the second trial ($p<.01$) and third trial ($p<.001$) of the math-task as compared to HiHo subjects not experiencing harassment. The effect of harassment was significant for LoHo subjects ($F(1,25)=6.90$, $p< .015$) indicating greater SBP responses for the LoHo/harassed vs LoHo/non-harassed subjects. Examination of the hostility group x trial interaction for harassment and non-harassment conditions separately revealed a trend for HiHo/harassed subjects to exhibit higher systolic blood pressure responses as compared to LoHo/harassed subjects by the third math-task trial ($F(2,50)=2.67$, $p<.08$). In the non-harassed condition, HiHo and LoHo subjects did not differ in their systolic blood pressure responses (see Figure 6). See Appendix O for ANOVA summary table.

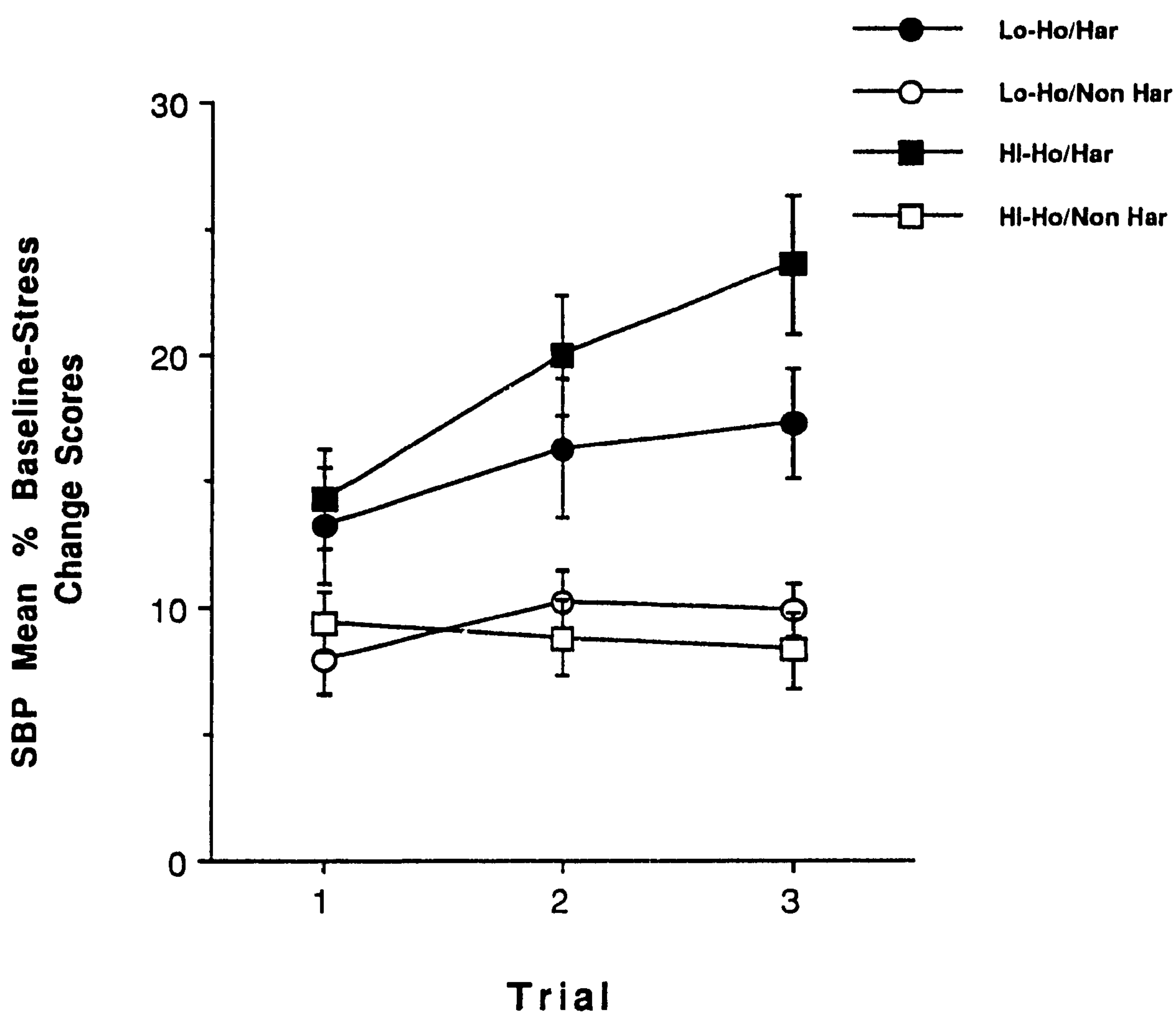
Diastolic Blood Pressure

A significant main effect of trial was obtained ($F(2,92)=5.73$, $p<.005$) as a result of a drop in diastolic blood pressure response in the third trial of the math-task. No other significant main or interaction effects were obtained. See Appendix P for ANOVA summary table.

Affect Ratings

To assess the effect of hostility group and harassment

Figure 6: Mean SBP % baseline-stress change scores and standard errors for high (Hi-Ho) and low hostile (Lo-Ho) harassed (Har) and non-harassed (Non Har) groups as a function of trial.


Lo-Ho/Har
Lo-Ho/Non Har
HI-Ho/Har
HI-Ho/Non Har
30
20
10
0
SBP Mean % Baseline-Stress
Change Scores
1
2
3
Trial

condition on resting affect scores, 2 (Harassment vs Non-Harassment) X 2 (Hostility group) ANOVAs were conducted on resting self-report scores for each of the 5 mood ratings (anxious, depressed, irritated, angry, upset). To examine the effect of hostility group and harassment condition on self-reported affective responses following the task, 2 (Harassment vs Non-Harassment) X 2 (Hostility group) ANOVAs were conducted on baseline-stress change scores calculated by subtracting the post-task affect rating from the resting rating. Means and standard errors of pre- and post-task affect levels by hostility group and harassment condition are presented in Table 3.

Affect Baseline Analyses

Main effects of hostility group were found for self-ratings of being upset ($F(1,47) = 4.76$, $p < .034$) and depressed ($F(1,47) = 5.42$, $p < .024$), indicating that HiHo subjects were significantly more upset and depressed than LoHo subjects even prior to engaging in the stressor. No other significant effects were obtained for these measures, nor were analyses for the other measures significant. See Appendix Q for ANOVA summary table.

Affect Stress Analyses

Significant main effects of harassment were obtained for upset ($F(1,47) = 21.42$, $p < .000$), angry ($F(1,47) = 11.63$, p

Table 3

Mean Affect Baseline Scores and Standard Errors for Harassed (Har) and Non-Harassed (Non-Har) Conditions as a Function of Hostility Group

	Variables					
Hostility Group	Anxious		Depressed		Irritated	
	Har	Non-Har	Har	Non-Har	Har	Non-Har
low	2.5 (0.4)	2.4 (0.2)	1.6 (0.3)	1.2 (0.1)	1.6 (0.3)	1.5 (0.3)
high	2.7 (0.4)	2.6 (0.5)	2.1 (0.3)	2.1 (0.4)	2.1 (0.3)	1.8 (0.4)
Hostility Group	Angry		Upset			
	Har	Non-Har	Har	Non-Har		
low	1.1 (0.1)	1.3 (0.2)	1.0 (0.0)	1.3 (0.3)		
high	1.3 (0.2)	1.3 (0.2)	1.4 (0.3)	2.1 (0.4)		

Table 3 (continued)

Mean Affect Baseline-Stress Change Scores and Standard Errors for Harassed (Har) and Non-Harassed (Non-Har) Conditions as a Function of Hostility Group

	Variables					
Hostility Group	Anxious		Depressed		Irritated	
	Har	Non-Har	Har	Non-Har	Har	Non-Har
low	1.1 (0.5)	0.5 (0.3)	0.3 (0.3)	0.2 (0.1)	2.0 (0.4)	0.8 (0.4)
high	0.3 (0.5)	0.3 (0.4)	0.0 (0.3)	-0.4 (0.4)	2.3 (0.5)	1.0 (0.3)
Hostility Group	Angry		Upset			
	Har	Non-Har	Har	Non-Har		
low	1.3 (0.5)	0.1 (0.1)	1.9 (0.6)	0.1 (0.1)		
high	1.7 (0.4)	0.4 (0.2)	1.8 (0.4)	-0.2 (0.4)		

< .001) and irritated ($F(1,47) = 6.98$, $p < .011$). In all these measures subjects reported greater levels of negative affect in the harassed as compared to the non-harassed condition. See Appendix R for ANOVA summary table.

Discussion

The goal of the present study was to examine the role of inter-personal stress in elevating salt-appetite in human male subjects with a particular focus on the effects of hostility in moderating this relationship. The hypothesis that individuals in the harassment condition would ingest significantly more salt than individuals in the non-harassment condition as well as the hypothesis that high hostile individuals would ingest significantly more salt than the low hostile individuals during the harassment condition was not confirmed. This study, however, provides some new data on the relationship between hostility and salt-intake. To the researcher's knowledge, this is the first study to observe that high hostile individuals ingest significant more salt than low hostile individuals. This relationship suggests an additional link between hostility and poor life-style behaviors that has been previously reported for high hostile individuals (Leiker & Hailey, 1988; Scherwitz & Rugulies, 1992). In addition, the results of the present study support previous research that links high hostility scores with increased cardiovascular reactivity especially when inter-personal stressors are utilized (Engebretson & Matthews, 1992; Hardy & Smith, 1988; Pope & Smith, 1991; Smith & Allred, 1989; Smith & Christensen, 1992; Houston, Matthew & Cates, 1989; Suarez & Williams, 1989; Williams, Barefoot & Shekelle, 1985; Weidner, Friend, Ficarretto & Mendell, 1989).

The present findings indicate that high hostile subjects exposed to harassment exhibited enhanced cardiovascular reactivity as compared to high hostile subjects who were not harassed or low hostile individuals whether harassed or not. More specifically, the high hostile harassed group exhibited significant greater systolic blood pressure, cardiac output, forearm blood flow and forearm vascular resistance when compared to high hostile non-harassed subjects. Low hostile subjects also were affected by harassment with those experiencing harassment exhibiting higher systolic blood pressure and forearm blood flow responses than the non-harassed low-hostiles. Nonetheless, the high hostile harassed individuals exhibited significantly greater cardiac output, forearm blood flow, and forearm vascular resistance than similarly harassed low hostile individuals by the end of the task. A trend in the same direction could also be observed for systolic blood pressure.

The results suggest that high and low hostile individuals react differentially to inter-personal stress with high hostile individuals becoming increasingly reactive as the harassment progressed and becoming more manifest.

These findings are consistent with other research that found that high hostile individuals exhibit greater cardiovascular reactivity to inter-personal stress (Hardy & Smith, 1988; Smith & Allred; Suarez & Willams, 1989; Weidner, Friend, Ficaretto & Mendell, 1989) than low hostile individuals. For example, Suarez & Williams (1989) who measured cardiovascular reactivity in young high and low hostile men during performance on an anagram task with and without harassment, found that harassment led to increased cardiovascular reactivity that was more pronounced for the high hostile individuals than the low hostile individuals. More specifically, the high hostile harassed individuals responded with significantly greater diastolic blood pressure and forearm blood flow changes during the task when compared to low hostile individuals. In addition, Smith and Allred (1989) found that high hostile individuals exhibited greater systolic blood pressure and greater diastolic blood pressure to inter-personal stress when compared to low hostile individuals.

In general, our findings demonstrate that high hostile individuals exhibit elevated cardiovascular responses to stress when compared to low hostile individuals. Whether such enhanced reactivity leads to cardiovascular disease is unclear, but enhanced sympathetic nervous system reactivity has been proposed as one mechanism that is involved in the onset of endothelial injury (Krantz & Manuck, 1984). Thus, this is one possible biological pathway that links hostility to the onset and/or pathogenesis of hypertension, coronary artery and coronary heart disease.

The hypothesis that high hostile individuals would ingest significantly more salt than the low hostile individuals during the harassment condition, perhaps as a result of the greater response to stress, was not confirmed. It is possible that the transient inter-personal stressor used in our laboratory was not lengthy enough to elicit an increase in salt-appetite. It is also possible that stress does not lead to immediate salt-appetite but induces salt-appetite only slowly. Tarjan & Denton (1990), for example, found that the administration of ACTH-dependent adrenal steroid hormones (cortisol, corticosterone, DOCA) induced a gradual increase in the sodium intake of rabbits. In human subjects it is also possible that salt appetite increases only gradually after stress. Because our study measured salt-appetite immediately after the stressor it is possible that any subsequent changes in salt-appetite remained unnoticed.

Of particular interest in this study is the finding that high hostile individuals ingested significantly more salt than low hostile individuals irrespective of the harassment condition. Leiker and Hailey (1988) found that high hostile scores were positively associated with reports of alcohol consumption and negatively associated with physical exercise and self-care (adequate sleep, dental hygiene). Consistent with these findings, Scherwitz and Rugulies (1992) found that high hostility scores were associated with increased prevalence of cigarette smoking, increased prevalence and amount of marijuana use, increased alcohol consumption, and total caloric intake. Also, Raikkonen and Keltikanagas-

Jarvinen (1991) found that hostility was related to physical inactivity, current and heavy smoking and alcohol consumption. The researchers suggest (Leiker and Hailey, 1988; Scherwitz and Rugulies,1992) that hostile individuals possess poorer life-style habits than low hostile individuals.

Our finding, that high hostile individuals ingest significantly more salt than low hostile individuals is consistent with such a poor life-style hypothesis. That is, the consumption of greater amounts of salt can be viewed as a poor life style habit. Excessive salt intake over time has been associated with a variety of detrimental health effects. For example, high salt-intake can expand blood volume and cardiac output, alters centrally mediated sympathetic tone, alters sodium transport at the cell membrane and related cellular function changes that can have an influence on the performance of myocardial and vascular smooth muscle cells and may increase the density and or sensitivity of peripheral adrenergic receptors (Dimsdale, Ziegler, Mills, & Berry, 1990; Fujita, Ando, & Ogata, 1990; Light, 1992). High salt-intake thus can have various effects on cardiovascular activity which have been associated with the development of essential hypertension (Dahl, 1977; Denton, 1982).

Hostility therefore may be a risk factor for cardiovascular disease via two pathways. Firstly, hostile traits may confer risk for hypertension and coronary artery and heart disease via an enhanced sympathetic nervous system reactivity to stress. Secondly, high hostile individuals may be more prone to disease processes via their poor life-style habits such as smoking, alcohol consumption, physical inactivity and excessive salt-intake. In addition, there is evidence that the two factors may interact to elevate disease risk. A stress-salt interaction has been reported by Anderson, Kearns & Better (1983). These researchers demonstrated that dogs exposed to a combination of stress and a high salt-intake exhibited progressive elevations of blood pressure. Of importance here is that neither the stress nor the high salt-intake alone could raise blood pressure. Furthermore, in a human experiment Haythornthwaite, Prately & Anderson (1992) found that high sodium intake during a high stress period resulted in greater elevations in resting systolic blood pressure and mean arterial pressure than either a normal sodium intake during a high stress period or a high sodium intake during a low stress period.

According to our results, high hostile individuals when compared to low hostile individuals may be especially prone to this stress-salt interaction. They not only experience heightened cardiovascular reactivity to stress but also indulge in more salt-intake than low hostile individuals. In fact, such high salt-intake may be related to the greater reactivity observed in our high hostile subjects through its effects on cardiovascular functions.

Although we did not observe elevated salt consumption as a result of harassment the higher salt intake of the hostile subjects may nonetheless be related to stress. Weidner, Friend, Fiacarretto & Mendell (1989), suggest that because high hostile individuals are more distrustful of people in general, they spend a considerable amount of time in a high arousal state, overreacting to situations that arouse their suspiciousness. Daily life-stress then may be significantly greater in high hostile individuals when compared to that of low hostile individuals. Of interest here are our findings that high hostile individuals are significantly more upset and depressed at rest than low hostile individuals. It is therefore possible that the greater continuous life-stress experienced by high hostile individuals leads to an increase in salt appetite and may account for the observed greater salt-intake in our high hostile individuals when compared to low hostile individuals.

There were some significant baseline differences as a function of harassment. It might be argued that baseline results differed because the experimenters treated harassed and non-harassed individuals in a different manner even prior to the beginning of the harassment manipulation. Arguing against this, however, is the fact that differences were found in only one measure and that within this measure it was only the low hostile subjects whose heart rate was affected by harassment. Given that the experimenters were blind as to the subject's hostility rating, and that the decision to assign subjects to the harassment and non-harassment condition was typically made after baseline recordings, this finding is likely spurious.

The present findings indicate that young, high hostile men exhibited greater cardiovascular reactivity to inter-personal stress when compared to low hostile men. In addition, high hostile young men ingested significantly more salt than the low hostile individuals irrespective of the harassment condition. Given that laboratory inter-personal stressors may not be sufficiently long to elicit enhanced salt-appetite in human subjects it would be worthwhile to investigate how daily stress modifies cardiovascular reactivity, mood and daily salt-intake in high hostile individuals. For example, the advancement of ambulatory blood pressure monitoring has given the researcher the opportunity to identify and study factors responsible for individual differences in cardiovascular response in the natural environment and could be applied to such investigation (Harshfield & Pulliam, 1992). It would be interesting to further investigate life-style habits in high hostile individuals. Future studies should undertake a more complete analysis of their customary life-style. For example, subjects could be asked about their smoking habits, their alcohol and drug consumption, their sleeping habits, their caloric intake etc.. Hostility may also be related to other detrimental health behavior. That is, due to a possible mistrusting personality style, hostile people may delay seeking medical treatment or fail to adhere to treatment (Suls & Sanders,1989). Thus questions about seeking medical help and adherence to treatment would give some more insight about these behaviors.

In addition, there exist only few studies that directly compared high hostile men and women (Dujovne & Houston, 1991; Engebretson & Matthews, 1992; Weidner, Friend, Ficarrotto & Mendell, 1989). To investigate any sex differences it would be interesting to assess hostility and its association with health and life-style behaviors in men and women.

Our study suggests two pathways by which hostility may confer risk for cardiovascular disease. Additional research, however, is needed to substantiate these findings and to further investigate cardiovascular reactivity and life-style habits in hostile individuals.

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Appendix A

Anger-Provoking Statements

Anger-Provoking Statements

The nine minute mathematical substraction task stressor was divided into three trials of three minutes each. At the beginning of each task and halfway through each three minute period the following statements were delivered to the subject:

Trial 1:

1. Did you understand the instructions?
2. The right button is correct, the left button is incorrect.

Trial 2:

3. Could you try harder this time.
4. Can't you do better than this.

Trial 3:

5. It isn't that hard you know.
6. I can do better than that.

Appendix B

Food Preference Questionnaire

Food Preference Questionnaire

1. I always salt my food True_____ False_____
2. I never salt my food True_____ False_____

On a scale from one to seven: Please circle

I salt my food

not at all						very much
1	2	3	4	5	6	7

3. I always add sugar to my food True_____ False_____
4. I never add sugar to my food True_____ False_____

On a scale from one to seven: Please circle

I sugar my food

not at all						very much
1	2	3	4	5	6	7

Appendix C

Subject and Parental Health Questionnaires

Subject Health Questionnaire

Name: ____

Telephone: ____

Please answer the following questions carefully.

Have you had any medical or surgical problems during the last year? Yes_____ No_____
Please specify ________________________________

Do you suffer from any chronic illnesses?
Yes_____ No_____
Please specify ________________________________

Have you ever had heart trouble of any kind?
Yes_____ No_____
Please specify ________________________________

Do you now, or have ever had high blood pressure?
Yes_____ No_____
Please specify ________________________________

Do you have diabetes? Yes_____ No_____

Have you ever had kidney trouble of any kind?
Yes_____ No_____
Please specify ________________________________

Do you suffer from epilepsy? Yes_____ No_____

Have you ever had liver trouble of any kind?
Yes_____ No_____
Please specify ________________________________

Do you have asthma? Yes_____ No_____

Do you now suffer from bronchitis or do you suffer from chronic bronchitis? Yes_____ No_____

Have you ever had a fainting spell? Yes_____ No_____
If yes, please explain ________________________________

Are you presently, or have you ever been treated for psychological or psychiatric reasons? Yes_____ No_____
If yes, please explain briefly ________________________________
____

Please list any medication that you are presently taking and the reason for taking it ________________________________
____

Please give the date (or approximate date) of your last medical check-up ________________________________

Signature: ____________________ Date: ____________

Parental Health Questionnaire

Name ____
Last First Middle

Present address and telephone number

____
Address Phone

____
City Province Postal Code

Date of Birth ______________________________
Month Day Year

The following questions refer to your biological parents.

Have either of your parents ever suffered

a. angina or heart pain?

____ Father ____ Mother ____ Neither ____ Don't know

b. a heart attack?

____ Father ____ Mother ____ Neither ____ Don't know

c. a stroke?

____ Father ____ Mother ____ Neither ____ Don't know

Do either of your parent have:

a. high blood pressure?

____ Father ____ Mother ____ Neither ____ Don't know

b. some other significant circulatory problems? If yes, please describe ______________________________

c. diabetes?

____ Father ____ Mother ____ Neither ____ Don't know

d. kidney disease?

____ Father ____ Mother ____ Neither ____ Don't know

Do either of your parents take medication for high blood pressure?

____ Father ____ Mother ____ Neither ____ Don't know

Appendix D

Means and Standard Deviations for Age, Weight and Customary Salt-Intake as a Function of Harassment and Hostility Group

Table 1

Means and Standard Errors for Age, Weight and Customary Salt-Intake as a Function of Harassment and Hostility Group

Age		
Hostility Group	Harassed	Non-Harassed
low	24.1(1.1) n=12	24.3(1.0) n=15
high	21.9(0.6) n=15	24.1(1.4) n= 9

Weight		
Hostility Group	Harassed	Non-Harassed
low	74.9(3.8) n=12	74.8(2.7) n=15
high	70.9(2.3) n=15	75.8(3.1) n= 9

Habitual Salt-Intake		
Hostility Group	Harassed	Non-Harassed
low	2.5(0.4) n=12	2.9(0.3) n=15
high	3.4(0.5) n=15	4.0(0.7) n= 9

Appendix E

Mood Questionnaire

Mood Questionnaire

HOW ARE YOU FEELING RIGHT NOW?

	Not at all	Extremely
DEPRESSED	1.....2.....3.....4.....5.....6.....7	
IRRITATED	1.....2.....3.....4.....5.....6.....7	
ANGRY	1.....2.....3.....4.....5.....6.....7	
UPSET	1.....2.....3.....4.....5.....6.....7	
ANXIOUS	1.....2.....3.....4.....5.....6.....7	

Appendix F

Harassment and Non-Harassment Preparation Scenario

Harassment Preparation Scenario

While researcher A (female) is explaining the math-task to the subject, the phone rings. Researcher B (male) comes into the testing room and tells researcher B:" Dr. Miller is on the phone". Researcher A: "Just a minute" and continues to explain the math-task to the subject. Once explained she excuses herself and enters the adjoining room. In a voice loud enough so that the subject can overhear researcher A (female) says: " Hello Dr. Miller. Right now? Oh, but I'm running a subject right now. Oh, okay - I'll ask if researcher A can take over for me. Ok - Thanks -Bye Bye."

Researcher B pretends to be angry with researcher A: "Now what?"

Researcher A: "Shhhhh! (pause) That was Dr. Miller."

B: "And"

A: "He wants to see me right away"

B: "Now?! But you have a subject in there!

A: "I know - but it sounds really important - would you mind taking over for me?!"

B: "Look - I won't be responsible if your results screw up!"

A: "Don't worry - nothing will go wrong - everything is set up in there - just follow the instructions"

B: "I don't normally deal with the subjects that's your job you know!"

A: "You know I would not ask you if I didn't have to. Everything will be fine! (pause) okay?! Thanks, I'll be back as soon as I can"

Researcher A goes into the testing room and tells the subject that she has to leave and that another researcher will take over for her.

Researcher A leaves the testing room and researcher B pretending to be angry, enters it.

Non Harassment Preparation Scenario

While researcher A (female) is explaining the math-task to the subject, the phone rings.

Researcher B (male) comes into the testing room and tells researcher A:" Dr. Miller wants to see you".

Researcher A: "Just a minute" and continues to explain the math-task to the subject. Once explained, she tells the subject that another researcher will take over for her, excuses herself and leaves the testing room. Researcher B enters the testing room. Researcher B is friendly towards the subjects throughout the math-task.

Appendix G

Informed Consent Form

Informed Consent Form

RESEARCH STUDY CONDUCTED AT CONCORDIA UNIVERSITY,

DEPARTMENT OF PSYCHOLOGY ON BEHALF OF DR. SYDNEY MILLER

We would like you to participate in a study investigating the effects of performance and stress on cardiovascular reactivity. In this study, changes such as increases in heart rate and blood pressure will occur. These increases will be only temporary, returning to normal after the experiment and causing no adverse effects.

Your participation in the study will require you to come for one session, lasting approximately one hour. During the session you will engage in a task that involves making a decision on several mathematical solutions. In addition you will have to eat a nutritious soup. We will obtain various physiological measures (heart rate, blood pressure, forearm blood flow, cardiac output) throughout the session. These physiological recordings are safe, painless and non-invasive (no needles are involved) and only require the placement of various transducers on the skin.

You will be paid $20.00 for your participation at the end of the session.

All information we obtain about you is completely confidential and will not be seen by anyone who is not a member of the research team. Ultimately, all data will be coded using subject numbers rather than names.

You are free to withdraw from the experiment at any time.

We ask you not to discuss the experiment with other persons who are participating in the study.

Once you have carefully studied and understood this form, you may sign it in indication of your free consent and agreement to participate in the study.

NAME (PLEASE PRINT):____________________________________

SIGNATURE:____

DATE:____

Appendix H

ANCOVA Summary Table for Salt-Intake

as a Function of Hostility Group and Harassment Condition

Table 1

ANCOVA Summary Table for Salt-Intake as a Function of Hostility Group and Harassment Condition

Source	df	SS	MS	F
Hostility Group	1	1.62	1.62	6.11*
Harassment Condition	1	0.69	0.69	2.58
Hos X Har	1	.01	0.01	0.05
Error	43	11.43	0.27	

*$p < .05$

Appendix I

ANOVA Summary Table for Heart Rate Baseline Values as a Function of Hostility Group and Harassment Condition

Table 1

ANOVA Summary Table for Heart Rate Baseline Values as a Function of Hostility Group and Harassment Condition

Source	df	SS	MS	F
Hostility Group	1	121.39	121.39	1.84
Harassment Condition	1	38.50	38.50	0.58
Hos X Har	1	310.74	310.74	4.72*
Error	47	3093.56	65.82	

*$p < .05$

Appendix J

<u>ANOVA Summary Table for Heart Rate Stress Values as a Function of Hostility Group, Harassment Condition and Trial</u>

Table 1

ANOVA Summary Table for Heart Rate Stress Values as a Function of Hostility Group, Harassment Condition and Trial

Source	df	SS	MS	*F*
Hostility Group	1	6.58	6.58	0.01
Harassment Condition	1	4169.16	4169.16	7.92**
Hos X Har	1	422.39	422.39	0.80
Error	47	24726.49	526.10	
Trial	2	310.04	155.02	6.27**
Hos X Trial	2	235.12	117.56	4.75*
Har X Trial	2	486.51	243.26	9.84***
Hos X Har X Trial	2	47.75	23.87	.97
Error	94	2324.91	24.73	

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

Appendix K

ANOVA Summary Table for Cardiac Output Stress Values as a Function of Hostility Group, Harassment Condition and Trial

Table 1

ANOVA Summary Table for Cardiac Output Stress Values as a Function of Hostility Group, Harassment Condition and Trial

Source	df	SS	MS	*F*
Hostility Group	1	51.73	51.73	0.07
Harassment Condition	1	4792.77	4792.77	6.75*
Hos X Har	1	906.52	906.52	1.28
Error	47	33368.05	709.96	
Trial	2	124.38	62.19	1.70
Hos X Trial	2	305.35	152.67	4.18*
Har X Trial	2	444.02	222.01	6.07**
Hos X Har X Trial	2	299.64	149.82	4.10*
Error	94	3435.43	36.55	

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

Appendix L

ANOVA Summary Table for Pre-Ejection Period Stress Values as a Function of Hostility Group, Harassment Condition and Trial

Table 1

ANOVA Summary Table for Pre-Ejection Period Stress Values as a Function of Hostility Group, Harassment Condition and Trial

Source	df	SS	MS	*F*
Hostility Group	1	61.10	61.10	0.29
Harassment Condition	1	1879.62	1879.62	8.97*
Hos X Har	1	282.64	282.64	1.35
Error	47	9844.38	209.45	
Trial	2	7.30	3.65	0.15
Hos X Trial	2	101.42	50.71	2.08
Har X Trial	2	123.69	61.85	2.54
Hos X Har X Trial	2	86.22	43.11	1.77
Error	94	2290.98	24.37	

$^*p < .01$

Appendix M

ANOVA Summary Table for Forearm Blood Flow Stress Values as a Function of Hostility Group, Harassment Condition and Trial

Table 1

ANOVA Summary Table for Forearm Blood Flow Stress Values as a Function of Hostility Group, Harassment Condition and Trial

Source	df	SS	MS	*F*
Hostility Group	1	7103.61	7103.61	0.56
Harassment Condition	1	227381.91	227381.91	17.79***
Hos X Har	1	45633.97	45633.97	3.57
Error	47	600768.71	12782.31	
Trial	2	8088.25	4044.12	2.98
Hos X Trial	2	6223.71	3111.86	2.30
Har X Trial	2	9824.31	4912.15	3.62*
Hos X Har X Trial	2	15840.08	7920.04	5.84**
Error	94	127448.52	1355.84	

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

Appendix N

ANOVA Summary Table for Forearm Vascular Resistance Stress Values as a Function of Hostility Group, Harassment Condition and Trial

Table 1

ANOVA Summary Table for Forearm Vascular Resistance Stress Values as a Function of Hostility Group, Harassment Condition and Trial

Source	df	SS	MS	F
Hostility Group	1	161.04	161.04	0.10
Harassment Condition	1	38227.57	38227.57	23.36**
Hos X Har	1	10695.88	10695.88	6.54*
Error	47	75268.34	1636.27	
Trial	2	470.25	235.12	1.05
Hos X Trial	2	681.83	340.92	1.52
Har X Trial	2	331.68	165.84	0.74
Hos X Har X Trial	2	867.57	433.79	1.93
Error	92	20653.96	224.50	

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

Appendix O

ANOVA Summary Table for Systolic Blood Pressure Stress Values as a Function of Hostility Group, Harassment Condition and Trial

Table 1

ANOVA Summary Table for Systolic Blood Pressure Stress Values as a Function of Hostility Group, Harassment Condition and Trial

Source	df	SS	MS	F
Hostility Group	1	93.04	93.04	0.70
Harassment Condition	1	2576.84	2576.84	19.52**
Hos X Har	1	162.30	162.30	1.23
Error	47	6205.24	132.03	
Trial	2	338.09	169.05	12.52**
Hos X Trial	2	10.32	5.16	0.38
Har X Trial	2	240.67	120.33	8.91**
Hos X Har X Trial	2	105.04	52.52	3.89*
Error	94	1269.47	13.50	

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

Appendix P

ANOVA Summary Table for Diastolic Blood Pressure Stress Values as a Function of Hostility Group, Harassment Condition and Trial

Table 1

ANOVA Summary Table for Diastolic Blood Pressure Stress Values as a Function of Hostility Group, Harassment Condition and Trial

Source	df	SS	MS	*F*
Hostility Group	1	563.90	563.90	1.61
Harassment Condition	1	499.07	499.07	1.43
Hos X Har	1	340.98	340.98	0.97
Error	46	16110.15	350.22	
Trial	2	580.06	290.03	5.96*
Hos X Trial	2	104.04	52.02	1.07
Har X Trial	2	12.00	6.00	0.12
Hos X Har X Trial	2	68.91	34.45	0.71
Error	94	4478.87	48.68	

*$P < .01$

Appendix Q

ANOVA Summary Table for Affect Baseline Scores

as a Function of Hostility Group and Harassment Condition

Table 1

ANOVA Summary Table for Upset Baseline Scores as a Function of Hostility Group and Harassment Condition

Source	df	SS	MS	*F*
Hostility Group	1	4.034	4.034	4.761*
Harassment Condition	1	3.150	3.150	3.718
Hos X Har	1	0.435	0.435	0.514
Error	47	39.822	0.847	

*$p < .05$

Table 2

ANOVA Summary Table for Depressed Baseline Scores as a Function of Hostility Group and Harassment Condition

Source	df	SS	MS	*F*
Hostility Group	1	5.669	5.669	5.422*
Harassment Condition	1	0.432	0.432	0.414
Hos X Har	1	0.558	0.558	0.534
Error	47	49.139	1.046	

*$p < .05$

Appendix R

ANOVA Summary Table for Affect Baseline-Stress Change Scores as a Function of Hostility Group and Harassment Condition

Table 1

ANOVA Summary Table for Upset Baseline-Stress Change Scores as a Function of Hostility Group and Harassment Condition

Source	df	SS	MS	*F*
Hostility Group	1	0.628	0.628	0.305
Harassment Condition	1	44.031	44.031	21.421*
Hos X Har	1	0.174	0.174	0.085
Error	47	96.606	2.055	

*$p < .001$

Table 2

<u>ANOVA Summary Table for Anger Baseline-Stress Change Scores as a Function of Hostility Group and Harassment Condition</u>

Source	df	SS	MS	*F*
Hostility Group	1	1.537	1.537	0.937
Harassment Condition	1	19.093	19.093	11.631*
Hos X Har	1	0.006	0.006	0.004
Error	47	77.156	1.642	

*$p < .01$

Table 3

ANOVA Summary Table for Irritation Baseline-Stress Change Scores as a Function of Hostility Group and Harassment Condition

Source	df	SS	MS	F
Hostility Group	1	0.686	0.686	0.257
Harassment Condition	1	18.611	18.611	6.979*
Hos X Har	1	0.014	0.014	0.005
Error	47	125.333	2.667	

*$p < .05$