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Dimensions of Hostility and Cardiovascular Reactivity to Interpersonal Stress

Lisa M. Dolgoy

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

July 1994

ISBN 0-612-01316-2

CONCORDIA UNIVERSITY

School of Graduate Studies

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By: Lisa M. Dolgoy

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Abstract

Dimensions of Hostility and Cardiovascular
Reactivity to Interpersonal Stress

Lisa M. Dolgoy

The present study examined the differential relationship between expressive hostility, neurotic hostility and cardiovascular responses to interpersonal stress. Seventy-nine male subjects, aged 18-35 years, originally completed the Buss-Durkee Hostility Inventory. A tercile split of Buss-Durkee expressive hostility and neurotic hostility subscale scores was used to assign subjects to either a high or low expressive hostile and a high or low neurotic hostile group. Subjects were randomly assigned to either a harassment or non-harassment condition and engaged in a 9-minute subtraction math-task. Results indicated that harassed high expressive hostile subjects exhibited significantly greater systolic blood pressure, heart rate and cardiac output responses relative to non-harassed high expressive hostile subjects as well as low expressive hostile subjects from both harassment conditions. Harassed high neurotic hostile subjects, on the other hand, exhibited significantly greater forearm blood flow when compared with non-harassed high neurotic hostile subjects and low neurotic hostile subjects, irrespective of harassment condition. Additional negative state affect analyses revealed that high, relative to low, neurotic

hostility was related to greater pre-task depression, post-task anger and marginally greater post-task guilt. Results suggest that interpersonal stressors, such as harassment, are necessary to mediate a positive relationship between both hostility dimensions and cardiovascular responses to stress. Moreover, given the suggestion that expressive and neurotic hostility were associated with different cardiovascular response patterns to stress, it is reasonable to speculate that they may be associated with risks for different disease endpoints.

Acknowledgements

I would first like to thank Dr. Sydney Miller for all his support, patience and incredible ability to clarify information over the telephone. I also would like to extend my appreciation to the members on my committee, Dr. Jane Stewart and Dr. Bill Bukowski, for their insightful comments and suggestions.

Special thanks go to my friends and fellow lab partners, Marianne Friese, for her support and participation in the study, and to Aurelio Sita for his invaluable assistance and encouragement.

Finally, I would like to acknowledge my parents and sisters who have always been there for me, and my wonderful friends, especially M.J., Danielle Sauvé and Howard Magonet.

This thesis is dedicated to Ethel Okell.

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Dimensions of Hostility and Cardiovascular Reactivity to Interpersonal Stress

For many years, researchers have been interested in identifying risk factors that contribute to the etiology of coronary heart disease (CHD), the leading cause of death in industrialized societies (Dembroski & Costa, 1987). CHD has been defined as a group of related syndromes (e.g., angina pectoris and myocardial ischemia) resulting from an inadequate supply of blood to the heart (Cotran, Kumar & Robbins, 1989). Traditional risk factors, such as elevated blood pressure, elevated serum cholesterol and cigarette smoking, as well as related putative behaviours including sedentary lifestyle, excessive intake of sodium, lipids and alcohol, habitual daily cigarette consumption, and failure to detect hypertension and/or maintain anti-hypertensive therapy, have all been implicated in the development of this life-threatening disease (Dembroski & Costa, 1987). Although strong epidemiologic evidence exists for the link between traditional risk factors and CHD, these factors have failed to predict adequately many new cases of the disease (Jenkins, 1978; Keys, 1970; Rosenman, 1983). The suggestion that additional risk factors are involved has sparked considerable research into the role of psychosocial influences in the pathogenesis of CHD.

Type A Behaviour Pattern and Coronary Heart Disease

The Type A Behaviour Pattern, first conceptualized by cardiologists Friedman and Rosenman in the 1950s, identified a group of behaviours including intense ambition, competitiveness, hard-driving job involvement, impatience, sense of time urgency, hostility and aggression that were hypothesized to play a role in the development of CHD (Friedman & Rosenman, 197). In order to assess Type A behaviour reliably, Friedman and Rosenman (1959) developed the Rosenman Structured Interview. Questions in this interview were posed in a confrontational manner in order to elicit the interviewee's response to challenge. The first evidence that Type A behaviour was predictive of CHD emerged from findings of the Western Collaborative Group Study (Rosenman et al. 1964), a large-scale prospective study following 3154 men, aged 30-59 for 8.5 years. At follow-up, Type A subjects were twice as likely to manifest symptoms of CHD as Type B subjects lacking Type A attributes (Brand, 1978; Rosenman et al. 1964; Rosenman et al. 1975). These findings were further strengthened by studies revealing that interview-derived Type A behaviour pattern was associated with severity of angiographically-documented coronary artery disease. (Blumenthal, Williams, Kong, Schanberg, & Thompson, 1978; Frank, Heller, Kornfeld, Sport, & Weiss, 1978; Friedman, Rosenman, Strauss, Wurm, & Kositchek, 1968; Williams et al. 1980). Coronary artery disease refers to atherosclerosis of the arteries supplying blood to the heart and often leads to CHD (Ross & Glomset, 1973).

At a time when Type A behaviour was becoming recognized as a viable risk factor for CHD (Cooper, Detre & Weiss, 1981), the emergence of contradictory findings challenged the validity of the Type A-CHD association. Results from the Multiple Risk Factor Intervention Trial, a large scale prospective study of 3110 males, aged 35-57 were particularly damaging. The Multiple Risk Factor Intervention Trial was unable to replicate the positive association between Type A behaviour and CHD mortality at a 7-year follow-up (Shekelle et al. 1985). Type A behaviour also failed to predict severity of coronary occlusion in a number of angiographic studies (Arrowood, Uhrick, Gomillion, Popio, & Raft, 1982; Dembroski, MacDougall, Williams, Haney, & Blumenthal, 1985; Dimsdale, Hackett & Hunter, 1979; Krantz, Sanmarco, Selvester & Matthews, 1979; Scherwitz et al. 1983; Siegman, Feldstein, Tommaso, Ringel & Lating, 1987). Moreover, when the Western Collaborative Group Study data was reanalysed, using appropriate statistical controls, the original claims of a Type A-CHD mortality link could no longer be substantiated (Ragland, Brand & Rosenman, 1987).

Given the accumulation of inconsistent findings, the interests of many researchers shifted from the multidimensional construct of Type A behaviour to its separate components in an attempt to identify specific coronary-prone behaviours. Among the Type A components, hostility became the focus of a considerable amount of attention.

Assessment of Hostility

In order to assess hostility and its potential influence in CHD etiology, a number of assessment instruments have been employed. Among them, the Structured Interview and the Cook Medley Hostility Scale (Cook & Medley, 1954), a questionnaire derived from the Minnesota Multiphasic Personality Inventory (MMPI), have been the most widely used.

Structured Interview

The association between Structured Interview-derived ratings of hostility and CHD incidence has been examined in a small number of prospective studies. In two separate reanalyses of the Western Collaborative Group Study data, for example, interview-ratings of hostility provided the best discrimination between initially healthy CHD cases and matched controls (Matthews, Glass, Rosenman & Bortner, 1977; Hecker, Chesney, Black & Frautschi, 1988). Dembroski, MacDougall, Schields, Petitto, and Lushene (1978) developed a widely used component scoring system for the Structured Interview featuring the Potential for Hostility rating, defined as the relatively stable tendency to experience anger, irritability, and resentment in response to frustrating events and/or to react with expressions of rudeness, antagonism, and uncooperativeness (Dembroski & Costa, 1987; Dembroski et al. 1985; MacDougall, Dembroski, Dimsdale, & Hackett, 1985) For this method, separate ratings of hostile content, intensity and interaction style are generated and used in assigning a total Potential for Hostility score. In a reanalysis of the Multiple Risk Factor Intervention Trial study, overall clinical Potential for Hostility ratings as well as the hostile interpersonal style subcomponent were found to predict CHD incidence whereas global Type A scores did not (Dembroski, MacDougall, Costa, & Grandits, 1989).

Potential for Hostility ratings have also been found to predict severity of angiographically-documented coronary artery disease in a number of cross-sectional studies (Dembroski et al. 1985; MacDougall et al. 1985). Barefoot (1992) found similar results linking interview-rated hostility to severity of coronary artery disease among angiography patients. Helmer, Ragland, and Syme, (1991), however, using a rating system developed by Hecker, Chesney, Black, and Frautschi (1988), failed to find a significant relationship between hostility and severity of coronary artery disease.

Cook Medley Hostility Scale

The Cook Medley Hostility Scale has also been employed in a number of cross-sectional and prospective studies investigating the hostility-CHD link. In an early cross-sectional study, Williams et al. (1980) were the first to significantly relate Cook Medley scores to severity of angiographically-documented coronary artery disease. This finding, however, was not replicated in angiography studies by Dembroski et al. (1985) or Helmer, Ragland, and Syme, (1991). Results from some prospective studies have indicated that Cook Medley scores were predictive of increased incidence of major coronary events (Barefoot, Dahlstrom, & Williams, 1983; Shekelle, Gale, Ostfeld, & Paul, 1983) and total morality (Barefoot et al. 1983; Barefoot, Dodge, Peterson, Dahlstrom & Williams, 1989; and Shekelle et al. 1983). Three prospective studies, however, failed to find a significant relationship between Cook Medley scores and coronary artery disease endpoints. (McCranie, Watkins, Brandsma & Sisson, 1986; Leon, Finn, Murray, & Bailey 1988; Hearn, Murray, & Luepker, 1989).

Mechanism Linking Hostility to Coronary Heart Disease

Despite inconsistent findings, a considerable amount of empirical evidence supports the linking between hostility to CHD. The mechanisms underlying this connection, however, are not fully understood. A prominent hypothesis by

Williams, Barefoot, and Shekelle (1985) is that heightened cardiovascular and neuroendocrine reactivity to stress mediates the relationship between hostility and CHD. It is suggested that hostile, unlike non-hostile, persons experience repeated and/or pronounced episodes of anger that translate into increased physiological reactivity. This hyperresponsitivity to stress, in turn, promotes and accelerates the coronary atherosclerotic process (Krantz & Manuck, 1984). A confirmation of this hypothesis would recognize that reactivity produces physiological changes which, in turn, cause CHD and, in addition, that at-risk hostile individuals exhibit exaggerated reactivity relative to non-hostile individuals (Suls & Sanders, 1989). Using an animal model, Ross and Glomset (1976) have reported that stress-induced sympathetic nervous system arousal creates elevations in blood pressure which cause damage to the inner lining of arterial vessels. Further support for the reactivity-CHD link has been found in studies showing that behaviourally-induced heart rate changes in cynomolgus monkeys were related to severity of coronary artery disease (Manuck, Muldoon, Kaplan, Adams & Polefrone, 1989). It is unknown, however, whether this same relationship exists in humans. Results from two studies in humans (Keys et al. 1971; Sparrow, Tifft, Rosner & Weiss, 1984), however, offer some preliminary evidence that behaviourally-induced changes in diastolic blood pressure significantly predict CHD.

Hostility and Cardiovascular Reactivity

Assessment of a hostility-cardiovascular reactivity relationship in humans has generated mixed results. In a number of studies using hostility ratings derived from the Structured Interview, (Dembroski et al. 1978; Dembroski, MacDougall, Herd & Shields, 1979; MacDougall, Dembroski & Krantz, 1981; Allen, Lawler, Matthews & Rakaczky, 1984; McCann & Matthews, 1988), Potential for Hostility ratings were positively associated with increased cardiovascular reactivity to laboratory stressors. These results, however, were not replicated by Diamond et al. (1984) who found no relationship between Potential for Hostility ratings and cardiovascular reactivity to stressors involving competition, frustration or harassment. Furthermore, Glass, Lake, Contrada, Kehoe, and Erlanger (1983) reported an inverse relationship between hostility ratings and blood pressure responses to cognitive tasks.

Evidence concerning an association between Cook Medley scores and cardiovascular reactivity has also been inconsistent. Three studies employing traditional laboratory stressors (e.g., mental arithmetic, cold pressor, stroop colour-word task) failed to find significant differences in cardiovascular reactivity between persons with high and low Cook Medley scores (Kamarck, Manuck, & Jennings, 1990; Sallis, Johnson, Trevorrow, Kaplan, & Melbourne, 1987; Smith & Houston, 1987). With the exception of two studies (Kamarck, Manuck, & Jennings, 1990; Allred & Smith, 1991), many studies using interpersonally challenging stressors (e.g., Hardy & Smith, 1988; Smith & Allred, 1989; Christensen & Smith, 1993; Smith & Brown, 1991; Weidner, Friend, Ficarrotto, & Mendell, 1989; Suarez & Williams, 1989) reported a significant association between high Cook Medley scores and heightened cardiovascular responses. Hardy and Smith (1988), for example, found that high hostile subjects, relative to low hostile subjects, exhibited greater diastolic blood pressure responses to a role-playing task involving high interpersonal conflict. No reactivity differences were observed between high and low hostile groups during the low conflict discussion. Smith and Allred (1989), using a debate task, found high hostile subjects to exhibit greater systolic and diastolic blood pressure responses than low hostile subjects. Furthermore, Suarez and Williams (1989), found high Cook Medley scores to be associated with elevated cardiovascular responses, only when an anagram task was combined with harassment. High and low hostile groups did not differ in cardiovascular reactivity when the anagram task was performed alone.

These latter results suggest an explanation of the inconsistencies in hostility-reactivity results. It has been proposed that differences in the stress tasks' effectiveness to elicit negative affective responses may account for some of the discrepant results. Positive results from studies using interpersonal stressors (e.g., Suarez & Williams 1989, 1990) offer support for the argument that interpersonally challenging stressors, successful in producing anger and irritation are necessary to mediate a positive relationship between hostility and cardiovascular reactivity.

Dimensions of Hostility

Another possible explanation for discrepant findings is that different assessment instruments tap different components of hostility. Although hostility has been broadly referred to as the tendency to feel anger toward others or the tendency to inflict harm on others (Smith, 1992), the absence of a clear delineation of the components has been the source of considerable confusion. According to Barefoot (1992), the construct of hostility can encompass various aspects of affect, cognition and behaviour. The affective component, for example, includes emotional states such as anger, annoyance, resentment and contempt (Buss & Durkee, 1957), whereas the cognitive component refers to cynical attitudes about human nature as well as attributional biases, leading one to interpret the behaviour of others as antagonistic and threatening. The behavioural component consists of physical and verbal aggression in addition to more subtle forms of antagonism and uncooperativeness. Although these hostility aspects may be interrelated, they are not all necessarily present together in a given individual. Anger, cynicism or antagonism can each be found in the absence of the other two (Barefoot, 1992).

The suggestion that hostility, like Type A behaviour, is itself multidimensional has prompted researchers to assess the construct validity of their assessment measures. Factor analyses of the Cook Medley scale, for example, has generated two factors labelled Cynical Mistrust and Paranoid Alienation. Hostility, according to the Cook Medley scale, consists of cynicism, suspiciousness, distrust and resentment (Costa, Zonderman, McCrae, & Williams, 1986). This description differs from the operationalized definition of Potential for Hostility which emphasizes anger and antagonistic behaviours (Costa et al. 1986; Smith & Frohm, 1985). Moreover, correlational analyses of Potential for Hostility ratings and the Cook Medley scale have revealed a significant but modest association ($r=.37$) (Dembroski et al. 1985) confirming that, despite some association, these two instruments may not necessarily measure the same hostility construct. The fact that hostility is multidimensional has also led researchers to speculate that only select dimensions may be linked to elevated physiological reactivity and development of CHD. Accordingly, inconsistent cardiovascular-reactivity findings may thus reflect the capacity of the different assessment instruments to successfully tap the alleged coronary-prone components of hostility.

Buss-Durkee Hostility Inventory

Although used in fewer studies, the Buss-Durkee Hostility Inventory (Buss & Durkee, 1957) may be particularly useful in the assessment of different hostility components and their relationship to CHD. This 75 true-false item questionnaire measures global hostility and also identifies seven hostility subscales including physical assault, indirect hostility, irritability, negativism, resentment, suspicion and verbal hostility as well as one subscale of guilt. Factor analyses of the Buss-Durkee scale has yielded two factors. The first, primarily defined by by the physical assault and verbal hostility subscales, reflects frustration-induced expressive aspects of hostility and has been labelled Expressive Hostility. The second factor, represented best by the resentment and suspicion subscales (Musante, MacDougall, Dembroski, & Costa, 1989; Bushman, Cooper, & Lemke, 1991) reflects the experience of anger and hostility and has been referred to as Experiential or Neurotic Hostility. Support for this distinction has been documented in a study in which the association between expressive and neurotic hostility factors and measures of neuroticism and antagonism was examined (Costa, McCrae, & Dembroski, 1989). Neurotic hostility, as the name suggests, was chiefly related to neuroticism, characterized by anxiety, depression and anger. Expressive hostility, on the other hand, was unrelated to neuroticism and correlated significantly with antagonism, consisting of irritability, uncooperativeness, callousness, cynicism and mistrust.

It is worth noting that both expressive and neurotic aspects of hostility are reflected in the Potential for Hostility rating and Cook Medley scale, albeit in varying degrees. Musante et al. (1991) found that Potential for Hostility scores correlated with some elements of neurotic hostility but largely reflected the expression of anger and hostility. Similarly, Potential for Hostility ratings were reported to be more strongly related to a dimension of Antagonism/Disagreeableness than to a dimension of neuroticism (Dembroski & Costa, 1987). According to Smith and Frohm (1985), the Cook Medley scale was more closely associated with neurotic aspects such as anger-proneness, resentment and suspiciousness than it was with expressive hostility. Thus, given that the Cook Medley scale and Potential for Hostility ratings may be tapping different hostility dimensions, this may explain certain inconsistencies in the literature.

In a study with patients undergoing angiography, Siegman, Dembroski and Ringel (1987) used the Buss-Durkee Hostility Inventory to examine the differential relationship of expressive and neurotic hostility to severity of coronary artery disease. The results indicated that expressive hostility was positively associated with severity of coronary artery disease in patients 60 years and younger, whereas neurotic hostility was inversely related to extent of disease. No significant relationship was observed between overall hostility scores and coronary artery disease severity. A possible interpretation of the unexpected inverse relationship between neurotic hostility and coronary artery disease is that neurotically hostile individuals may be more prone to complain of angina-like symptoms, in the absence of disease, nevertheless prompting referrals for coronary angiography (Siegman et al. 1987).

There are few studies on the role of Buss Durkee-defined expressive and neurotic hostility in elevated cardiovascular reactivity to stress. Siegman and Anderson (1990), found no significant correlations between expressive hostility and cardiovascular reactivity to a serial subtraction task in male subjects. Neurotic hostility, on the other hand, was negatively correlated with heart rate reactivity. In a similar experiment, however, Siegman, Anderson, Herbst, Boyle, and Wilkinson (1992) combined the math task with harassment and found expressive hostility to be positively correlated with systolic and diastolic blood pressure responses whereas neurotic hostility was unrelated to cardiovascular reactivity. In Suarez and Williams' (1990) study of 53 male subjects, the Buss-Durkee Hostility

Inventory and other scales were used to form expressive and neurotic hostility factors. Results showed that when harassment was added to the anagram task, expressive hostility was generally a better predictor of increased cardiovascular arousal than neurotic hostility. Unlike Siegman et al.'s (1992) results, however, neurotic hostility was positively related to one measure of reactivity, forearm blood flow. Furthermore, in a recent study investigating the role of hostility and harassment in women's cardiovascular and emotional responses, Suarez, Harlan, Peoples, and Williams (1993) found that for harassed women, expressive hostility, relative to neurotic hostility, was positively related to increases in systolic blood pressure. Among the results of another recent study by Lawler, Harralson, Armstead and Schmied (1993), high expressive hostility factor scores were associated with greater diastolic blood pressure reactivity to a reaction time task with harassment, stroop colour-word conflict task, and anger recall interview in males. Although the limited number of findings preclude strong conclusions, they provide some support for the hypothesis that expressive and neurotic hostility may have differential effects on cardiovascular reactivity. There is also evidence to suggest that interpersonal stressors, such as harassment, may be particularly important in eliciting these differences between hostility groups.

The purpose of the present study was to examine the differential role of expressive and neurotic hostility in males' cardiovascular reactivity to a 9-minute subtraction math task with and without harassment. Factor scores from the Buss-Durkee Hostility Inventory were used to assign male subjects into high and low expressive and neurotic hostility groups. Separate analyses of high versus low expressive hostility and high versus low neurotic hostility were then conducted. A wide range of cardiovascular measures, reflecting both cardiac and vascular reactivity were employed. Previous research typically focused on a limited number of cardiac measures (e.g., blood pressure and heart rate), thus excluding relevant vascular measures such as forearm blood flow, forearm vascular resistance, and total peripheral resistance. It is unknown to what extent the exclusion of additional measures may have affected previous results linking hostility dimensions to cardiovascular reactivity. Another primary goal of the study was to assess the moderating influence of harassment on the differential relationship between expressive and neurotic hostility dimensions and cardiovascular reactivity. Hostility group differences in negative state affect responses to both harassment and non-harassment conditions were also examined. In keeping with previous findings (Siegman et al. 1992; Suarez & Williams, 1990; Suarez et al. 1993), it was hypothesized that expressive hostility, relative to neurotic hostility, would be more strongly related to increased cardiovascular reactivity to harassment.

Method

Subjects

Seventy-nine healthy, normotensive males between the ages of 18 and 35 years were recruited from the Concordia University student population and completed the Buss-Durkee Hostility Inventory (see Appendix A). A tercile split of Buss-Durkee expressive hostility (EH) and neurotic hostility (NH) subscale scores was used to assign subjects to either a high or low expressive hostile group and a high or low neurotic hostile group. Subjects with EH subscale scores <8 were classified as low expressive hostile subjects (Low EH: n=22). Subjects with EH subscale scores >12 were classified as high expressive hostile subjects (High EH: n=24). Similarly, subjects with NH subscale scores <3 were categorized as low neurotic hostile subjects (Low NH: n=23), whereas subjects with NH subscale scores >6 were categorized as high neurotic hostile subjects (High NH: n=25). Subjects from each hostile group were randomly assigned to either a harassment or non-harassment condition and engaged in a 9-minute subtraction math-task, consisting of three 3-minute trials. Prior to testing, all subjects completed a screening health questionnaire and were excluded from the study if they reported any serious physical or psychological health problems and/or regularly used medication which affects blood pressure (see Appendix B).

Physiological Measures and Apparatus

Systolic (SBP) and diastolic blood pressure (DBP) measurements (in mmHg) were obtained at one minute intervals using an IBS Model SD-700A Automatic Blood Pressure Monitor and a blood pressure cuff placed on the subject's left thigh. All blood pressure values were corrected for distance between cuff and heart level according to the manufacturers' specifications. Heart rate (HR: in bpm), cardiac output (CO: in l/min), total peripheral resistance (TPR: in dyne-sec.cm^{-5}) and stroke volume (SV: in ml) were recorded non-invasively by way of impedance cardiography, requiring a Minnesota Impedance Cardiograph (Model 304B), the Cardiac Output Program (C.O.P) developed by Bio-Impedance Technology, Chapel Hill, North Carolina, and an IBM AT personal computer. A tetrapolar band-electrode configuration was used. Two inner recording electrode bands were placed around the base of the neck and the thorax over the tip of the xiphoid process. Two outer electrode bands were positioned at least a 3 cm distance from the inner electrode bands around the neck and thorax.

An ECG signal was recorded independently using three spot electrodes. Two electrodes were placed on either side of the torso below the ribcage and a ground electrode was positioned on the right hip bone. The ECG signal was filtered through a Coulbourn Instrument bypass filter before being routed to the Minnesota Impedance Cardiograph.

Recordings of HR, CO, TPR, and SV were taken during the first 30 seconds of each minute and ensemble averaged by the C.O.P. system to obtain values for that minute.

Forearm blood flow (FBF: in ml/min/100ml) was measured each minute using venous occlusion plethysmography in the left arm and was recorded by Coulbourn Instruments, amplifiers, transducers, the Coulbourn Videograph system and an AT computer. For this procedure, a mercury-in-silastic strain gauge was placed around the subject's left forearm which rested on a comfortable support slightly above heart level. Blood pressure cuffs were positioned on the subject's left wrist and upper arm. Prior to forearm blood flow recording, manual inflation of the wrist cuff above the subject's maximum systolic blood pressure was first achieved, resulting in loss of hand circulation. One minute later, the Hokanson AG 101 Automated Cuff Inflator was used to inflate the upper arm cuff to 40-45 mmHg resulting in venous occlusion. Measures of forearm blood flow were derived from changes in forearm circumference caused by the inflow of blood while venous return was blocked. It is assumed that percentage change in arm girth may be doubled to yield a percentage change in arm volume (Whitney, 1953).

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

Psychological Measures

Expressive and neurotic hostility group classifications were derived from Buss-Durkee Hostility Inventory scores. The Buss-Durkee Hostility Inventory consists of 75 true-false items and measures general hostility in addition to seven hostility subcomponents including physical assault, indirect hostility, irritability, negativism, resentment, suspicion, verbal hostility and one subscale of guilt. Test-retest reliability for the total score is .82, with individual subscale reliability ranging from .66 to .88 (Biaggo, Supplee & Curtis, 1981). Two factors, Expressive Hostility and Neurotic Hostility have emerged from factor analyses of the Buss-Durkee scale. Expressive Hostility is primarily defined by the physical assault and verbal hostility subscales, whereas Neurotic Hostility is best defined by the resentment and suspicion subscales (Musante et al. 1989; Bushman et al. 1991). Subjects also completed the Cook Medley Hostility Scale, a 50 true-false item questionnaire derived from the Minnesota Multiphasic Personality Inventory (MMPI). The Cook Medley scale has relatively high internal consistency (Cronbach alphas averaging approximately .80) and good test-retest reliability (Smith & Frohm, 1985). Additional psychological measures designed to assess the subjects' experience and expression of anger were also employed. The Spielberger Trait Anger Inventory was used to assess individual differences in trait anger, defined as the disposition to experience anger. (Spielberger et al. 1985) To assess anger expression, subjects completed Spielberger's Anger Expression Scale (AX) (Spielberger et al. 1985). This 24-item Likert scale yields two subscale modes of expression, anger-in, referred to as the tendency to suppress anger, and anger-out, defined as the tendency to direct anger outwards toward others. Cronbach alphas have ranged from .73 to .84. Subjects also completed the Spielberger Trait Anxiety Inventory (Spielberger et al. 1985).

A state affect scale measuring anxiety, depression, irritation, anger, upset and guilt on a 7-point Likert Scale ranging from 1 (not at all) to 7 (extremely) was completed by all subjects at baseline and post-task (see Appendix C).

Computerized Math Subtraction Task

The mathematical subtraction task stressor (math-task) employed was the Computerized Subtraction Version 1.21 computer program by Turner, Sherwood & Lutz, in conjunction with an IBM compatible PC computer and a Truemouse Model TX 300 computer mouse. The 9-minute math-task, divided into three 3-minute trials, consists of a series of mathematical subtraction equations presented with either correct or incorrect solutions. During each trial a total of 180 equations are presented on the computer monitor. Each equation is presented for a three second duration.

Subjects, using the right and left computer mouse buttons, must respond within three seconds as to whether the solution on the screen is correct or incorrect. Auditory feedback, either a high or low pitched tone, informs the subjects if they answered correctly. No tone is emitted if the subjects fail to respond within the allotted time. Subtraction equations fluctuate in terms of level of difficulty, becoming easier or harder depending on each subject's performance. The math-task is designed so that each subject will attain a 50 to 60 percent correct response rate.

Procedure

Prior to the beginning of the testing session, subjects were informed that the purpose of the study was to assess their math-task performance and physiological responses. All subjects were blind to the real purpose of the study. Each subject participated in a 1 1/2 hour session. All subjects were asked to refrain from smoking and drinking coffee for four hours prior to the testing session. Subjects were randomly assigned to either a harassment or non-harassment condition. Experimenters interacting with the subjects were kept blind as to the subjects' assigned hostility group. They were also kept blind about the subject's harassment or non-harassment grouping until the beginning of the math-task. At the beginning of the testing session, each subject, comfortably seated in a reclining chair, was connected to the physiological recording apparatus by researcher A (female). After the apparatus was calibrated, the subject rested for 13 minutes. Baseline cardiovascular measures were recorded during the last three minutes of this rest period. Subjects then completed the state affect scale. Following its completion, researcher A began explaining the math-task instructions to the subject.

For subjects in the harassment condition, Researcher B (male) entered the testing room, interrupting Researcher A's instructions, to tell her that she had a phone call from her supervisor. After the instructions were completed, Researcher A excused herself and exited to the adjacent room, leaving the door ajar. In a loud voice, Researcher A pretended to engage in a telephone conversation in which she was being asked to leave the testing session. Researcher A then asked Researcher B to continue the testing for her. Researcher B voiced his opposition, stating angrily that he would not be responsible for any problems. Researcher A returned to the testing room, explained to the subject that Researcher B would be taking over and then left the room. Researcher B, feigning anger, entered the testing room to start the math-task (see Appendix D for a more detailed description).

During the math-task, Researcher B delivered six anger-provoking statements to the subject at predetermined times.

Sample statements include: "Did you understand the instructions?!" and "Can't you do better than this?!" (see Appendix E). Subject comments were ignored unless the subject wanted to stop the experiment.

For subjects in the non-harassment condition, Researcher B interrupted Researcher A's instructions to tell her that her supervisor wanted to speak with her on the telephone. Once the instructions were explained, Researcher A left the room and then returned to explain that she must leave and that Researcher B would continue the testing. Researcher A exited the room and Researcher B entered to begin the math-task. In the non-harassment condition, Researcher B remained courteous and friendly throughout the 9-minute math-task (see Appendix D).

After the math-task was completed, harassed and non-harassed subjects completed the state affect scale a second time. The testing session was stopped following a five minute rest period. All subjects were then debriefed about the deception, the purpose of the harassment and the true rationale for the experiment. Subjects who reported feeling suspicious about the harassment manipulation were excluded from the final data set. All subjects were paid ten dollars for their participation.

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

Data Reduction and Analyses

Cardiovascular data recorded during the testing sessions were reduced in the following manner. For each cardiovascular measure, values collected during baseline were averaged to obtain a mean baseline value. Similarly, all values obtained during the math-task were averaged across the nine minutes yielding a mean math-task value. To facilitate stress analyses, baseline-stress change scores were calculated by subtracting mean baseline cardiovascular values from the corresponding mean math-task values. Change scores were used in all stress analyses given the uncertainty regarding the validity of impedance-derived volume measures when absolute values are employed (Sherwood, Allen, & Fahrenberg, 1990). Separate ANOVAs were conducted for the expressive and neurotic hostility groups. Univariate analyses were employed in this research in keeping with the majority of research in this area which uses univariate instead of multivariate analyses (McCann & Matthews, 1988; Polefrone & Manuck, 1988; Smith & Allred, 1989; Suarez & Williams, 1989). Post-hoc comparisons were conducted using the Student-Newman Keuls test.

Results

Subject Characteristics

To assess whether subjects differed in age, weight and height as a function of hostility dimension and harassment condition, 2 (High/Low) x 2 (Harass/Non-harass) analyses of variance (ANOVAs) were conducted in both expressive and neurotic hostility analyses using mean age, weight and height values. No group differences in weight and height were observed. For expressive hostility, a marginal main effect was observed for age ($F(1, 44) = 3.92$, $p < .06$), indicating that low expressive hostile subjects were slightly older (24.0 ±0.7 vs. 22.3 ±0.6 years) than the high expressive hostile subjects. Means and standard errors of age, weight and height by hostility dimension and harassment condition are presented in Table 1. See Appendix G for ANOVA summary table.

Questionnaire Analyses

To assess whether high and low expressive hostile subjects and high and low neurotic hostile subjects differed in trait anger, trait anxiety, anger expression and hostility (defined by the Cook-Medley Hostility Scale), a series of one-way ANOVAs were conducted on subjects' questionnaire scores. Significant expressive hostility main effects were found for trait anger ($F(1, 44) = 4.89$, $p < .032$), anger-out ($F(1, 44) = 19.23$, $p < .000$) and Cook

Table 1

Mean Age, Weight, Height and Standard Errors for High and Low Expressive Hostile (EH) and Neurotic Hostile (NH) Groups as a Function of Harassment and Non-Harassment Conditions

		High EH	Low EH
Age (yrs)	Harass	22.4(0.6)	24.3(1.1)
	Non-Harass	22.1(1.0)	23.8(0.9)
Weight (kg)	Harass	75.5(2.4)	72.0(4.5)
	Non-Harass	80.2(3.8)	74.4(2.9)
Height (m)	Harass	1.8(0.02)	1.8(0.02)
	Non-Harass	1.8(0.02)	1.8(0.04)

		High NH	Low NH
Age (yrs)	Harass	22.6(0.7)	24.0(1.1)
	Non-Harass	24.7(0.3)	22.9(0.9)
Weight (kg)	Harass	70.9(2.9)	76.6(4.0)
	Non-Harass	74.3(2.5)	73.4(3.2)
Height (m)	Harass	1.8(0.03)	1.8(0.01)
	Non-Harass	1.8(0.02)	1.8(0.04)

Medley hostility ($\underline{F}(1, 44) = 16.75$, $\underline{p} < .000$), indicating that high expressive hostile subjects reported greater trait anger, anger-out, and hostility than did low expressive hostile subjects. No significant differences in trait anxiety or anger-in scores were found between high and low expressive hostile subjects. For neurotic hostility, significant main effects for trait anger ($\underline{F}(1, 46) = 9.11$, $\underline{p} < .004$), trait anxiety ($\underline{F}(1, 46) = 18.83$, $\underline{p} < .000$), anger-in ($\underline{F}(1, 46) = 6.40$, $\underline{p} < .015$) and Cook Medley hostility ($\underline{F}(1, 46) = 57.80$, $\underline{p} < .000$) were observed. High neurotic hostile subjects reported significantly more trait anger, trait anxiety, anger-in and Cook Medley hostility than did low expressive hostile subjects. No significant neurotic hostility group differences were found for anger-out scores. Means and standard errors of questionnaire scores by hostility dimension are presented in Table 2. See Appendix H for ANOVA summary tables.

Cardiovascular Analyses

Baseline Analyses

The effects of high versus low expressive hostility and harassment condition on baseline cardiovascular values were assessed using 2 (High/Low) x 2 (Harass/Non-harass) analyses of variance (ANOVAs) for each of the following cardiovascular measures: SBP, DBP, HR, CO, SV, FBF, TPR, and FVR. Similarly, to assess the effects of high versus low

Table 2

Means and Standard Errors of Psychological Questionnaire Scores for High and Low Expressive Hostile (EH) and High and Low Neurotic Hostile (NH) Groups

	High EH	Low EH
Trait Anger	30.3(1.7)	25.7(1.2)
Trait Anxiety	39.5(2.0)	36.9(1.4)
Anger-In	14.8(0.6)	16.1(0.7)
Anger-Out	17.2(1.0)	12.4(0.4)
Cook Medley	24.9(1.4)	16.9(1.4)

	High NH	Low NH
Trait Anger	31.0(1.5)	24.9(1.2)
Trait Anxiety	44.2(1.9)	34.4(1.2)
Anger-In	15.8(0.6)	13.8(0.4)
Anger-Out	15.5(0.8)	14.0(0.9)
Cook Medley	28.3(1.3)	15.6(1.1)

neurotic hostility and harassment condition on baseline cardiovascular values, 2 (High/Low) x 2 (Harass/Non-harass) ANOVAs were conducted for each of the 8 cardiovascular measures. Means and standard errors of baseline cardiovascular measures by hostility dimension and harassment condition are presented in Tables 3 and 4.

An expressive hostility x harassment condition interaction ($F(1, 42) = 7.75$, $p < .008$) for stroke volume was found. Post-hoc analyses of this two-way interaction revealed that high expressive hostile subjects exhibited significantly greater resting stroke volume than low expressive hostile subjects in the harassment condition. In addition, a neurotic hostility main effect ($F(1, 44) = 4.49$, $p < .04$) was found for total peripheral resistance whereas a marginal neurotic hostility main effect was observed for cardiac output ($F(1, 44) = 3.92$, $p < .054$). These results indicated that high neurotic hostile subjects, relative to low neurotic hostile subjects, had significantly lower resting total peripheral resistance and marginally higher resting cardiac output. Given that the validity of using impedance-derived absolute values is questionable, interpretations of baseline findings must be made with caution. See Appendix I for ANOVA summary tables.

Stress Analyses

To assess the effects of high versus low expressive

Table 3

Mean Cardiovascular Baseline Scores and Standard Errors for High and Low Expressive Hostile (EH) Groups as a Function of Harassment and Non-Harassment Conditions

		High EH	Low EH
SBP (mmHg)	Harass	110.2(2.2)	114.2(3.0)
	Non-Harass	115.1(3.5)	111.7(2.9)
DBP (mmHg)	Harass	60.8(2.7)	60.6(2.9)
	Non-Harass	65.5(2.2)	64.3(1.7)
HR (bpm)	Harass	60.0(2.5)	64.1(2.2)
	Non-Harass	66.7(1.9)	61.6(2.5)
CO (l/min)	Harass	8.4(0.4)	7.2(0.4)
	Non-Harass	7.4(0.4)	7.4(0.5)
SV (ml)	Harass	142.9(7.9)	112.5(7.1)
	Non-Harass	110.7(5.7)	121.3(7.3)
FBF (ml/min/100ml)	Harass	3.4(0.4)	3.3(0.4)
	Non-Harass	4.4(0.5)	3.2(0.5)
FVR (units)	Harass	28.5(3.8)	27.3(3.0)
	Non-Harass	20.4(1.8)	31.3(4.0)
TPR (dyne-sec.cm^{-5})	Harass	738.6(52.5)	910.1(64.3)
	Non-Harass	911.8(47.3)	903.7(67.5)

Table 4

Mean Cardiovascular Baseline Scores and Standard Errors for High and Low Neurotic Hostile (NH) Groups as a Function of Harassment and Non-Harassment Conditions

		High NH	Low NH
SBP (mmHg)	Harass	111.5(3.4)	110.3(2.6)
	Non-Harass	112.7(3.3)	114.7(2.6)
DBP (mmHg)	Harass	62.1(3.5)	63.4(2.0)
	Non-Harass	63.5(2.4)	60.1(3.4)
HR (bpm)	Harass	65.3(2.2)	64.9(2.0)
	Non-Harass	66.7(1.7)	62.9(2.6)
CO (l/min)	Harass	8.2(0.4)	7.3(0.5)
	Non-Harass	7.7(0.3)	7.0(0.6)
SV (ml)	Harass	127.5(6.7)	113.0(6.7)
	Non-Harass	116.4(5.0)	111.5(8.2)
FBF (ml/min/100ml)	Harass	3.3(0.4)	2.9(0.3)
	Non-Harass	3.9(0.4)	2.4(0.4)
FVR (units)	Harass	30.4(4.0)	37.5(9.7)
	Non-Harass	22.3(1.6)	27.6(3.4)
TPR (dyne-sec.cm^{-5})	Harass	762.2(64.5)	905.0(62.4)
	Non-Harass	842.4(37.7)	957.3(77.5)

hostility and harassment condition on cardiovascular reactivity to stress, 2 (High/Low) x 2 (Harass/Non-harass) ANOVAs were conducted using baseline-stress change scores for each cardiovascular measure. The effects of high versus low neurotic hostility and harassment condition on cardiovascular reactivity to stress were analyzed in the same way, using 2 (High/Low) x 2 (Harass/Non-harass) ANOVAs conducted on baseline-stress change scores for each cardiovascular measure. Means and standard errors of baseline-stress change scores by hostility dimension and harassment condition are presented in Tables 5 and 6.

Systolic Blood Pressure

For expressive hostility, a significant harassment main effect ($F(1, 42) = 13.18$, $p < .001$) and expressive hostility x harassment condition interaction effect ($F(1, 42) = 4.39$, $p < .04$) were found. Post-hoc comparisons indicated that high expressive/harassed subjects exhibited elevations in systolic blood pressure when compared to high expressive /non-harassed subjects as well as low expressive subjects in both harassed and non-harassed conditions. For neurotic hostility, only the harassment condition main effect ($F(1, 44) = 10.75$, $p < .002$) was significant. Harassed subjects exhibited greater systolic blood pressure in comparison to non-harassed subjects. No other significant effects were found. See appendix J for ANOVA summary table 1.

Table 5

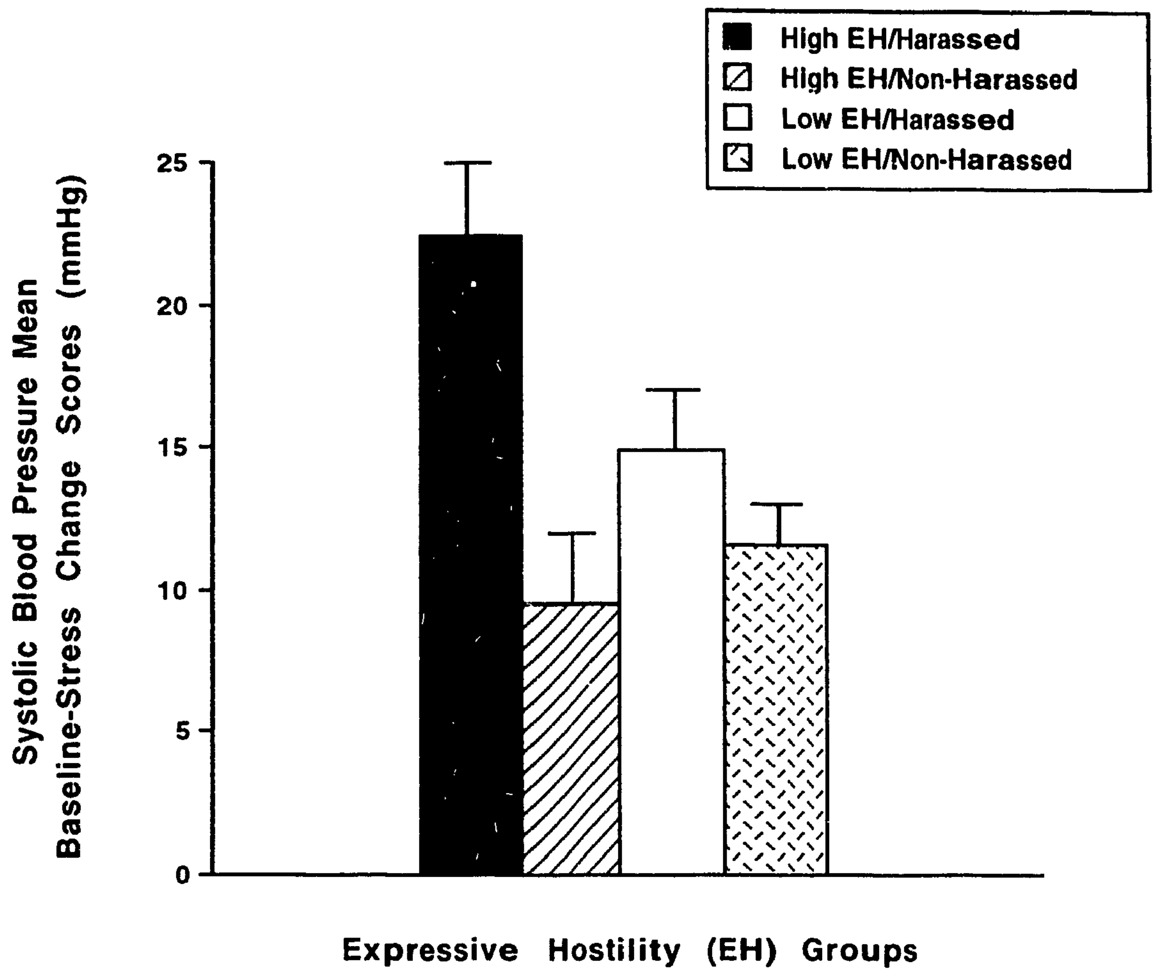
Mean Cardiovascular Baseline-Stress Change Scores and Standard Errors for High and Low Expressive Hostile (EH) Groups as a Function of Harassment and Non-Harassment Conditions

		High EH	Low EH
SBP (mmHg)	Harass	22.4(2.6)	14.9(2.1)
	Non-Harass	9.5(2.5)	11.6(1.5)
DBP (mmHg)	Harass	12.6(1.9)	9.5(1.6)
	Non-Harass	9.2(1.5)	6.8(1.4)
HR (bpm)	Harass	16.7(2.1)	9.8(1.3)
	Non-Harass	7.2(1.5)	6.9(0.9)
CO (l/min)	Harass	1.4(0.3)	0.4(0.2)
	Non-Harass	0.2(0.1)	0.5(0.2)
SV (ml)	Harass	-10.1(3.0)	-10.3(2.1)
	Non-Harass	-7.9(1.8)	-4.9(2.4)
FBF (ml/min/100ml)	Harass	3.2(0.8)	1.7(0.6)
	Non-Harass	0.9(0.5)	0.7(0.3)
FVR (units)	Harass	-11.5(2.3)	-7.5(2.9)
	Non-Harass	-1.7(1.9)	-2.4(2.6)
TPR (dyne-sec.cm^{-5})	Harass	30.5(21.2)	83.2(33.7)
	Non-Harass	73.9(34.8)	33.9(26.9)

Table 6

Mean Cardiovascular Baseline-Stress Change Scores and Standard Errors for High and Low Neurotic Hostile (NH) Groups as a Function of Harassment and Non-Harassment Conditions

		High NH	Low NH
SBP (mmHg)	Harass	19.2(2.4)	18.8(2.9)
	Non-Harass	10.5(1.4)	13.5(1.3)
DBP (mmHg)	Harass	8.2(1.4)	9.0(1.7)
	Non-Harass	7.8(1.6)	8.4(1.2)
HR (bpm)	Harass	14.2(2.3)	14.5(3.1)
	Non-Harass	7.4(1.3)	9.6(1.7)
CO (l/min)	Harass	1.5(0.4)	0.9(0.5)
	Non-Harass	0.5(0.2)	0.6(0.3)
SV (ml)	Harass	-1.0(3.5)	-11.1(3.2)
	Non-Harass	-5.5(2.3)	-7.4(1.3)
FBF (ml/min/100ml)	Harass	3.5(0.7)	1.1(0.5)
	Non-Harass	0.5(0.2)	1.6(0.5)
FVR (units)	Harass	-12.8(2.3)	-10.2(4.8)
	Non-Harass	-0.6(1.1)	-5.7(2.6)
TPR (dyne-sec.cm^{-5})	Harass	-21.4(27.4)	51.8(41.7)
	Non-Harass	43.6(25.9)	72.1(34.6)



<u>Figure 1.</u> Mean systolic blood pressure baseline-stress change scores and standard errors for harassed and non-harassed high and low expressive hostile (EH) groups.

Diastolic Blood Pressure

No significant main or interaction effects were observed for either the expressive or neurotic hostility dimension.

Heart Rate

In the expressive hostility analyses, significant main effects were found for expressive hostility ($F(1, 42) = 5.63$, $p < .022$) and harassment condition ($F(1, 42) = 14.85$, $p < .001$). An expressive hostility x harassment condition interaction was also found to be significant ($F(1, 42) = 4.09$, $p < .05$). Post-hoc comparisons revealed that high expressive/harassed subjects showed greater elevations in heart rate, relative to high expressive/non-harassed subjects and low expressive subjects, irrespective of harassment condition. For neurotic hostility, again only a significant harassment condition main effect ($F(1, 44) = 7.23$, $p < .01$) was found. Harassed subjects, in comparison to non-harassed subjects, displayed greater heart rate reactivity. No other effects involving neurotic hostility were found. See Appendix J for ANOVA summary table 2.

Cardiac Output

For expressive hostility, a significant harassment condition main effect ($F(1, 42) = 4.51$, $p < .04$) and expressive hostility x harassment condition interaction

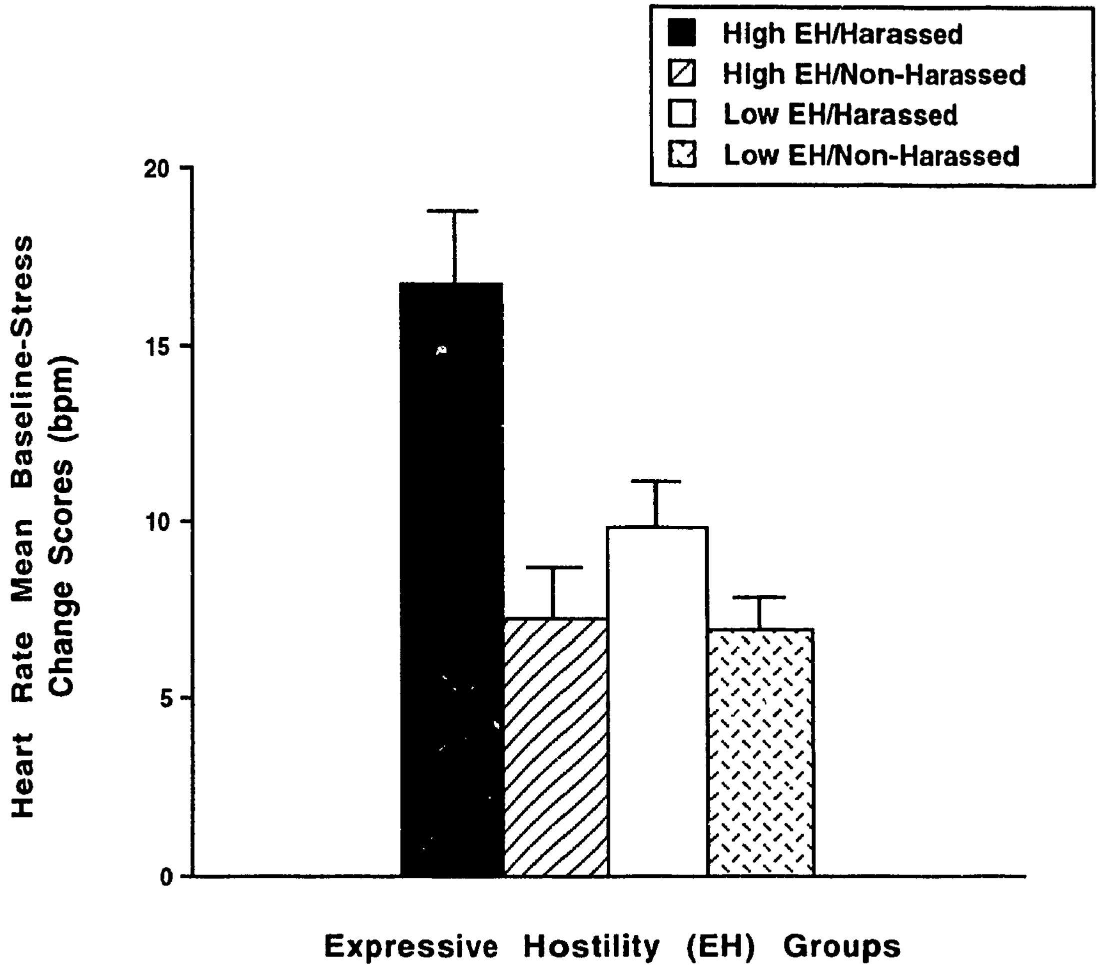


Figure 2. Mean heart rate baseline-stress change scores and standard errors for harassed and non-harassed high and low expressive hostile (EH) groups.

($\underline{F}(1, 42) = 6.96$, $\underline{p} < .012$) were observed. Post-hoc tests revealed that high expressive/harassed subjects exhibited greater cardiac output than high expressive/non-harassed subjects and low expressive subjects from both harassment conditions. No significant effects involving neurotic hostility were observed for cardiac output. See Appendix J for ANOVA summary table 3.

Stroke Volume

No significant effects were observed for the expressive hostility dimension. For neurotic hostility, a significant neurotic hostility main effect ($\underline{F}(1, 44) = 4.76$, $\underline{p} < .035$) was found, such that subjects low in neurotic hostility exhibited a greater decline in stroke volume than did high neurotic hostility subjects. See Appendix J for ANOVA summary table 4.

Forearm Blood Flow

In the expressive hostility analyses, a significant harassment condition main effect ($\underline{F}(1, 42) = 6.89$, $\underline{p} < .012$) was observed for forearm blood flow. Harassed subjects exhibited greater forearm blood flow when compared with non-harassed subjects. In the neurotic hostility analyses, a significant harassment condition main effect ($\underline{F}(1, 44) = 7.10$, $\underline{p} < .011$) and neurotic hostility x harassment condition interaction ($\underline{F}(1, 44) = 13.29$, $\underline{p} < .001$) was observed. Post-

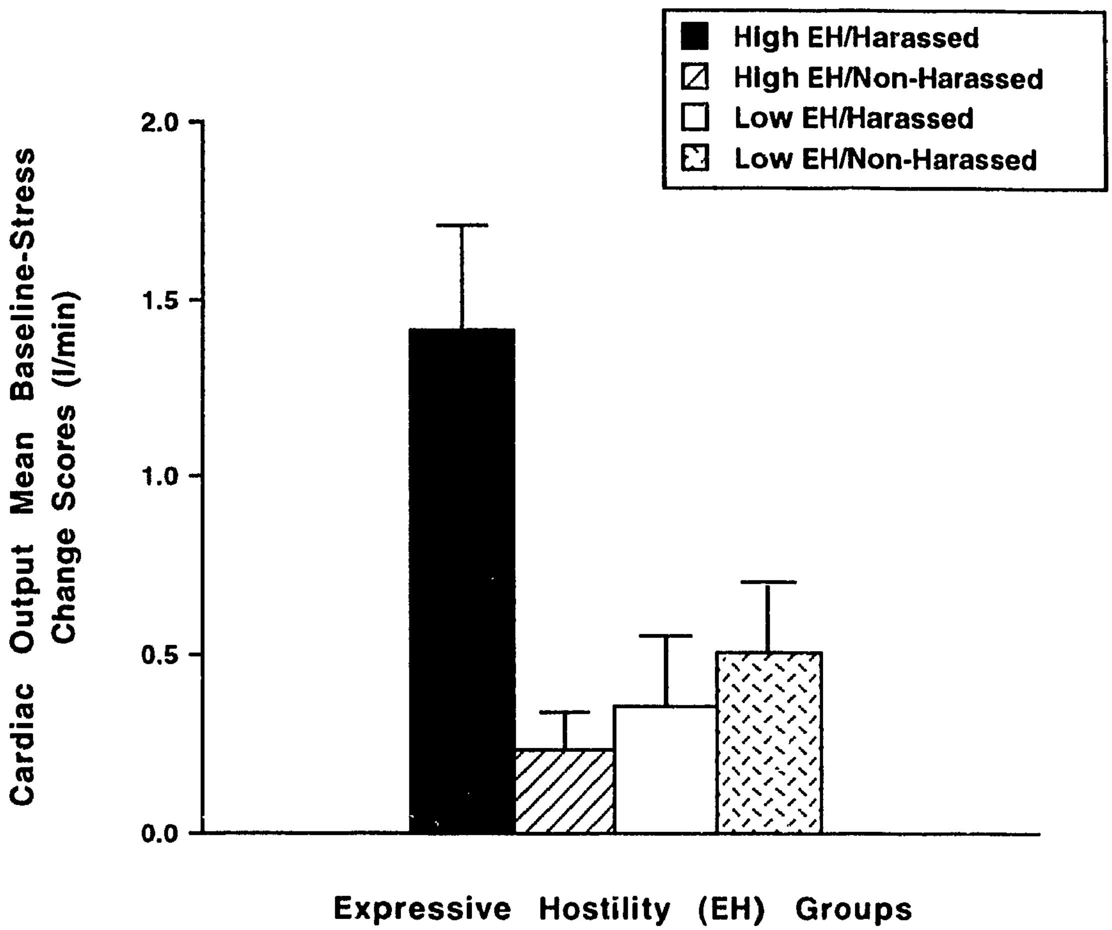


Figure 3. Mean cardiac output baseline-stress change scores and standard errors for harassed and non-harassed high and low expressive hostile (EH) groups.

hoc analyses indicated that high neurotic/harassed subjects showed a significant elevation in forearm blood flow when compared with high neurotic/non-harassed subjects as well as low neurotic subjects from either harassment condition. See Appendix J for ANOVA summary table 5.

Total Peripheral Resistance

No significant effects or interactions were observed in either expressive or neurotic hostility analyses.

Forearm Vascular Resistance

A significant harassment condition main effect was found in both the expressive hostility ($F(1, 42) = 8.93$, $p < .005$) and neurotic hostility ($F(1, 44) = 8.27$, $p < .006$) analyses. In both cases, harassed subjects, displayed significantly greater reductions in forearm vascular resistance relative to their non-harassed counterparts. No other significant results were found for either hostility dimension. See Appendix J for ANOVA summary table 6.

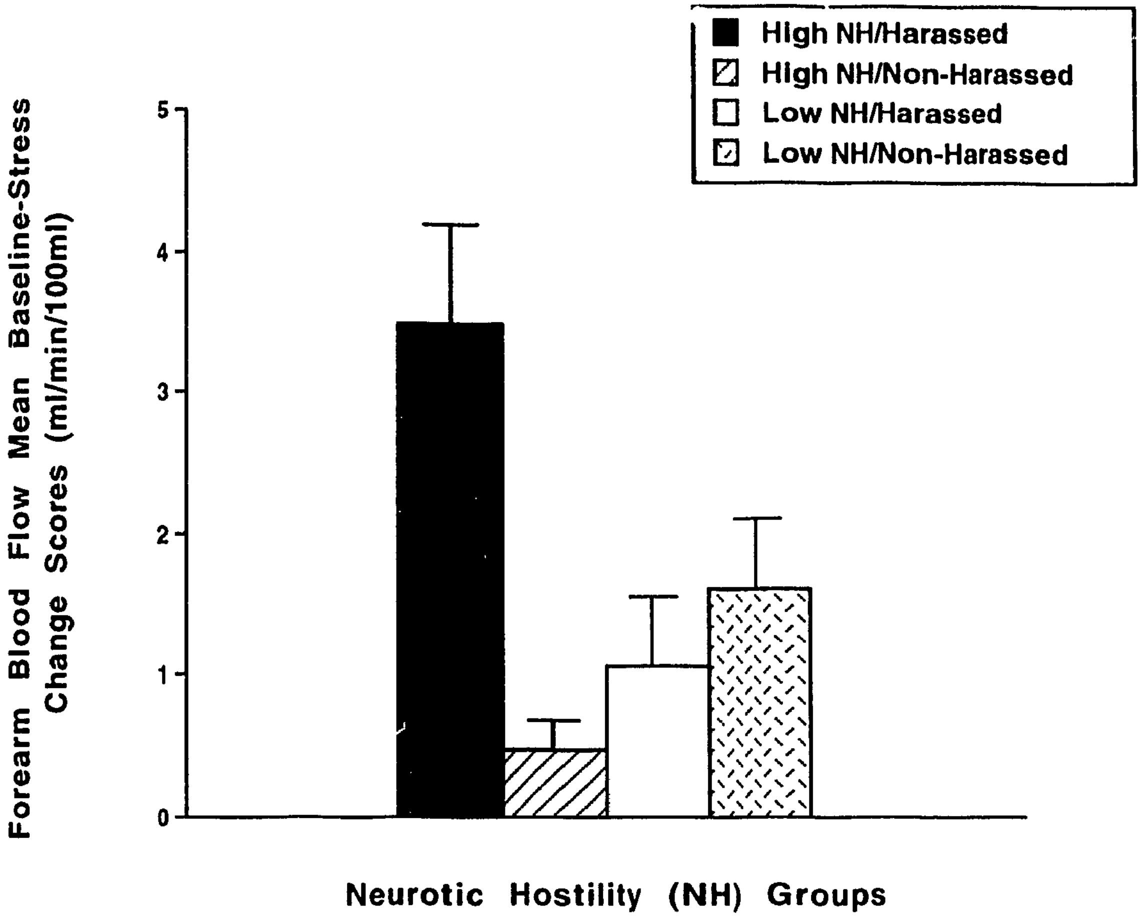


Figure 4. Mean forearm blood flow baseline-stress change scores and standard errors for harassed and non-harassed high and low neurotic hostile (NH) groups.

State Affect Analyses

To assess the effects of hostility dimension and harassment condition on baseline (pre-task) self-report affect scores for each of the 6 affect measures (anxious, depressed, irritated, angry, upset, guilt), 2 (High/Low) x 2 (Harass/Non-harass) ANOVAS were conducted for each hostility dimension. Similarity, 2 (High/Low) x 2 (Harass/Non-harass) ANOVAS were conducted on baseline-stress affect scores (covaried for baseline values) to assess the effects of hostility dimension and harassment condition on self-reported state affect scores following exposure to the math-task trials (post-task). Means and standard errors of baseline affect and baseline-stress affect change scores by hostility dimension and harassment condition are presented in Tables 7, 8, 9 and 10.

Baseline Affect Analyses

A significant neurotic hostility main effect ($\underline{F}(1, 44) = 6.63$, $\underline{p} < .013$) was found for depressed affect indicating that high neurotic hostile subjects reported significantly more depressed feelings than low neurotic hostile subjects prior to exposure to either harassment condition. No other effects involving neurotic or expressive hostility were found for any baseline state affect measure. See Appendix K for ANOVA summary table.

Stress Affect Analyses

For expressive hostility, significant harassment condition main effects were found for the angry ($F(1, 42) = 7.17$, $p < .011$), and upset ($F(1, 42) = 13.24$, $p < .001$) affect scales. Both high and low expressive hostile subjects exposed to harassment reported significantly more anger and upset when compared to their non-harassed counterparts. Similarly, for neurotic hostility, significant harassment main effects were observed for the angry ($F(1, 44) = 8.38$, $p < .006$), irritated ($F(1, 44) = 4.38$, $p < .042$) and upset ($F(1, 22) = 7.77$, $p < .008$) affect measures. Harassed subjects, whether high or low in neurotic hostility, experienced more anger, irritation and upset than subjects who were not exposed to harassment during the math-task trials. Furthermore, a neurotic hostility main effect was found for anger ($F(1, 44) = 5.05$, $p < .03$) whereas a marginal neurotic hostility main effect was observed for guilt ($F(1, 44) = 3.87$, $p < .055$). These results indicated that high, relative to low, neurotic hostile subjects, reported more feelings of anger and guilt, irrespective of harassment condition. No interaction effects were observed for either expressive or neurotic hostility dimensions. See Appendix L for ANOVA summary tables.

Table 7

Mean State Affect Baseline Scores and Standard Errors for High and Low Expressive Hostile (EH) Groups as a Function of Harassment and Non-Harassment Conditions

		High EH	Low EH
Anxiety	Harass	2.9(0.4)	2.4(0.4)
	Non-Harass	3.1(0.6)	2.5(0.3)
Depression	Harass	1.6(0.3)	1.9(0.3)
	Non-Harass	2.2(0.4)	1.4(0.2)
Irritation	Harass	1.9(0.3)	1.7(0.4)
	Non-Harass	1.5(0.3)	1.4(0.3)
Anger	Harass	1.2(0.2)	1.1(0.1)
	Non-Harass	1.2(0.1)	1.5(0.3)
Upset	Harass	1.3(0.3)	1.1(0.1)
	Non-Harass	1.7(0.3)	1.5(0.3)
Guilt	Harass	1.1(0.1)	1.4(0.2)
	Non-Harass	1.2(0.1)	1.5(0.2)

Table 8

Mean State Affect Baseline Scores and Standard Errors for High and Low Neurotic Hostile (NH) Groups as a Function of Harassment and Non-Harassment Conditions

		High NH	Low NH
Anxiety	Harass	2.7(0.4)	2.3(0.3)
	Non-Harass	2.4(0.3)	2.5(0.3)
Depression	Harass	2.3(0.4)	1.4(0.1)
	Non-Harass	2.1(0.5)	1.4(0.2)
Irritation	Harass	2.2(0.3)	1.3(0.1)
	Non-Harass	1.8(0.3)	1.6(0.4)
Anger	Harass	1.3(0.2)	1.1(0.1)
	Non-Harass	1.6(0.3)	1.4(0.3)
Upset	Harass	1.5(0.3)	1.0(0.0)
	Non-Harass	2.2(0.4)	1.5(0.4)
Guilt	Harass	1.5(0.3)	1.1(0.1)
	Non-Harass	1.4(0.2)	1.3(0.2)

Table 9

Mean State Affect Baseline-Stress Change Scores and Standard Errors for High and Low Expressive Hostile (EH) Groups as a Function of Harassment and Non-Harassment Conditions

		High EH	Low EH
Anxiety	Harass	0.2(0.5)	1.3(0.4)
	Non-Harass	0.8(0.4)	1.1(0.4)
Depression	Harass	0.1(0.4)	0.3(0.3)
	Non-Harass	-0.5(0.5)	0.1(0.2)
Irritation	Harass	1.8(0.5)	2.0(0.4)
	Non-Harass	0.7(0.5)	1.4(0.5)
Anger	Harass	1.1(0.4)	1.6(0.6)
	Non-Harass	0.2(0.2)	0.3(0.2)
Upset	Harass	1.3(0.5)	2.1(0.6)
	Non-Harass	-0.2(0.4)	0.3(0.2)
Guilt	Harass	0.2(0.2)	0.1(0.3)
	Non-Harass	0.2(0.2)	-0.1(0.2)

Table 10

Mean State Affect Baseline-Stress Change Scores and Standard Errors for High and Low Neurotic Hostile (NH) Groups as a Function of Harassment and Non-Harassment Conditions

		High NH	Low NH
Anxiety	Harass	0.4(0.6)	1.1(0.3)
	Non-Harass	0.9(0.4)	0.5(0.1)
Depression	Harass	-0.2(0.3)	0.1(0.3)
	Non-Harass	-0.2(0.4)	0.1(0.1)
Irritation	Harass	2.2(0.6)	2.3(0.4)
	Non-Harass	1.7(0.5)	0.6(0.2)
Anger	Harass	2.1(0.5)	1.0(0.4)
	Non-Harass	0.8(0.3)	0.2(0.2)
Upset	Harass	2.1(0.5)	1.0(0.4)
	Non-Harass	0.5(0.6)	0.2(0.1)
Guilt	Harass	0.4(0.3)	0.0(0.1)
	Non-Harass	0.3(0.2)	-0.1(0.2)

Discussion

The results of the present study offer support for the hypothesis that expressive and neurotic hostility relate differentially to increased cardiovascular reactivity. As hypothesized, expressive hostility, relative to neurotic hostility, was more strongly associated with enhanced cardiovascular reactivity when an interpersonal stressor was used. Contrary to expectation, an association between neurotic hostility and harassment-induced cardiovascular reactivity was also found, albeit in only one measure. These findings therefore provide evidence that harassment plays an essential role in moderating the positive relationships between both hostility dimensions and cardiovascular reactivity. Furthermore, given our results suggesting that expressive and neurotic hostility were associated with different cardiovascular response patterns under harassment, it is reasonable to speculate that expressive and neurotic hostility may be risk factors for different disease endpoints. In addition, results of the present study also provide some interesting data on negative state affect responses among expressive and neurotic hostile groups under both harassment and non-harassment conditions.

Expressive Hostility: Cardiovascular and Affective Responses

Consistent with previous research, the present findings provide evidence for a positive, significant association between expressive hostility and elevated cardiovascular responses to harassment. That is, high expressive hostile subjects exposed to harassment displayed significantly greater increases in systolic blood pressure, cardiac output and heart rate when compared with non-harassed high expressive hostile subjects, as well as harassed and non-harassed low expressive hostile subjects. Our result linking expressive hostility to elevated systolic blood pressure replicates previous findings (Siegman et al. 1992; Suarez & Williams, 1990; Suarez et al. 1993). To the author's knowledge, this is the first study also to observe a positive relationship between expressive hostility and harassment-induced increases in heart rate and cardiac output. One major strength of the present study is that, relative to previous studies, a broader selection of cardiovascular measures, reflective of both cardiac and vascular activity were assessed. This was particularly important since it afforded an opportunity to investigate potential response pattern differences between expressive and neurotic hostile groups. Accordingly, since high expressive hostile subjects exhibited greater reactivity in three measures reflecting cardiac activity, this suggests that expressive hostility may be associated with a cardiac response pattern to stress.

Results from our analyses of the relationship between expressive hostility and negative state affect indicate that harassed subjects, whether high or low in expressive hostility, became more angry and upset when compared with non-harassed subjects. This finding is not particularly surprising since the harassment manipulation was specifically designed to provoke more intense, angry reactions. Of particular interest, harassed high and low expressive hostile subjects failed to exhibit significantly different negative state affect responses. Both high and low expressive hostile groups, in other words, were equally angry and upset once harassed. According to our data relating expressive hostility to trait psychological measures, expressive hostility was positively associated with trait anger, Cook Medley hostility and an anger-out expressive style. Given the suggestion that anger, and its outward expression, are prominent characteristics of expressive hostility, it is surprising that high expressive, relative to low expressive, hostile subjects did not report more anger after exposure to harassment. Suarez and Williams (1990), for example, documented that subjects with high expressive hostility factor scores reported more negative affect, such as anger, irritation, upset and tension after exposure to harassment.

By combining findings from both reactivity and affective analyses, it is evident that harassed high expressive hostile subjects were more reactive, yet not more angry, relative to harassed low expressive hostile subjects. They were, however, more angry when compared to non-harassed subjects. According to the two-factor model of reactivity proposed by Manuck, Morrison, Bellack and Polefrone (1985), cardiovascular reactivity is dependent on a combination of stable hostile traits and anger-related states in response to interpersonal challenge. Both, in other words, are necessary to elevate cardiovascular responsitivity. Consistent with this model, our results provide evidence that high expressive hostility combined with harassment-induced state anger resulted in heightened cardiovascular reactivity. Our results also show that neither trait hostility (e.g., high expressive hostility), nor state anger, alone, sufficiently elicited greater cardiovascular responses. High expressive hostile subjects in the non-harassment condition, for example, were not more angry and were not reactive. As well, low expressive hostile subjects when harassed were more angry but were not reactive. Based on these findings, then, it seems reasonable to speculate that expressive hostile individuals will likely not exhibit greater cardiovascular reactivity unless they also encounter interpersonally challenging situations that elicit anger. Correspondingly, if, as hypothesized, cardiovascular reactivity is implicated in elevated coronary heart disease risk, it follows that expressive hostile persons may not be at greater risk for disease if they experience little anger in their environment. This, however, is unlikely, given their hypothesized tendency to create their own hostile environment (Smith, 1992).

Neurotic Hostility: Cardiovascular and Affective Responses

Contrary to most previous studies reporting no or negative associations between neurotic hostility and cardiovascular reactivity to stress (e.g., Siegman & Anderson, 1990; Siegman et al. 1992; Suarez et al. 1993), the present findings demonstrate that neurotic hostility was positively linked to harassment-induced increases in forearm blood flow. More specifically, harassed high neurotic hostile subjects displayed significantly greater forearm blood flow responses relative to non-harassed high neurotic hostile subjects as well as low neurotic hostile subjects, irrespective of harassment condition. Interestingly, this result is consistent with Suarez and Williams' (1990) finding that high neurotic hostility factor scores predicted elevated forearm blood flow responses to an anagram task combined with harassment. Given that significant positive relationships between neurotic hostility and elevated reactivity have only been found in studies measuring forearm blood flow, it is reasonable to speculate that previous studies failed to find positive results because forearm blood flow had not been included in their design.

With respect to the relationship between neurotic hostility and negative state affect, the present findings reveal that both harassed high and low neurotic hostile groups reported more anger, irritation, and upset when compared to their non-harassed counterparts. This finding, in conjunction with results from the expressive hostility analyses, provides evidence that the harassment manipulation was effective in eliciting greater negative state affect among all subjects. More importantly, our results also demonstrated that high neurotic hostile subjects reported greater pre-task depression, post-task anger and guilt when compared with low neurotic hostile subjects. Given that neuroticism is characterized by these negative emotions (Siegman, 1989), and as the name suggests, is a predominant feature of neurotic hostility, it is not surprising that high neurotic hostile subjects scored higher on these state affect scales. Consistent with the neurotic hostile profile, we also found neurotic hostility to be positively associated with trait anxiety, trait anger, anger-in expression and Cook Medley hostility.

Although it is understandable that high neurotic hostile subjects reported more anger in response to harassment and also showed greater reactivity, it is less clear why they reported more anger in the non-harassment condition where they did not show greater reactivity. It is possible that high neurotic hostile subjects may have perceived the non-harassment scenario as equally threatening, though why this did not lead to greater reactivity, and why this did not occur for the high expressive hostile subjects as well, is not clear.

Expressive Hostility, Neurotic Hostility and Disease Risk

According to the present findings, both expressive and neurotic hostility were associated with heightened cardiovascular responses to harassment. If, as speculated, hostility translates into disease via enhanced sympathetic nervous system reactivity, our findings linking expressive hostility to cardiovascular reactivity may suggest that expressive hostility is a likely risk factor for coronary heart disease. Similar findings from other reactivity studies, in addition to Siegman et al.'s (1992) angiographic data linking expressive hostility to severity of coronary artery disease, help to further support this hypothesis. Results from these studies, however, do not appear to implicate neurotic hostility in the pathogenesis of coronary heart disease. Siegman et al. (1992), for example, did not find neurotic hostility to predict coronary artery disease in their investigation of patients undergoing angiography.

Of particular interest, results from our study suggest that expressive and neurotic hostility were associated with different cardiovascular response patterns to stress. That is, high expressive hostile subjects exhibited responses (e.g., cardiac output, heart rate, systolic blood pressure) that best reflect cardiac activity, whereas the high neurotic hostile group displayed increased peripheral vascular activity, indicated by increased forearm blood flow. Although speculative, one possible interpretation of these reactivity differences is that they may translate into different disease endpoints. Thus, expressive hostility, may be a factor leading to coronary heart disease via elevated cardiac responses to stress. Neurotic hostility, on the other hand, given its association with an elevated peripheral vascular response, may possibly be a risk factor for the development of hypertension.

According to Folkow (1978), structural peripheral vascular adaptation is hypothesized to be implicated in the development of the hypertensive disease process among at-risk individuals. Stress-induced elevations in blood flow are postulated to, over time, cause hypertrophy of the vascular smooth muscle resulting in thickening and hardening of vessel walls. The consequent narrowing of vessel diameter, in turn, is hypothesized to lead to permanently elevated peripheral resistance and blood pressure.

In support of this theory, studies investigating risk for hypertension have reported stress-induced elevations in peripheral vascular reactivity among at-risk persons relative to controls. Ditto and Miller (1989), for example, observed that offspring of hypertensive parents displayed significantly greater forearm blood flow responses to an extended stress task when compared with offspring of normotensive parents. Similarly, Anderson, Mahoney, Lauer and Clarke (1987) reported a positive association between parental history of hypertension and elevated forearm blood flow responses to stress. Given that in our study neurotic hostile subjects exhibited a peripheral vascular response pattern, similar to that found in persons at risk for hypertension, it seems conceivable that neurotic hostility may be related to an elevated hypertension risk.

Additional evidence linking neurotic hostility to risk for hypertension may be found in studies investigating suppression of anger. Unlike expressive hostility, a notable aspect of neurotic hostility is the tendency to suppress anger or direct anger inward. Suarez and Williams (1990), in their factor analyses of expressive and neurotic hostility, found anger-in scores to load highly on the neurotic hostility factor. Neurotic hostility was also positively related to anger-in expression in the present study. Interestingly, suppressed anger has also been implicated in the development of hypertension. According to Alexander's "Specificity Hypothesis" (1939), recurrent experiences of anger, combined with the chronic suppression of these angry feelings were postulated to lead to chronically elevated blood pressure. Many studies have investigated the relationship between anger-in and hypertensive status or blood pressure levels. Johnson, Spielberger, Worden, and Jacobs (1987), for example, found a significant association between anger-in and increased diastolic and systolic blood pressure in a sample of black and white adolescents. Furthermore, studies examining the interaction between anger-in and stress on blood pressure levels have found stressed individuals who suppress their anger to exhibit significantly higher blood pressure levels (Harburg, Erfurt, & Hauenstein, 1973; Gentry, 1985; Cottington, Matthews, Talbott, & Kuller, 1986).

In addition, according to Alexander (1939), suppressed anger leads to feelings such as anxiety, depression and guilt. Empirical evidence for an association between hypertension and anxiety has been documented in some studies (e.g., Baer, Collins, Bourianoff & Ketchel, 1979; Sullivan et al. 1981). Moreover, Harburg et al. (1973) reported that guilt feelings over one's outward expression of anger predicted higher blood pressure levels. In the present study, it is worth noting that neurotic hostility was significantly related to trait anxiety, whereas expressive hostility was not. As well, high neurotic, relative to low neurotic, hostile subjects reported feeling more intense negative affect, such as depression, anger and guilt.

Overall, given that some interesting parallel findings in forearm blood blow reactivity, suppression of anger and negative emotional responses have been observed in studies of both neurotic hostility and risk for hypertension, it is reasonable to speculate that some relationship may exist between them.

Summary

In conclusion, the major findings of the present study support previous research indicating the importance of expressive hostility, characterized by antagonism and outward anger expression, in predicting cardiovascular responses to harassment. Given that a range of different measures, reflecting both cardiac and peripheral vascular activity were also employed, we have further demonstrated a relationship between neurotic hostility, characterized by neuroticism and anger suppression, and cardiovascular reactivity to harassment. We also had the opportunity to obtain evidence that expressive and neurotic hostility may be associated with different cardiovascular response patterns to stress. Since, under harassment, expressive hostile subjects displayed cardiac responses, whereas neurotic hostile subjects exhibited a peripheral vascular response, one possible interpretation, although speculative, is that the hostility dimensions may be predictive of different disease endpoints. That is, expressive hostility may be linked with increased risk for coronary heart disease, whereas neurotic hostility, instead, may be associated with elevated hypertension risk. Evidence that neurotic hostile persons and persons at-risk for hypertension share similar characteristics (e.g., heightened forearm blood flow reactivity to stress), may provide some support for this hypothesis linking neurotic hostility to hypertension risk. Given these interesting results, it would appear worthwhile for future research to also analyze a broader range of cardiac and vascular measures to further investigate potential response differences to stress among expressive and neurotic hostile persons.

Consistent with previous research, the present findings also underscore the importance of employing interpersonal stressors, effective in arousing negative affective responses, in order to elicit positive, significant associations between both hostility dimensions and cardiovascular reactivity. Given that our significant results were dependent upon the type of stressor we used, it would be important that future studies consider stressor characteristics when investigating hostility-reactivity relationships. Evidence, thus far, strongly suggests that positive hostility-reactivity links are more likely to be documented when interpersonally challenging stressors are used (Suarez & Williams, 1990). In accordance, it would seem worthwhile to consider the nature of the interpersonal stress experienced by hostile persons in their environment, in order to determine adequately their potential disease risk.

To date, only a limited number of studies have investigated the differential relationship between expressive hostility, neurotic hostility, and cardiovascular reactivity. Given that these studies have typically focused on male populations, future attention should be directed at assessing the differential relationship between both hostility dimensions and reactivity among women to determine if sex differences may exist. Undoubtedly, additional research is needed to corroborate our findings and to further explore the role of both hostility dimensions in the development of cardiovascular diseases, such as coronary heart disease and hypertension, for men and women.

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Appendix A

Buss-Durkee Hostility Inventory

Buss-Durkee Hostility Inventory

Read the questions carefully and circle your answer.

1. I seldom strike back, even if someone hits me first. T F
2. I sometimes spread gossip about people I don't like. T F
3. Unless somebody asks me in a nice way, I won't do what they want. T F
4. I lose my temper easily but get over it quickly. T F
5. I don't seem to get what's coming to me. T F
6. I know that people tend to talk about me behind my back. T F
7. When I disapprove of my friends' behavior, I let them know it. T F
8. The few times I have cheated, I have suffered unbearable feelings of remorse. T F
9. Once in a while I cannot control my urge to harm others. T F
10. I never get mad enough to throw things. T F
11. Sometimes people bother me just by being around. T F
12. When someone makes a rule I don't like I am tempted to break it. T F
13. Other people always seem to get the breaks. T F
14. I tend to be on my guard with people who are somewhat more friendly than I expected T F
15. I often find myself disagreeing with people. T F
16. I sometimes have thoughts which make me feel ashamed of myself. T F
17. I can think of no good reason for ever hitting anyone. T F
18. When I am angry, I sometimes sulk. T F
19. When someone is bossy, I do the opposite of what he/she asks. T F
20. I am irritated a great deal more than people are aware of. T F
21. I don't know any people that I downright hate. T F
22. There are a number of people who seem to dislike me very much. T F
23. I can't help getting into arguments when people disagree with me. T F
24. People who shirk on the job must feel very guilty. T F
25. If somebody hits me first I let him have it. T F
26. When I am mad I sometimes slam doors. T F
27. I am always patient with others. T F
28. Occasionally when I am mad at someone I will give him/her the "silent treatment." T F
29. When I look back on what's happened to me, I can't help feeling mildly resentful. T F
30. There are a number of people who seem to be jealous of me. T F

31. I demand that people respect my rights. T F
32. It depresses me that I do not do more for my parents. T F
33. Whoever insults me or my family is asking for a fight. T F
34. I never play practical jokes. T F
35. It makes my blood boil to have somebody make fun of me. T F
36. When people are bossy I take my time just to show them. T F
37. Almost every week I see someone I dislike. T F
38. I sometimes have the feeling that others are laughing at me. T F
39. Even when my anger is aroused, I don't use "strong language." T F
40. I am concerned about being forgiven for my sins. T F
41. People who continually pester you are asking for a punch in the nose. T F
42. I sometimes pout when I don't get my own way. T F
43. When someone annoys me, I am apt to tell him/her what I think of him/her. T F
44. I often feel like a powder keg ready to explode. T F
45. Although I don't show it, I am sometimes eaten up with jealousy. T F
46. My motto is "Never trust strangers." T F
47. When people yell at me, I yell back. T F
48. I do many things that make me feel remorseful afterward. T F
49. When I really lose my temper, I am capable of slapping someone. T F
50. Since the age of ten, I have never had a temper tantrum. T F
51. When I get mad, I say nasty things. T F
52. I sometimes carry a chip on my shoulder. T F
53. If I let people see the way I feel, I'd be considered a hard person to get along with. T F
54. I commonly wonder what hidden reason another person may have for doing something nice for me. T F
55. I could not put someone in his/her place, even if he/she needed it. T F
56. Failure gives me a feeling of remorse. T F
57. I get into fights about as often as other people do. T F
58. I can remember being so angry that I picked up the nearest thing and broke it. T F
59. I often make threats I don't really mean to carry out. T F
60. I can't help being a little rude to people I don't like. T F
61. At times I feel I get a raw deal out of life. T F
62. I used to think that most people tell the truth but now know otherwise. T F
63. I generally cover up my poor opinion of others. T F

64. When I do wrong, my conscience punishes me severely. T F
65. If I have to resort to physical violence to defend my rights I will. T F
66. If someone doesn't treat me right, I don't let it annoy me. T F
67. I have no enemies who really wish to harm me. T F
68. When arguing, I tend raise my voice. T F
69. I often feel that I have not lived the right kind of life. T F
70. I have known people who push me so far that we have come to blows. T F
71. I don't let a lot of unimportant things irritate me. T F
72. I seldom feel that people are trying to anger or insult me. T F
73. Lately, I have been kind of grouchy. T F
74. I would rather concede a point than get into an argument over it. T F
75. I sometimes show my anger by banging on the table. T F

Appendix B

Subject Health Questionnaire

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 you 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 you last medical check-up ____________________

Signature: ____________________ Date: ____________________

Appendix C

State Affect Scale

State Affect Scale

HOW ARE YOU FEELING RIGHT NOW?

	Not at all					Extremely
Anxious	1.....2.....3.....4.....5.....6.....7					
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					
Guilty	1.....2.....3.....4.....5.....6.....7					

Appendix D

Harassment and Non-Harassment Preparation Scenarios

Harassment Preparation Scenario

While researcher A (female) is explaining the math-task instructions to the subject, the phone rings. Researcher B (male) enters the testing room to tell Researcher A that her supervisor is on the phone.

B: "Dr. Miller is on the phone."

A: "Just a minute please."

Researcher A completes the instructions, excuses herself and exits to the adjacent room, leaving the door ajar. In a loud voice Researcher A pretends to talk on the phone.

A: "Hello Dr. Miller. Right now? Well, I'm running a subject right now. Oh, okay, I'll ask if Researcher B can take over for me. Okay, thanks, bye bye".

Researcher B pretends to be angry with Researcher A.

B: "Now what?!" (angrily)

A: "Shhhh! (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 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 returns to the testing room and tells the subject that she must leave and that another researcher will be taking her place. Researcher A then leaves the testing room and Researcher B soon enters it, pretending to be angry.

Non-Harassment Preparation Scenario

While researcher A (female) is explaining the math-task instructions to the subject, the phone rings. Researcher B (male) enters the testing room to tell Researcher A that her supervisor is on the phone.

B: "Dr. Miller is on the phone."

A: "Just a minute please."

Researcher A completes the instructions, excuses herself and exits to the adjacent room. Researcher A soon returns and explains that her supervisor wants to see her and that another researcher will be taking her place. Researcher A then leaves the testing room. Researcher B soon enters the testing room and is friendly towards the subject throughout the math-task.

Appendix E

Anger-Provoking Statements

Anger-Provoking Statements

The 9-minute subtraction task stressor consisted of three 3-minute trials. During each trial, two anger-provoking statements were delivered, one at the beginning, and the other halfway through each 3-minute period.

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 F

<u>Informed Consent Form</u>

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. 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 placements of various transducers on the skin.

You will be paid $10.00 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 withdrawn 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 G

ANOVA Summary Table for Age Values as a Function of Expressive Hostility (EH) Group and Harassment Condition

Table 1

ANOVA Summary Table for Age Values as a Function of Expressive Hostility (EH) Group and Harassment Condition

Source	df	SS	MS	*F*	*p*
EH Group	1	36.93	36.93	3.92	.06
Harassment Condition	1	1.43	1.43	.15	
EH Group x Harassment	1	.13	.13	.01	
Error	41	385.90	9.41		

Appendix H

ANOVA Summary Tables for Psychological Measures as a Function of Hostility Group

Table 1

ANOVA Summary Table for Trait Anger Scores as a Function of Hostility Group

Source	df	SS	MS	*F*
EH Group	1	248.35	248.35	4.88*
Error	44	2238.11	50.87	
NH Group	1	438.03	438.03	9.11**
Error	46	2210.79	48.06	

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

Table 2

ANOVA Summary Table for Anger-Out Scores as a Function of Expressive Hostility (EH) Group

Source	df	SS	MS	*F*
EH Group	1	259.39	259.39	19.23***
Error	44	593.41	13.49	

*** $p < .001$

Table 3

ANOVA Summary Table for Cook Medley Hostility Scores as a Function of Hostility Group

Source	df	SS	MS	*F*
EH Group	1	736.00	736.00	16.75***
Error	44	1933.65	43.95	
NH Group	1	1948.82	1948.82	57.80***
Error	46	1551.09	33.72	

*** $p < .001$

Table 4

ANOVA Summary Table for Trait Anxiety Scores as a Function of Neurotic Hostility (NH) Group

Source	df	SS	MS	*F*
NH Group	1	1143.14	1143.14	18.83***
Error	46	2792.84	60.71	

*** $p < .001$

Table 5

ANOVA Summary Table for Anger-In Scores as a Function of Neurotic Hostility (NH) Group

Source	df	SS	MS	F
NH Group	1	46.68	46.68	6.40*
Error	46	335.30	7.29	

* $p < .05$

Appendix I

ANOVA Summary Tables for Cardiovascular Baseline Scores as a Function of Hostility Group and Harassment Condition

Table 1

ANOVA Summary Table for Stroke Volume Baseline Scores as a Function of Expressive Hostility (EH) Group and Harassment Condition

Source	df	SS	MS	F
EH Group	1	1518.61	1518.61	2.45
Harassment Condition	1	1710.63	1710.63	2.78
EH group x Harassment	1	4763.22	4763.22	7.75**
Error	42	25828.52	614.97	

** p <.01

Table 2

ANOVA Summary Table for Total Peripheral Resistance Baseline Scores as a Function of Neurotic Hostility (NH) Group and Harassment Condition

Source	df	SS	MS	F
NH Group	1	198729.97	198729.97	4.49*
Harassment Condition	1	53568.04	53568.04	1.21
NH Group x Harassment	1	2333.48	2333.48	.05
Error	44	1945551.73	44217.09	

* $p < .05$

Table 3

ANOVA Summary Table for Cardiac Output Baseline Scores as a Function of Neurotic Hostility (NH) Group and Harassment Condition

Source	df	SS	MS	*F*	*p*
NH Group	1	8.67	8.67	3.93	.054
Harassment Condition	1	2.32	2.32	1.05	
NH Group x Harassment	1	.08	.08	.04	
Error	44	97.19	2.21		

Appendix J

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

Table 1

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

Source	df	SS	MS	*F*
EH Group	1	108.82	108.82	.18
Harassment Condition	1	778.88	778.88	13.18***
EH Group x Harassment	1	259.34	259.34	4.39*
Error	42	2482.28	6.78	
NH Group	1	20.44	20.44	.37
Harassment Condition	1	594.95	594.95	10.75**
NH Group x Harassment	1	35.41	35.41	.64
Error	44	2434.76	55.34	

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

Table 2

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

Source	df	SS	MS	*F*
EH Group	1	169.13	169.13	5.63*
Harassment Condition	1	445.77	445.77	14.85***
EH Group x Harassment	1	122.64	122.64	4.09*
Error	42	1260.84	30.02	
NH Group	1	18.43	18.43	.33
Harassment	1	410.65	410.65	7.23**
NH Group x Harassment	1	10.71	10.71	.19
Error	44	2497.86	56.77	

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

Table 3

ANOVA Summary Table for Cardiac Output Baseline-Stress Change Scores as a Function of Expressive Hostility (EH) Group and Harassment Condition

Source	df	SS	MS	*F*
EH Group	1	2.28	2.28	3.19
Harassment Condition	1	3.22	3.22	4.51*
EH Group x Harassment	1	4.97	4.97	6.96*
Error	42	29.97	.71	

* $p < .05$

Table 4

ANOVA Summary Table for Stroke Volume Baseline-Stress Change Scores as a Function of Neurotic Hostility (NH) Group and Harassment Condition

Source	df	SS	MS	*F*
NH Group	1	428.90	428.90	4.76*
Harassment Condition	1	4.59	4.59	.05
NH Group x Harassment	1	204.22	204.22	2.27
Error	44	3966.80	90.16	

* $p < .05$

Table 5

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

Source	df	SS	MS	*F*
EH Group	1	8.67	8.67	1.95
Harassment Condition	1	30.60	30.60	6.89*
EH Group x Harassment	1	4.48	4.48	1.01
Error	42	186.42	4.44	
NH Group	1	5.05	5.05	1.78
Harassment Condition	1	20.23	20.23	7.10*
NH Group x Harassment	1	37.86	37.86	13.29***
Error	44	125.36	2.85	

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

Table 6

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

Source	df	SS	MS	F
EH Group	1	39.44	39.44	.56
Harassment Condition	1	632.39	632.39	8.93**
EH Group x Harassment	1	60.83	60.83	.86
Error	42	2972.80	70.78	
NH Group	1	19.17	19.17	.18
Harassment Condition	1	862.55	862.55	8.27**
NH Group x Harassment	1	179.91	179.91	1.73
Error	44	4589.31	104.30	

** $p < .01$

Appendix K

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

Table 1

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

Source	df	SS	MS	*F*
NH Group	1	8.71	8.71	6.63*
Harassment Condition	1	.17	.17	.13
NH Group x Harassment	1	.05	.05	.04
Error	44	57.82	1.31	

* $p < .05$

Appendix L

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

Table 1

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

Source	df	SS	MS	F
EH Group	1	.96	.96	.47
Harassment Condition	1	12.88	12.88	7.17*
EH Group x Harassment	1	60.83	60.83	.86
Error	42	2972.80	70.78	
NH Group	1	8.36	8.36	5.05*
Harassment Condition	1	13.88	13.88	8.38**
NH Group x Harassment	1	.74	.74	.44
Error	44	94.98	2.02	

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

Table 2

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

Source	df	SS	MS	*F*
EH Group	1	4.85	4.85	2.09
Harassment Condition	1	30.75	30.75	13.24***
EH Group x Harassment	1	.31	.31	.14
Error	42	97.55	2.93	
NH Group	1	5.58	5.58	2.37
Harassment Condition	1	18.32	18.32	7.77**
NH Group x Harassment	1	1.93	1.93	.37
Error	44	103.78	2.36	

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

Table 3

ANOVA Summary Table for Irritated Baseline-Stress Change Scores as a Function of Neurotic Hostility (NH) Group and Harassment Condition

Source	df	SS	MS	*F*
NH Group	1	2.81	2.81	.99
Harassment Condition	1	12.47	12.47	4.38*
NH Group x Harassment	1	3.88	3.88	1.36
Error	44	125.23	2.85	

* p <.05

Table 4

ANOVA Summary Table for Guilt Baseline-Stress Change Scores as a Function of Neurotic Hostility (NH) Group and Harassment Condition

Source	df	SS	MS	*F*	*p*
NH Group	1	1.99	1.99	3.87	.055
Harassment Condition	1	.12	.12	.24	
EH group x Harassment	1	.001	.001	.002	
Error	44	22.60	.51		