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Analysis of the Differences in Physiological Measurements in African American and Caucasian Women During Racist Stressors Compared to Anger Stressors

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Analysis of the Differences in Physiological Measurements in African American and Caucasian Women During Racist Stressors Compared To Anger Stressors

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April 23, 1999
Analysis of the Differences in Physiological Measurements in African American and Caucasian Women During Racist Stressors Compared To Anger Stressors

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Analysis of the Differences in Physiological Measurements in African American and Caucasian Women During Racist Stressors Compared To Anger Stressors

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Abstract

The major purpose of this study was to demonstrate the difference in physiological measurements in African American women and Caucasian women during an anger stressor versus a racist stressor. While some studies have looked at each stressor separately, this study compared the blood pressure, heart rate, cardiac output, stroke volume, and total peripheral resistance of all subjects and determined that African American women and Caucasian women respond to anger and racist stressors differently. The hypothesis for this study predicted that all physiological measurements would be higher in African American women than Caucasian women during the racial stressor. The findings showed that the racist stressor had a significant differential affect on diastolic blood pressure and total peripheral resistance in the African American women, producing a greater response than in the anger stressor alone. Interestingly and contrary to my hypothesis, stroke volume showed a main effect that indicated that Caucasian females demonstrated elevated levels of stroke volume during the racist stressor compared to the African American women. The concept of examining the exposure, frequency, and intensity of racism are presented for further research.
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Chapter 1: Type A Behavior

In 1959, Friedman and Rosenman developed the concept of Type A Behavior Pattern. These researchers found that Type A Behavior Pattern is based upon several characteristics such as impatience, hostility, job involvement, sense of time urgency, and competitiveness. The inverse of Type A is Type B Behavioral Pattern, which is considered to be the absence of Type A characteristics (Kaplan, 1992). While Type A is generally associated with negative characteristics, Type B Behavior Pattern appears to have positive characteristics, such as high self-esteem, forgiveness, and a good balance between demands and realization (Kaplan, 1992). Using these behavioral patterns, in 1974, Rosenman and Friedman assessed approximately 1000 men and designated them as either Type A or B. These researchers performed a longitudinal study in which they found that Type A individuals were two and a half times more likely to have a heart attack than the Type B individuals (Rosenman, 1993). After this historic finding, several studies have been performed to examine this phenomenon and assess the accuracy of the Type A Behavioral Pattern.

To assess whether an individual is Type A or Type B, two methods and their accuracy were compared in a study to measure Type A Behavior Pattern. These two approaches are the Structured Interview and the Jenkins Activity Scale. Usually these techniques are used in conjunction with hostility scales such as the Cook Medley Scale to provide thorough results. According to one study performed by K.A. Matthews (1988), the combination of both Type A-SI (Structured Interview) and Type A-JAS (Jenkins
Activity Scale) with the Cook Medley did not prove to be an adequate predictor of disease. However, Matthews determined that hostility measured by either Type A-SI or the Cook Medley Scale was a reliable predictor of the cardiovascular disease based on various population studies. Because the Type A-SI includes a measurement of hostility, Matthews believes that this method is more accurate than the Type A-JAS, which does not include hostility as a factor.

While Matthews concluded that Type A-SI was a better measurement than Type A-JAS, other researchers still believe in using the Jenkins Activity Scale. A study done by Fichera and Andreassi in 1998 examined Type A Behavior Pattern using the Jenkins Activity Scale. This study also looked at the hostility component as a possible predictor of cardiovascular disease. Fichera and Andreassi examined a sample of 96 women who came from diverse backgrounds. The subjects participated in an experiment to determine the relationship between Type A Behavior Pattern and cardiovascular reactivity using two different tasks, which consisted of an oral IQ quiz and a reaction time task. The participants were screened for Type A/B behavior using the Jenkins Activity Survey and the Cook Medley Hostility Scale. The participants were then grouped into four categories: Type A (low hostile), Type A (high hostile), Type B (low hostile), and Type B (high hostile). This experiment determined that the only two groups that showed significant differences were the Type A (high hostile) and the Type B (low hostile) with the Type A (high hostile) showing greater reactivity. Also, according to the authors, the Type A women were more reactive to both of the tasks rather than just one. Therefore, in the oral IQ quiz and the reaction time tasks, the women showed an increase in heart rate.
and an increase in blood pressure when subjected to stressors. The authors also noted that the personal nature of the tasks might have been a factor. In examining the results, Fichera and Andreassi concluded that the interpersonal tasks are more salient to Type A personality and are more likely to elevate cardiovascular reactivity.

Other studies focused on various aspects of Type A behavior as it related to physiological levels and mechanisms. A study done by Lundberg, Hedman, Melin and Frankenhauser (1989), showed that elevated levels of catecholamine, cortisol, serum cholesterol, and in particular, low density lipoprotein (LDL) are considered potential risk factors for cardiovascular disease. Since this study was concerned with environmental stress in healthy white-collar men and women, a sample of individuals was examined during a work day and a work-free day. Type A behavior was assessed using the VSI, which is a videotaped version of the structured interview. This videotaped version makes assessments for the following: hostile/aggressive behavior, psychomotor activity, and speech and voice characteristics. The results of this study showed a partial correlation between the levels of epinephrine, norepinephrine, and cortisol and Type A for both men and women at work. Also, the Type A working men and women showed elevated systolic and diastolic blood pressures and heart rate. In addition, as the researchers predicted, the relationship between Type A behavior and the physiological variables including the lipids were the most pronounced for subjects at the opposite or extreme ends of the Type A and Type B scales. The authors also discussed the competitiveness factor of the Type A personality. Lundberg and colleagues found that the strongest association with the physiological reactivity at work for men was found in the
competitiveness subscale. Because of this finding, these authors indicated that competition was the most important factor in eliciting elevated reactivity in men. In comparison to the men, the women of this study had a negative corresponding correlation to competitiveness. This finding was consistent with Frankenhauser's, one of the researchers in this study, earlier experiments (Frankenhauser, Lundberg, & Forsman, 1980) in which she demonstrated a positive correlation between achievement-related variables and catecholamine excretion in males. This correlation was not found in females. Therefore, the researchers in this study are interpreting the results to mean that highly competitive women at work are less stressed at work than at home, but overall highly competitive women are more stressed than non-competitive women.

In a study done by Contrada, Czarnecki, and Pan (1997), Type A behavior pattern was looked at as a coping mechanism for stress. Using Glass's 1977 model of Type A, they looked at several studies and distinguished between two related types of control, environmental control and self-control. They defined environmental control as the tendency of Type A individuals to exhibit aggressiveness and pressured drive while striving to overcome a potentially uncontrollable situation. On the other hand, self control is referred to as a tendency for Type A individuals to suppress or ignore internal states such as fatigue and emotional distress that signal potential loss of control and may interfere with efforts to master environmental demands. Furthermore, both forms of control were found to be used as coping mechanisms. In the past, environmental control and self-control have been studied separately in explaining either behavior or physiological reactivity of Type A individuals.
Interestingly, there has also been some evidence that Type A is not a risk factor for cardiovascular disease. For example, in a longitudinal study following 862 patients who had survived myocardial infarction, Type A-SI was associated with sudden death, but not with the reoccurrence of a heart attack or a non-sudden death (Brackett & Powell, 1988; King, 1997). These researchers found that neither hostility, Type A-SI, nor Type A-JAS, were linked to cardiac mortality of non-fatal events. Similarly, Barefoot and colleagues (1994) performed a longitudinal prospective study which followed 1,201 men and 266 women with documented cases of coronary heart disease for six years, which did not show a significant correlation between hostility, Type A behavior or mortality. Instead, these researchers found that individuals with Type A personality had a better survival rate than type B; however, this was only true for those with a relatively poor ventricular function (Barefoot, Patterson, & Haney, 1994; King, 1997). Barefoot et al. (1997) concluded by stating that “explanations for these findings must look at the fact that the effect of type A behavior on survival takes the form of an interaction with disease severity. It is not a main effect” (p. 431).

Like these experiments on adults, other researchers have found evidence that Type A behavior may not be detrimental to health, and may even be beneficial in some cases with children. A study by Kennard et al., (1993) demonstrated that children ages 6-16 who were classified as Type A actually had lower systolic and diastolic blood pressure than the children assessed as Type B. In addition, in a recent longitudinal prospective study, researchers assessed school-age children as Type A/B by the Jenkins Activity Scale and followed them through high school. They found that Type A behavior pattern
was not associated with elevated blood pressure nor did it predict an increase in blood pressure over a ten-year period (Lee, Gomez-Marin & Prineas, 1996). In fact, this study showed that both sexes that were classified as Type B had a higher diastolic blood pressure than those classified as Type A. Furthermore, evidence exists that Type A behavior may even be beneficial to adolescents (Kennard et al., 1993). Kennard’s group found that children classified as Type A had lower total serum and LDL-cholesterol levels. Also, these children had better exercise endurance and higher social competence than those Type B children. While Type A behavior does not seem to demonstrate a high risk factor in adolescents, most researchers believe that a specific sub-component of Type A behavior, hostility, has been shown to be related to higher lipid levels, smoking, and other behavioral factors for cardiovascular disease (King, 1997).

According to a preponderance of evidence, it seems clear that there exists some type of relationship between Type A behavior and the incidence of coronary heart disease. However, because of inconsistencies within the research, over the last few years, the terminology of the “Type A Behavior Pattern” has begun to shift to “coronary-prone behavior pattern” (King, 1997). This adaptation in the scientific language is acknowledging that only part of the original concept of Type A Behavior Pattern may be harmful to one’s health: that part is the hostility component.
Chapter 2: Hostility

Because of the lack of consistent predictability in studies concerning Type A behavior pattern, several researchers began to examine the individual features of the behavior pattern, specifically the sub-component hostility. Because of its importance, hostility has been dubbed the “toxic” component of the Type A behavior pattern by several researchers (Dembroski & Costa, 1987; Rancho, Snaderman, Bouma, Buunk, and van den Heuvel, 1997). Similarly, Williams proposed a “hostility complex,” consisting of cynicism, angry feelings, and aggressive behavior in response to provocation (Williams, 1987). Williams, like many others, believes that this hostility factor is the major psychological risk factor for cardiovascular disease. Although the exact definition of hostility is not generally agreed upon, hostility is considered more cognitive than emotional or behavioral (Smith 1992; Fichera & Andreassi, 1998). The overall evidence from both prospective studies and cross-sectional studies warrants the conclusion that hostility predicts the onset of coronary heart disease.

Several models have been proposed to analyze this hostility factor. The first model, and the most understood, is called the psychophysiological model. This model suggests that hostility heightens cardiovascular and neuroendocrine activity. Because of this heightened reactivity, the body may exhaust itself in the long run by “initiating and heightening the atherosclerosis process” (King, 1997). Also, immediate effects of this excessive reactivity may trigger symptoms or acute events. For this model, the blood pressure variable is the possible mechanism by which psychological factors and health behaviors present an increased risk of coronary artery disease and acute coronary
symptoms (Sloan, Shapiro, Bagiella, Myers, & Gorman, 1999). Furthermore, this study suggests that the blood pressure variable may have pathogenic effects on the coronary endothelium, plaque formation, and plaque stability. Thus, these researchers state that this model maintains that established psychological and behavioral risk factors for coronary artery disease, such as hostility, are associated with diminished autonomic control and may interfere with the blood pressure variable. The psychosocial model suggests that specific types of psychosocial variables such as low social support and excessive interpersonal conflict are related to hostility and can lead to disease. The transactional model combines both the psychophysiologic and psychosocial models and suggests that “people high in hostility not only respond to the environment with heightened physiologic reactivity, but create more frequent and provocative environments by their own thoughts and action” (King, 1997, p. 265). The last behavioral model is the health behavior model. This theory believes that hostile individuals have poor health habits, thus they are at greater risk for disease (King, 1997; Miller, Friese, Dolgoy, Sita, Lavoie, & Campbell, 1998).

To assess hostility and health risks, several studies have been performed. One study looked at the structured interview (SI) ratings of Caucasian women, men, and boys of three categories: hostile content, intensity, and style. In this experiment by Engebretson and Matthews (1992), they found that the rating for potential for hostility and hostile style were more related to the expressive aspects of hostility than other aspects. Furthermore, it was found that men who have an elevated rating for potential for
hostility also reported expressing their anger outwardly. In addition, researchers 
Engebretson and Matthews found that while anger expression among men and boys was 
unrelated to hostile style, holding anger-in did show a relationship among women. For 
clarification, Engebretson and Matthews stated that Hostile Style was defined differently 
for males and for females. For men, according to Framingham Type A, Hostile Style is 
associated with a tendency to be competitive, hard-driving, and time-pressured 
(Engebretson & Matthews, 1992). Among women, Hostile Style seems related to 
withholding anger expressions (Engebretson & Matthews, 1992). Therefore, these sex 
differences raise questions about how expressive hostility assessed by the Structured 
Interview Hostile Style may differ in males and females. Furthermore, in men, those 
with a high Hostile Style tended to demonstrate elevated cardiovascular responses during 
standard stressors, while the women and the boys participating in the study showed a 
relative absence of associations between reactivity and hostility. Engebretson and 
Matthews speculate that in women and boys there exists a higher threshold of hostility 
that may be required before there can be documented associations between these two 
dimensions. This study further proved that hostility might have different functions 
physiologically and psychologically depending on age and sex.

Other studies have also examined the various facets of the hostility component. 
In a study by Ranchor and colleagues (1998), they sought to directly examine whether 
exposing hostile individuals to stress might influence health risks behaviors in addition to 
increasing cardiovascular reactivity. Using three distinct groups, healthy normal 
individuals, recovering myocardial infarction patients, and non-coronary heart disease
individuals, they examined which one of these dimensions, experience of hostility or expression of hostility, represents the toxic component. The results showed that the experience dimension proved to be more strongly related to disease than the expression aspect. Also, in examining the different groups, the researchers assessed each group of individuals on three categories of aggression, suspicion, and resentment. The results of these assessments showed that there were not any significant differences between the health control group and the coronary heart disease group.

Because hostility seems to stem from poor health habits, it seems reasonable to expect that hostility adversely effects other diseases as well. While some researchers tend to focus on hostility as a risk factor for coronary heart disease, other studies have proven that hostility predicts the mortality rate for many other diseases and not solely for heart disease. Barefoot and colleagues found that hostility could predict mortality over an extended period of time; however, it did not relate significantly to an overall increased risk of myocardial infarction (Barefoot, Peterson & Harrell, 1989).
Chapter 3: Anger

Like hostility, the suppression and expression of anger has been associated with coronary heart disease and hypertension for many years. According to Fichera and Andreassi (1998) and Smith (1992), anger is defined as an emotion or emotional state rather than a set of thoughts of actions that is considered to be feelings of mistreatment or provocation. In 1939, Alexander's "Specificity Hypothesis" proposed that the frequent expression of anger, in conjunction with chronic suppression of angry feelings caused intense and prolonged blood pressure responses that help establish such disease as hypertension (King, 1997). Furthermore, according to definitions proposed by Spielberger (King, 1997), anger as opposed to hostility can be easily provoked and studied among subjects in a typical laboratory situation. Also, because of the variety of dimensions of anger, the expression style is particularly important in the study of anger and its link to heart disease. Elevated blood pressure and many causes of mortality are linked to anger suppression. In addition, more studies have demonstrated a link between unacknowledged anger and elevated autonomic activity in individuals with hypertension. However, support of this theory has been mixed because of the confusion in identifying the individuals who do not acknowledge their angry feelings.

In a 1990 study done by Siegman, Anderson, and Berger, these researchers looked at whether an increase in speech rate and loudness during an angry exchange correspond to increased cardiovascular reactivity. These researchers asked "if an angry person reduces his/her speech rate and loudness level, will this reduce heart rate, and conversely, will an increase in speech rate and loudness have the opposite effect?" (p. 641). This
experiment determined that modification of speech rate and loudness would effect a speaker's cardiovascular reactivity. Siegman proposed a model to discuss what occurs during angry communications: "As people get angry they experience an increase in cardiovascular reactions, accelerate their speech, and raise their voice" (Siegman, Anderson & Berger, 1990 p. 641). Therefore, it corresponds that as people get continually angry, their heightened feelings and voice style may increase cardiovascular reactions. Siegman states that in males, voice manipulations had a significant impact on subjects' anger self-ratings and blood pressure responses during both the angry and neutral communications. However, in females, the voice manipulations did not have any significant effect on the female subjects' reactivity during the neutral scene. Because of the inconsistencies, Siegman believes that there needs to be more research done.

The results of the Siegman et al., (1990) study demonstrated that changes in cardiovascular reactivity in response to anger-arousing questions or provocations can severely underestimate people's cardiovascular reactivity during real-life anger-arousing situations. Their results showed the difference in blood pressure when exposed to anger-arousing events as opposed to neutral events. For instance, the participants' average physiological change from neutral to anger-arousing events was 18 mm Hg for systolic blood pressure, 12 mm Hg for diastolic blood pressure, and 7 beats per minute for heart rate. Interestingly, they state that when the experimenters induced their subjects to change their speaking style to a slow and soft speech tone while discussing a frustrating event, the individuals' blood pressure and heart rates were reduced to level occurring when describing neutral events. Therefore, Siegman et al. (1990), humorously
occurring when describing neutral events. Therefore, Siegman et al. (1990), humorously state that there does exist some truth to the saying “Let’s sit down and discuss this quietly.”

Another study looked at anger-coping styles in African American and Caucasian males. Harburg, Gleinerman, Russell and Cooper (1991), stress that the importance of studying anger-coping styles and blood pressure levels is to establish valid risk factors that predict high blood pressure. The researchers also discuss their belief that inappropriate forms of anger may relate to high blood pressure (Harburg, Gleinerman, Russell & Cooper, 1991). The authors believe that “the idea of reflective anger may be the most appropriate for blood pressure control while resentful anger (being anger in or anger out) is less appropriate” (Harburg, Gleinerman, Russell & Cooper, 1991). In addition, in the analysis of the anger styles, the types which try to reflectively solve problems seem to be correlated to lower blood pressure and low anxiety individuals; however, the resentful styles may relate to higher blood pressure. The later is often true for certain minorities, especially African Americans and women, who consistently demonstrate higher levels of anxiety about anger (Harburg et al., 1991). The results of this study showed that older African American males who had a high level of anger constraint and tried to solve experimental laboratory problems demonstrated low blood pressure, while those individuals who had a low level of anger constraint had a higher blood pressure. However, older African American males who had a high anger-out mode had a higher blood pressure level than those low on this scale. This same Anger-out
pattern was established for older Caucasian males, but there was not a pattern with Anger-out and blood pressure for younger Caucasian males. In this study, there did not exist any correlation between anger-in and blood pressure; however, younger African American males showed the highest anger-in scores.

Evaluation of the psychosocial data suggests that these factors may play a possible role in group differences in reactivity. Relative to Caucasian men and to African American and Caucasian women, African American men reported more hostility and distrust of others and repeated lack of assistance from others when in need (Saab, Llubre, Schneiderman et al., 1997). Furthermore, African American men also showed the least optimism about their likelihood for success. The propensity of enhanced inhibitory-passive coping responding among black men may provide insights into the precursors to hypertension.

Because of the concern that self-reported anger expression style was not an accurate index of a person's anger behavior, Lai and Linden (1992) combined the examination of gender and anger expression style in their study. This study was designed to examine the interactions of gender and anger expression style (anger-in versus anger-out) in an anger-inducing situation, followed by either an opportunity to ventilate the subject's frustration or no opportunity to vent. The main objectives were: to assess the cardiovascular response to harassment based on the subject's gender, to investigate whether anger-ins given an opportunity to express their anger after provocation would do
so or not, and to replicate the observation that women do not benefit from releasing angry feelings (Lai & Linden, 1992). This experiment clearly showed that men showed that men showed greater cardiovascular responsivity to stressors than women. As for the women, anger-in women displayed a significantly better recovery on systolic blood pressure than anger-out women. For men, anger expression style bore no relationship to the differential cardiovascular recovery. This study proposed that anger-in tendencies or anger suppression does not have any negative implications, and this factor may even have a positive impact on women. Also, Lai and Linden (1992), discovered that since holding anger has been a traditional women’s response, it should not produce conflict; therefore, it is consistent with the observed faster systolic blood pressure recovery and lower state anger for anger-in women.

Although this experiment did not establish a correlation between anger suppression and elevated physiological measurements in women, another study did demonstrate these results. Harralson, Suarez, and Lawler (1997), found that for women, anger suppression was positively associated with diastolic blood pressure while being negatively associated with systolic blood pressure responses. In men, these researchers found that anger suppression was negatively correlated with diastolic blood pressure. They explained their results by stating that the women in their study may have been evoking passive control, which may increase the diastolic blood pressure readings (Harralson et al., 1997). Obviously, more research should be done on this topic because of the increasing inconsistencies within the literature.
Chapter 4: Ethnicity

Compared with Caucasians, the African American population has a higher incidence of hypertension. In fact, it has been suggested that in relation to all other ethnic groups, African Americans are at the greatest risk for hypertension (McNeilly, Robinson, & Anderson, et al., 1995). Hypertension, or elevated blood pressure, is the major cause of congestive heart failure and strokes. It has been found that once diagnosed as hypertensive, blacks have both a greater risk of developing organ damage and a higher mortality rate (Kaplan, 1986). For example, in looking at only Caucasian and African American women, African American women, ages 45 to 64, are twice as likely to die of heart disease as Caucasian women of the same age (National Center of Health Statistics, 1997). Justifiably, since heart disease is the leading cause of death, African Americans in general have a higher age-adjusted death rate than Caucasians (Lechler, Rogers, & Peters, 1998).

Since there are significant differences between the incidence of heart-related problems between African Americans and Caucasians, many studies have examined the racial differences within hypertensive individuals. For example, there are certain biological mechanisms that differ between African American and Caucasian subjects. In one study, researchers found that African Americans have increased pressor sensitivity to norepinephrine while on high salt diets and that psychological stress effects the cardiovascular system differently in Caucasian than African American hypertensives (Kaplan, 1986; McGrady & Roberts, 1992). This finding suggests a complex interaction between stress, salt, and blood pressure. Also, because low renin hypertension is more
common in African Americans than in Caucasians, African Americans have traditionally been treated with more potent medication, such as diuretic antihypertensive medication (McGrady & Roberts, 1992). Similarly, differential response to propranolol and labetalol have also been reported in African Americans compared with Caucasians in lowering the blood pressure of African American patients (McGrady & Roberts, 1992). Labetalol was shown to be superior to propranolol because it contains both alpha and beta-adrenergic blocking properties, whereas propranolol is simply a beta-blocker. However, in Caucasian hypertensives, labetalol and propanolol were both equally effective (McGrady & Roberts, 1992).

In looking at the biological mechanism of hypertension, there exists longitudinal studies that show reactivity to stressors (mental arithmetic, video games) produces a beta-adrenergic response, which predicts elevations of blood pressure and development of hypertension (Markovitz, Racynski, Wallace, Chettur & Chesney, 1998). In comparison, studies using a cold pressor test have been less consistent because it is thought that this stressor primarily elicits an alpha-adrenergic response (Markovitz et al., 1998).

In addition to physiological differences, there are many studies that examine the psychological and non-drug therapeutic side to hypertension. For example, there was a study examining the racial differences in the relaxation responses of hypertensive patients. The results of this study demonstrated that both African Americans and Caucasian hypertensives lowered their diastolic blood pressure significantly with biofeedback assisted relaxation (McGrady & Roberts, 1992). Non-drug therapies, such as stress management, have also been used successfully in some studies to lower blood
pressure in patients with mild or moderate form hypertension (McGrady & Roberts, 1992). The typical stress management program consists of both electromyograph biofeedback and thermal biofeedback, which may be used to assist individuals in learning the relaxation response. With this type of treatment, patients are trained to decrease forehead muscle tension and to increase finger temperature. The researchers usually place most of their emphasis on the post-training values of muscle tension, finger temperature, and on the degree of change in those variables. Because of this type of non-pharmaceutical treatment, McGrady and Roberts (1992) examined whether or not there would be a difference between the responses of African American and Caucasian hypertensives to psychological stress and stress management procedures. These researchers hypothesized that “it would be more likely that the difference would be evident in the finger temperature and not in the muscle tension since the former is related to the degree of vasoconstriction in the skin vascular bed, which contributes to blood pressure” (McGrady & Roberts, 1992, p. 72). In this study, experimenters provided nonpharmacological treatment including relaxation training, thermal biofeedback, and for some, electromyographical feedback to hypertensive subjects on diuretic medication. The results showed that both African Americans and Caucasians decreased blood pressure and muscle tension, but African Americans showed no increase in finger temperature compared with Caucasian subjects.

Just as the relaxation techniques vary within races, cardiovascular reactivity has also differed between races. Several studies have compared African Americans and Caucasians and their cardiovascular systems using various stressors. For instance, in one
study, researchers used a regression-based approach to classify participants into cardiovascular responder types: myocardial, vascular, and mild (Llabre, Klein, Saab, McCalla, & Schneiderman, 1998). By classifying subjects, the researchers were able to examine whether these groups differed in responses to laboratory stressors and were able to determine whether responder types can predict hypertensive status, family history of hypertension, and ambulatory blood pressure. Of the three aims, the last objective is most important to this discussion. The participants of this study were approximately 50 black and 100 white men and women, all of whom were healthy normotensive and mildly hypertensive adults. The subjects experienced three tasks: a speech preparation task in which subjects were asked to present a hypothetical scenario about a circumstance when they were wrongfully accused of shoplifting, a mirror tracing of a six-pointed star while the experimenter delivered mildly harassing comments about the individual’s performance, and immersing the subjects left foot in a pail of ice and water at 4 degrees Celsius for 90 seconds (cold pressor test). The results of this study demonstrated that in the myocardial responders, there exists a greater diastolic blood pressure outside the laboratory. Thus, these subjects had a greater likelihood of being classified as hypertensive than any other group. Also, this study states that there are important implications based upon devising a classification of myocardial and vascular influences (Llabre, Klein, Saab, McCalla, & Schneiderman, 1998). For instance, vasoconstriction may lead to hypertension, which in turn develops structural and functional changes in the arteries and myocardium and thus increasing cardiac output (Llabre et al., 1998).

Furthermore, a combined therapy of beta-blockers and vasodilators has been found to
benefit myocardial and vascular responders, respectively, from vasoconstriction (Llabre, Klein, Saab, McCalla, & Schneiderman, 1998).

In addition to different task stressors, several studies are now focusing more on verbal provocation and its effects on the heart, especially as a social stressor among black individuals. Racism has been reported to prevail as a primary stressor facing African Americans of all ages in our society (Cross, 1991). Correspondingly, according to Utsey (1998), “Racism in American society is insidious, pervasive, and ubiquitous; for many African Americans, the consequences of experiencing it on a daily basis can be severe.” Furthermore, recent sociological and epidemiological literature have indicated that large amounts of exposure to the chronic stress of racism, prejudice, and discrimination may contribute greatly to the excessively high rate of hypertension among African Americans (McNeilly, Robinson, Anderson, et al., 1995; Cross, 1991; Utsey, 1998). A study performed at Duke University examined the effects of the chronic exposure to racism as it relates to the high rates of hypertension among African Americans and African American women in particular. In this study, the negative effects of racism and the positive effects of social support on cardiovascular reactivity were clearly seen. While being exposed to the racist provocation, the participants showed elevated levels of emotional and cardiovascular responses. Individuals showed greater blood pressure and heart rate reactivity on average while verbally responding during the racist stressor compared with the non-racist stressor, and greater blood pressure reactivity was shown during the recovery from the racist stressor compared with non-racist stressor (McNeilly, Robinson, Anderson, et al., 1995). As with the cardiovascular changes during speaking,
the differences for systolic blood pressure and heart rate were greater while listening to racist provocation contrary to non-racist provocation, but the diastolic blood pressure was the same for both. Interestingly, the results showed that the participants were actively engaging in responses to racist provocation, but also during the intervals in which the individuals sat quietly listening to a white debater state her arguments and viewpoints. These results were consistent with a previous study in which blood pressure and heart rate elevations remained high while participants were similarly listening to a comparable type of argument (Gerin, Pieper, Levy & Pickering, 1992). In addition, this study compared the recovery periods following the racist and non-racist stressors and determined that an augmented cardiovascular reactivity rate persisted throughout the recovery period following the racial stressor only. While augmented levels existed in different periods, the greatest reactivity, by far, was seen in individuals while speaking during a racist provocation response task.

Along with the physiological responses, this study examined emotional responses while being exposed to racist provocation. According to the data collected from this experiment, the racist content largely affected the self-ratings of anger, resentment, cynicism, and anxiety with higher ratings being observed in the racist conditions compared to the non-racist conditions. According to McNeilly et al. (1995), main effects were found for resentment, cynicism, and anxiety. As for the anger category, as hypothesized by the authors, the participants in the no-support/racist provocation condition showed the greatest increases in anger. According to McNeilly et al. (1995),
this study provides important insight into this area of research because the subjects were placed “in a face-to-face situation with a White individual espousing a racist viewpoint.” (p. 333).

An important discovery from this study was the persistence of elevated blood pressure during the recovery intervals. To emphasize the importance of this, McNeilly et al. (1995) state,

“Not only were substantial cardiovascular and emotional responses observed during both the active (responding) and passive (listening) phases of the stressor, but blood pressure also remained elevated relative to pre stress baseline levels for at least 10 minutes after the debate had ended” (p. 334).

Similarly, researchers Gerin and Pickering (1995) have stated that long-lasting effects may be more important than the immediate cardiovascular response during the stressor. This is because it may be the persistent elevations in cardiovascular reactivity which eventually leads to vascular pathology and disease.

Gerin and Pickering (1995) believe that the effect of a stressor on a recovery period depends upon each individual. These researchers suggest that the mechanism could be central or peripheral. An example of a central mechanism is the persistence of autonomic arousal, or the inability to return to a homeostatic state after a stressor. Furthermore, they discuss the impairment of baroflex sensitivity. These researchers state the baroflex functions to buffer acute changes in blood pressure, and an insensitive or damaged reflex could produce an enhance and prolonged response to a stressor. While the aforementioned mechanisms are central, a peripheral mechanism may be an abnormal
structural change in the vasculature, such as hypertrophy and remodeling, which could result in delayed response of relaxation of vascular smooth muscle following a stimulus (Gerin & Pickering, 1995; McNeilly, Robinson, Anderson, et al., 1995).
Chapter 4: Methods

Overview

The purpose of the proposed study is to determine whether psychological stressors affect cardiovascular responses differently in Caucasian and African American women. Since the majority of previous studies have demonstrated significant differences between races on standard laboratory stressors, this study hopes to further compare specific cardiovascular reactivity variables when related to anger and racism, as more ecologically valid life stressors.

Specific Aim

The specific goal of this study is to investigate the physiological reactivity differences in systolic and diastolic blood pressure, heart rate, stroke volume, cardiac output, and total peripheral resistance between Caucasian and African American women while experiencing an anger compared to a racist stressor. My hypothesis is that the African-American women will show elevated levels on all physiological measurements compared with the Caucasian women.

Subjects

The data used in this study are a portion of those previously collected by Armstead (1990). Approximately 100 women were recruited for this study with the criteria of being pre-menopausal, either of African American or Caucasian decent, and between the ages of 25 to 50 years of age. Sixty of these women were selected with exactly half being African American and the other thirty were Caucasian.
Armstead approached the subjects through religious and social organizations, and held an initial recruitment meeting. At this meeting, each subject was personally given a letter describing the research, to which an addressed stamped postcard was attached. Interested individuals scheduled an appointment with Armstead to participate in the study by providing subject’s name, address, phone number, and date and time of desired appointment on the postcard. Upon returning the postcard to Armstead, the individuals were provided with a questionnaire packet that was to be completed at home. Armstead contacted the individuals approximately one day before the scheduled appointment to confirm their participation. Also, Armstead asked them to refrain from certain food and activities, such as consuming beverages or foods with caffeine, to avoid eating chocolate and to avoid strenuous exercises at least 2 hours prior to arriving at the experimental site. As an incentive to participate, each individual was entered into a cash drawing, in which there were two prizes for $75.00 and one prize of $150.00. These drawing occurred at the end of the recruitment process, with the regulation that participants could only win one prize.

**Apparatus**

As described by Armstead, the experimental session was carried out in three of the rooms contained in the Human Psychophysiology Laboratory. The waiting room (15 X 19 foot) contained a chair and a desk at which subjects filled out the consent form. In the sound-proofed, subject room (5 X 9 foot), there was a counter on which materials for the tasks and physiological recordings were
placed. Also, there was a straight-back chair for the experimenter and a reclining lounge chair for the subject. A Quasar Video Viewer, a 13” color television monitor, was placed approximately twenty-six inches in front of the subject. A kitchen timer and a Panasonic audiotape recorder (Model #RQ-2739) also shared this counter. To allow the experimenter to monitor the progress of the stimulus portion of the experiment, a FM wireless room monitor (Model # 43-208) was placed inconspicuously in the experimental chamber near the subject. The monitor receiver was also located in the equipment room. In addition, the equipment room contained a Bo-med CCOM-3 Cardiovascular Monitor and a Roche Model 1216 Arteriosonde automatic blood pressure monitor. A 6cm-diameter hole in the wall allowed for electrical and recording cables to pass from the equipment room to the subject room. Female assistants of the same race were assigned to subjects for physiological hook-up and testing. According to Armstead, this technique was thought to control for gender and racial effects of the experimenter on physiological reactivity.

**Film Stimuli**

The stimuli used in this study consisted of three video taped film excerpts, which were approximately 2.5 minutes each in duration. The excerpts reflected three conditions: neutral, anger provoking, and racialistic. Subjects were assigned to view each video in a random order.

**Description of the Film Excerpts:**

**Neutral:** The neutral scene consisted of three minutes of nature scenes photographed along a riverbank. The subjects viewed water, birds, and other flora and fauna.
Anger: The anger-provoking excerpt consisted of three minutes of a scene from the movie “Lean on Me” in which the assistant principal reprimanded the principal concerning his arrogant attitude and his poor treatment of staff members.

Racist: The racist scene consisted of three minutes of an excerpt from the movie “The Color Purple” in which the mayor’s wife made a plethora of patronizing remarks based solely on race and toward, Sophia, an African American character in the movie.

Questionnaire/Demographic and Health Status Form

Each participant completed a questionnaire packet. While the subject was participating in the experiment, a trained assistant examined each questionnaire carefully for missing data before the participant left the laboratory. The demographic and health status form was a set of questions assembled for use in this study to obtain information about age, socioeconomic status, health, menstrual history and family history of hypertension.

Physiological Recording

Heart rate, cardiac output, and stroke volume were recorded by eight Medex electrodes and measured by the NCCOM-3 bioimpedence device continuously during each stage of the protocol. Two pairs of the electrodes were placed bilaterally vertically on the subject’s neck with five centimeters apart and two pairs of electrodes were placed on the axilla at the level of the xiphoid process. The NCCOM-3 (Bo-Med Medical Manufacturing Ltd, Irvine CA) is a continuous noninvasive thoracic bioimpedance monitor. According to a study by Appel, Kram, Mackabee, Fleming and Shoemaker (1986), the NCCOM-3 has been found to show
validity and reliability in measurements of cardiac output when compared to simultaneous Fick and thermodilution procedures.

The Roche Model 1216 Arteriosonde automatic blood pressure monitor was used to measure blood pressure. Attached to an occluding cuff was an ultrasound detector covered with transmission gel (Burdick Corporation Lectrosonic Gel.) After palpating the brachial artery on the nonpreferred arm of the subject, the cuff was placed over the upper arm so that the detector will be over the artery. Inflation of the cuff was monitored in the equipment room. To account for any mechanical failures, every fifteenth subject's blood pressure was taken manually by a sphygmomanometer to verify the readings by the automatic monitor.

Procedure

After subjects initially read and signed the consent form and researchers answered any questions the subjects had regarding the procedure, the subject was randomly assigned to one of the 3 film conditions, where the subjects was taken to the subject room to apply the Medex electrodes and blood pressure cuff. During the protocol involving the film stimuli, the experimenter gave instructions to the participants that were accessible earlier. In these instructions, the participant was told that she would view some film scenes and have blood pressure, heart rate, stroke volume, and cardiac output reading taken during each scene. Pertaining to this experiment, the videotaped provided these instructions:
1. “The scene is about to begin.”

2. “Imagine yourself as ___________________ (description of character) in the scene. Get into what you are seeing and hearing. Feel what she feels. Become her.”

3. The scene was presented.

During each minute of the stimuli, blood pressure was taken. Blood pressure was also taken during the rest periods following minutes 1, 3, and 5. The remaining two segments were presented using an identical procedure. Following the videos, the participants were asked if they had viewed any of the scenes prior to this study.

For this study, the experimental manipulation was as follows: Initial Rest (15 minutes), Film Stimulus 1 (2.5 minutes), Rest 1 (5 minutes), Film Stimulus 2 (2.5 minutes), Rest 2 (5 minutes), Film Stimulus 3 (2.5 minutes), and Final Rest (5 minutes).

**Stimulus Conditions**

Blood pressure readings were taken during minutes 1 and 2 of each of the three film conditions. Stroke volume, heart rate and cardiac output data during each of the films were quantified into global sums for minutes 1 and 2 (Formula CO = SV X HR). Total systemic vascular resistance during each of the film stimuli was calculated from the resulting cardiac output and mean arterial pressure scores.

**Operational Definitions**

To clarify the research goals of the Armstead (1990) study, it was necessary to operationalize the variables studied. Racial stress was defined as
imagining one’s self as the target of racism in a videotaped stimulus scene depicting racism. Stress due to anger was defined as imaging oneself as the anger in a videotaped stimulus depicting anger. Cardiovascular reactivity was defined as the amount of change from the initial resting baseline blood pressure, heart rate, stroke volume, mean arterial pressure and systemic vascular resistance for the film stimuli.

**Design**

The design of this study was a 2 x 2 factorial design, using two races (African American and Caucasian) and two orders of viewing (an anger-provoking stimulus and a racialistic stimulus). Subjects were randomly assigned to view one of the two-video stimuli with appropriate designations to these conditions by race.
Chapter 6: Results

To examine for possible physiological differences between races and video-type (anger versus racist), an ANCOVA was performed. The physiological parameters that were analyzed were systolic blood pressure, diastolic blood pressure, heart rate, cardiac output, stroke volume, and total peripheral resistance. The first analysis consisted of a 2 X 2 ANCOVA with the factors: race (African American or Caucasian) times video-type (anger versus racist). This analysis showed some significant findings for both, video-type and race. The second set of analyses is a 2 X 3 ANCOVA, with the factors being race (African American or Caucasian) and video-type (neutral, anger, and racist). In these analyses, there was a minimal number of significance reported (all p values > .05). In all of these analyses, a covariate was used to account for baseline differences in African Americans and Caucasians. All means and standard deviations of physiological parameters for race X video-type interaction are shown in Table 1.

Systolic Blood Pressure:

For systolic blood pressure, there was a marginal main effect of video-type ($F (1,68) = 3.73, p < .06$). However, there was also a marginal interaction of video-type and race ($F (1,68) = 3.21, p < .07$). As shown in Table 1 and Figure 1, systolic blood pressure means were higher overall in the African American
women, with a slightly elevated average for the racist stressor than the anger stressor.

**Diastolic Blood Pressure:**

As shown in Table 1, the results for diastolic blood pressure showed significant differences for both video-type and race. Diastolic blood pressure was higher during the racist video than the anger video ($F(1,68) = 3.89, p < .05$). However, this finding was modified by a significant interaction of race and video-type ($F(1,68) = 4.09, p < .05$). Caucasian subjects displayed no difference in diastolic blood pressure between the racist and anger videos, while the African American participants showed a significantly higher diastolic blood pressure during the racist stressor compared to the anger stressor (See Figure 2).

**Total Peripheral Resistance:**

Analysis of covariance revealed that the total peripheral resistance was higher during the racist video compared to the anger video ($F(1, 67) = 3.41, p < .05$). However, this result was qualified by the race X video-type interaction ($F(1, 67) = 5.168, p < .03$). As shown in Figure 3, while the Caucasian subjects displayed minimal differences between videos in total peripheral resistance, the African Americans displayed a significantly elevated total peripheral resistance to the racial video compared to the anger-provoking video.
Heart Rate/Cardiac Output:

The analyses did not find any significant differences in heart rate or cardiac output for Caucasian and African American women. As shown in Table 1, the means for the Caucasian women are higher than the African American women in both measures (See Figures 4 and 5).

Stroke Volume:

For stroke volume, there exists a significant video-type by race interaction (F (1, 68) = 4.13, p<.05.) However, the means for stroke volume showed that the Caucasian women had a higher stroke volume during the racial video than the African American women (See Table 1 and Figure 6).
Table 1
Means and Standard Deviations of Race X Video-type Interaction for Physiological Parameters

<table>
<thead>
<tr>
<th>Physiological Measure</th>
<th>WHITES</th>
<th></th>
<th>BLACKS</th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Racist</td>
<td>Anger</td>
<td>Racist</td>
<td>Anger</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>115.30</td>
<td>115.17</td>
<td>124.37</td>
<td>120.82</td>
</tr>
<tr>
<td>SD</td>
<td>14.04</td>
<td>11.35</td>
<td>13.66</td>
<td>16.62</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>79.14</td>
<td>79.17</td>
<td>85.72</td>
<td>83.07</td>
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<tr>
<td>SD</td>
<td>9.28</td>
<td>9.49</td>
<td>11.75</td>
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</tr>
<tr>
<td>TPR (pru)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>1502.20</td>
<td>1509.83</td>
<td>1740.38</td>
<td>1672.93</td>
</tr>
<tr>
<td>SD</td>
<td>451.40</td>
<td>425.50</td>
<td>491.33</td>
<td>490.65</td>
</tr>
<tr>
<td>CO (L/min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>5.23</td>
<td>5.15</td>
<td>4.92</td>
<td>4.95</td>
</tr>
<tr>
<td>SD</td>
<td>1.38</td>
<td>1.32</td>
<td>1.65</td>
<td>1.50</td>
</tr>
<tr>
<td>HR (bpm)</td>
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<td>75.99</td>
<td>76.58</td>
<td>73.80</td>
<td>73.77</td>
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<tr>
<td>SD</td>
<td>9.34</td>
<td>9.58</td>
<td>10.54</td>
<td>10.69</td>
</tr>
<tr>
<td>SV (ml)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>70.59</td>
<td>68.59</td>
<td>67.47</td>
<td>67.84</td>
</tr>
<tr>
<td>SD</td>
<td>20.45</td>
<td>19.74</td>
<td>21.05</td>
<td>19.59</td>
</tr>
</tbody>
</table>

n = 60
Chapter 7: Discussion

The purpose of this analysis of the Armstead (1990) data was to investigate and compare the differences in specific physiological parameters between Caucasian and African American women during anger-provoking and racist stimuli. African American and Caucasian females viewed two videos, racist and anger and cardiovascular variables were assessed at rest and during the film segments. My hypothesis was that in comparing the racist stressor to the anger-provoking stressor, the African American females would show higher levels in all the physiological measurements (systolic blood pressure, diastolic blood pressure, total peripheral resistance, heart rate, cardiac output, and stroke volume) than the Caucasians women.

The major finding of this study showed that diastolic blood pressure and total peripheral resistance proved to be significantly related to race and video-type. Analysis of these physiological measurements revealed that compared to the anger stressor, the African Americans showed an increase in total peripheral resistance, and diastolic blood pressure when viewing the racist video. Also, as shown in Table 1, the Caucasians did not show a physiological difference between the racist and anger stimuli for these two measures. Therefore, it appears that the racist stressor had a differential affect on cardiovascular responses in the African American women, producing a greater response than anger alone. Whereas total peripheral resistance and diastolic blood pressure demonstrated significance, analysis of systolic blood pressure indicated marginal effects.
For cardiac output and heart rate, there was not any significant effects. Interestingly, and contrary to my hypothesis, an interaction emerged for stroke volume in which the Caucasian women demonstrated higher levels while watching the racist video compared to the African American women.

In an attempt to explain these results, I looked to past research. In the Llabre et al. (1998) study, which compared vascular and myocardial responders, the researchers found that vascular responders had greater reactivity in total peripheral resistance and diastolic blood pressure, while the myocardial responders demonstrated greater responses on stroke volume and cardiac output. Supporting my hypothesis, Llabre and colleagues believe the Caucasians surveyed appear to be myocardial responders whereas the African Americans elicit more of a vascular responder type. Using the results from the Llabre et al. study, Caucasians appear to be myocardial responders; therefore, they are more likely to show greater responses for such physiological measurements as stroke volume, as shown in Table 1. Likewise, the rationale of the inconsistent and non-significant results of cardiac output and heart rate can also be attributed to the myocardial responder factor. Since cardiac output equals heart rate times stroke volume, and these measures were quantified in Armstead's (1990) data, it would seem reasonable to expect these parameters to influence each other.

Along with responder types, more studies are examining the importance of alpha and beta-adrenergic receptors and their properties to elucidate inconsistent results. Llabre
and colleagues found that their laboratory tasks (mirror tracing and cold pressor) which elicited alpha adrenergic responses evoked stronger total peripheral resistance reactivity and lower cardiac output reactivity relative to tasks that elicit beta adrenergic responses (speech preparation task). However, there appears to be some inconsistencies in the research with alpha and beta-adrenergic responses. A longitudinal study showed that reactivity to stressors (mental arithmetic, video games) produces beta-adrenergic responses, which in turn produce elevated blood pressure, and increase the likelihood of hypertension. Whereas, these researchers state the studies using the cold pressor tests are less consistent because it elicits an alpha-adrenergic response (Markovitz et al., 1998).

The alpha and beta-adrenergic differences also play a role in hypertensive drug therapy. In examining the potency of pharmaceutical hypertensive treatments, McGrady & Roberts (1992) discussed a theory of differences in biological mechanisms in which certain medications work better for African American individuals, such as labetalol, which acts on both alpha and beta-adrenergic blocking properties. Therefore, these biological and physiological mechanisms may underlie the differences in reactivity in races.

Close attention must also be given to the racist component of these findings. The significant results of the diastolic and systolic blood pressure and total peripheral resistance highlight the importance of racism as a psychological stressor. To date, few studies that examine the physiological effects of racism have been conducted. In a
previously mentioned study done by Llabre, Klein, Saab, et al. (1998), these researchers determined that African Americans, when asked to discuss a scenario, in which they were wrongfully accused of shoplifting (a misdemeanor typically stereotyped with African Americans), in a laboratory setting exhibited elevated blood pressure levels. Also, Clark, Moore, and Adams (1998) found that African American female college volunteers showed the elevated reactivity for diastolic blood pressure, stroke volume, and heart rate when viewing a blatant racist scene. Clark and colleagues (1998) allude to the physiological homeostatic mechanism which states that during stressful, challenging or threatening situations the sympathetic nervous system releases epinephrine and norepinephrine, which in turn increases cardiac function. These results follow recent research, which exclaim “Racism in American society is insidious, pervasive and ubiquitous; for many African Americans, the consequences of experiencing it of a daily basis can be severe” (Utley, 1998, p. 269). Utley seems to be suggesting that constant exposure to racism can lead to permanent health consequences. Correspondingly, diseases such as hypertension, renal artery stenosis, and myocardial infarction are all associated with elevated blood pressure levels and increased total peripheral resistance. Furthermore, the results of this finding support the statistics, which state that African Americans are the leading ethnic group in hypertension.

Not only are viewing racist stressors important, but how individuals respond to this type of stimulus also needs to be examined. For example, Horsten et al., (1999) has
shown that anger suppression or not being able to express emotion contributes to low heart rate variability and elevated blood pressure. Furthermore, Harralson, Suarez, and Lawler (1997) found that anger suppression increased diastolic blood pressure, presumably because of passive control. Since women in this study were unable to speak or verbally express any emotions while watching the disturbing videos, these results further support these associations.

Future studies are warranted for several aspects of this study. Studies examining the subjects' previous exposure to racism, its frequency, and intensity, and their coping styles are necessary to clarify the correlation between racism and elevated physiological measures. Also, while several studies have found that viewing filmed, fictional racism increases blood pressure in African Americans, further research would suggest that individuals subjected to first-hand experienced racism would be expected to have an even greater effect. Extensive research in this area may be able further the understanding of the high incidence of hypertension and other cardiovascular diseases in African Americans.
Figure 1
Systolic Blood Pressure Differences in Blacks and Whites During Racial and Anger Stressors
Figure 2
Diastolic Blood Pressure Differences in Blacks and Whites During Racial and Anger Stressors

Whites
Blacks

DBP (mmHg)

88
86
84
82
80
78
76
74

Racist
Anger
Figure 3
Total Peripheral Resistance in Blacks and Whites During Racial and Anger Stressors

TPR (pru)
1800
1750
1700
1650
1600
1550
1500
1450
1400
1350

Whites
Blacks

Racist
Anger
Figure 4
Cardiac Output Differences in Blacks and Whites During Racial and Anger Stressors

Whites

Blacks

Racist

Anger
Figure 5
Heart Rate Differences in Blacks and Whites During Racial and Anger Stressors

Whites
Blacks

Racist
Anger
Figure 6
Stroke Volume Differences in Blacks and Whites During Racial and Anger Stressors
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