

Discrimination, Dispositions, and Cardiovascular Responses to Stress

Laura Smart Richman
Duke University

Gary G. Bennett
Harvard School of Public Health and Dana-Farber
Cancer Institute

Jolynn Pek
National University of Singapore

Ilene Siegler and Redford B. Williams, Jr.
Duke University Behavioral Medicine Research Center

Objective: Recent research suggests that past exposure to discrimination may influence perceptions of, and physiological responses to, new challenges. The authors examined how race and trait levels of hostility and optimism interact with past exposure to discrimination to predict physiological reactivity and recovery during an anger recall task. **Design:** A community sample of 165 normotensive Black and White adults participated in an anger recall task while having their cardiovascular function monitored. **Main Outcome Measures:** Blood pressure and heart rate indicators of physiological reactivity and recovery. **Results and Conclusion:** Participants had higher reactivity and slower recovery to the anger recall task when they had high past discrimination, low cynicism, or high optimism. The pattern of effects was similar for both racial groups, but Blacks had more acute reactivity and slower recovery than Whites. These results are consistent with the perspective of discrimination as a chronic stressor that is related to acute stress responses, particularly for Blacks.

Keywords: perceived discrimination, hostility, optimism, cardiovascular outcomes

Accumulated evidence points to the important role that discrimination plays in cardiovascular outcomes, particularly among Blacks. Psychophysiological research suggests that laboratory analogues of ethnic discrimination and mistreatment, whether directed toward the self or others, are associated with physiological arousal (see Harrell, Hall, & Taliadro, 2003 for review; see also Armstead, 1989; Clark, 2000; Guyll, Matthews, & Bromberger, 2001). Past research has primarily focused on cardiovascular (CV) reactivity and recovery from laboratory-imposed discriminatory stimuli or retrospective accounts of past experiences and concomitant or subsequent CV responses. Little is known, however, about how past exposure to discrimination in daily life may have an impact on how acute stressors are experienced.

Laura Smart Richman, Department of Psychology and Neuroscience, Duke University; Gary G. Bennett, Department of Society, Human Development and Health, Harvard School of Public Health, and the Center for Community-Based Research, Dana-Farber Cancer Institute, Boston, Massachusetts; Jolynn Pek, Department of Psychology, National University of Singapore; Ilene Siegler and Redford B. Williams, Jr., Duke University Behavioral Research Center.

Jolynn Pek is now at the Department of Psychology, University of North Carolina at Chapel Hill.

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Correspondence concerning this article should be addressed to Laura Smart Richman, Department of Psychology and Neuroscience, Duke University, Box 90085, Flower Drive, Durham, NC 27708. E-mail: lrichman@duke.edu

Some evidence suggests that chronic stress in general may influence cardiovascular responses during acute stress and recovery. In one study, Lepore, Miles, and Levy (1997) found that male and female college students with high levels of chronic stress had greater heart rate and blood pressure responses to acute stress than those individuals who had less chronic life stressors. However, empirical work by Matthews, Gump, and Owens (2001) found that a community sample of men and women under chronic occupational and relationship stress tended to have suppressed acute stress responses, with lower systolic blood pressure (SBP) during the stress tasks and lower cortisol levels during recovery. These studies suggest that these responses may vary considerably by population and/or the stressor being examined.

In a review of the available literature on acute stress reactivity as a function of background stressors, Gump and Matthews (1999) found that most, though not all studies, showed enhanced acute stress cardiovascular responses and delayed recovery in participants who reported high background stress. The authors noted the importance of distinguishing between ongoing, important background stressors (associated with enhanced responses to acute stress) from background stressors that were resolved, infrequent, or avoidable (associated with less pronounced acute stress response). For many, discrimination may be a particularly pernicious background stressor. Experiences of discrimination are likely highly salient, uncontrollable, and thus potentially related to heightened cardiovascular responses to an acute stressor and delayed recovery.

Indeed, mounting evidence suggests that experiencing discrimination may be associated with cardiovascular dysregulation. In a study specifically measuring past discrimination as a stressor, Guyll et al. (2001) found that subtle mistreatment related posi-

tively to diastolic blood pressure reactivity for Black female participants. Similarly, among a sample of adult Black men, Merritt, Bennett, Williams, Edwards, and Sollers (2006) recently showed that exposure to a neutral laboratory stimulus, compared with a blatantly offensive stimulus, was associated with elevated blood pressure responses in a psychophysiological protocol. It is interesting to note that those who reported perceiving more discriminatory bias in the neutral condition experienced the highest cardiovascular responses to stress. In a community sample, Brondolo, Kelly, and Coakley (2005) found a positive relationship between higher levels of lifetime exposure to discrimination and tendencies to perceive future occurrences as threatening or harmful. The accumulated evidence suggests that discrimination is associated with heightened cardiovascular responses; however, the extent to which these responses vary by dispositional characteristics remains unknown.

Certain dispositional characteristics may magnify the effects of discrimination experiences (thus potentially resulting in heightened cardiovascular responses), whereas others might attenuate the effects of discrimination. A stress-and-coping approach to understanding the experience of discrimination highlights the importance of examining how stressors are cognitively appraised, the coping strategies targets use to deal with stressful events and the personal, situational, and structural factors that affect cognitive appraisals and coping processes (Major, Quinton, & McCoy, 2002). In the present investigation, we extend previous findings by examining the interplay of frequency of past discrimination experiences, dispositional factors that may particularly affect appraisals of discrimination, and CV responses to an acute stressor. Two traits that have emerged in this literature as being related to CV responses to stress are hostility and optimism. Both of these traits reflect ways of viewing outcomes in life and are related to expectations and appraisals of events.

Numerous studies have linked dispositional hostility with CV morbidity and mortality (Barefoot, Larsen, Lieth, & Schroll, 1995; Rozanski, Blumenthal, & Kaplan, 1999) perhaps via its promotion of heightened blood pressure responses during stress (e.g., Davis, Matthews, & McGrath, 2000), particularly in situations characterized by exposure to anger-provoking stressors (Suarez & Williams, 1989, 1990). Cynical hostility in particular is positively associated with elevated CV risk factors and disease (Almada et al., 1991; Julkunen, Salonen, Kaplan, Chesney, & Salonen, 1994). Several investigators (Neumann, Waldstein, Sollers, Thayer, & Sorkin, 2004; Suarez, Harlan, & Peoples, 1993) have also found that high-hostile participants maintained greater SBP levels during recovery as compared with low-hostile participants, especially after an anger provocation. Researchers have speculated that experiences of discrimination may cause anger and accumulated psychological stress, which together might be related to physiological reactivity (see Anderson, McNeilly, & Myers, 1992). Most studies linking hostility with coronary heart disease, however, used samples of upper- and middle-class White participants (Miller, Smith, Turner, Guijarro, & Hallet, 1996). We extend this work in the present article by examining hostility and stress responses in a sample of both Black and White, high- and low-socioeconomic status (SES) participants.

Unlike hostility, optimism has long been found to serve as a buffer against the negative effects of stressful events and, thus, may be beneficial or protective for health (see Taylor, Kemeny,

Reed, Bower & Gruenewald, 2000, for review). There is some evidence to support a link between *optimism*, referring to a generalized expectation of positive outcomes, and a reduced risk of coronary heart disease (CHD). For example, Kubzansky, Sparrow, Vokonas, and Kawachi (2001) found that, compared with pessimistic participants, those with the highest levels of optimism accounted for fewer than half the number of cases of angina and nonfatal and fatal heart attacks among the sample of older men. Optimistic women have also been found to be less likely to show progression of carotid disease in midlife as compared with pessimists (Matthews, Raikkonen, & Sutton-Tyrrell, 2004). There is some evidence that positive emotions in general may speed homeostatic processes, specifically for CV functioning (Fredrickson & Levenson, 1998), and, as a result, positive emotions may reduce stress on the CV system in the face of negative life events. Subsequent studies have found some support for this theory (e.g., Fredrickson, Mancuso, Branigan, & Tugade, 2000), though the way positive emotion or optimistic beliefs may interact with perceived discrimination has not been examined.

In summary, perceived discrimination and hostility are risk factors, and optimism is a protective factor for CV outcomes. Whether these experiences and dispositions interact to influence reactivity and recovery from an acute stressor is not yet known. These are important variables to examine given the more current emphasis on multiple pathways by which discrimination can influence health outcomes (e.g., Krieger, 1999). We examined whether past experiences of discrimination relate differently to blood pressure and CV responses, depending on one's ethnic group. Furthermore, we sought to examine CV reactivity as well as recovery, given the increasing demonstration of its association with coronary outcomes (e.g., Neumann et al., 2004; Singh et al., 1999).

Consistent with previous findings, we hypothesized that race would interact with past discrimination such that the more frequent experiences of discrimination in daily life would be related to greater CV reactivity and a slower recovery to a laboratory stressor and that this association would be more pronounced among Blacks than Whites. We further predicted that dispositional hostility would interact with past discrimination experiences such that for those with high levels of hostility, past discrimination would be related to heightened reactivity and slower recovery from an acute stressor. We further predicted that race would moderate this effect, resulting in more pronounced physiological responses among Blacks. Finally, we predicted that those with both high discrimination and high levels of optimism would have less reactivity and faster recovery to the laboratory stressor.

Method

Participants

A community sample of 165 normotensive adults, ages 18–50 ($M = 33.89$, $SD = 8.54$), were recruited through ads in the public media, flyers distributed in supermarkets and other public locations (e.g., barbershops, churches), and outreach screening events at civic organization meetings and other public events. Blacks were specifically targeted in this study in order to recruit approximately equal proportions of Black and White participants. Individuals who self-reported being diabetic, hypertensive, or taking

prescribed medication for any other major illness were excluded from the study. All participants underwent a comprehensive examination using a modified structured clinical interview (SCID) as well as medical history, physical exam, electrocardiogram, chest radiograph, hemoglobin, hematocrit, white cell count, and blood chemistries to rule out current psychiatric and medical disorders. Use of any prescription drugs as well as use of illegal drugs (as detected by a urine screening prior to entry into the study) were grounds for exclusion. Screening procedures resulted in 167 persons entering the experimental protocol. In this article, we report data on 165 of those who participated in the study. Two persons were excluded, as medical problems were found after they completed the study, and they were removed from the data set. One person was excluded, as discussed in the *Data Reduction* section below.

The sample included 71 White (39 men and 32 women) and 94 Black (52 men and 42 women) participants, of which 40% were of low and 60% were of high SES, as determined from a combination of income and education cut points gathered at the time of recruitment. Two categories of income were used—below or equal to \$24,900 and above \$24,900, based on the 40th-percentile rank of household incomes in Durham County, North Carolina, according to the 1990 Census (Burroughs et al., 2003). The low-SES cluster includes those who had income of less than or equal to \$24,900 and who had less than a college degree. The high-SES group included those who had income greater than \$24,900, regardless of education. Participants were recruited according to their classified SES in order to have approximately equal groups of low and high SES. Informed consent was obtained in accordance with Duke University Medical Center's Institutional Review Board Guidelines. As part of a larger study examining the genetics of biobehavioral risk factors for CHD, each participant was involved in two 2.5-hr laboratory sessions and was compensated with \$500 for completion of the study.

Psychosocial Measures

Participants completed a modified version of the McNeilly et al. (1996) Perceived Racism Scale, which measures the frequency of exposure to discrimination across three domains: the job (e.g., "I'm assigned jobs no one else wants to do"), public realm (e.g., "People 'talk down' to me"), and exposure to discriminatory statements (e.g., "Over the past few years, people like myself have gotten more economic and educational breaks than we deserve"). For each item, participants were asked to indicate the frequency of their exposure to discrimination both in the past year and during their lifetime. The measure was adapted to assess general discrimination as experienced by both Blacks and Whites. The 33 items of the scale were rated on a 6-point Likert scale ranging from 0 (*not applicable*) to 5 (*several times a day*) and was scored by taking the mean of these 33 items.

The Cook-Medley Hostility (Ho) Scale (Cook & Medley, 1954) was used to measure dispositional hostility. Using the scoring method outlined in Barefoot, Dodge, Peterson, Dahlstrom, & Williams (1989), Ho comprised three subscales: Cynicism, Hostile Affect, and Aggressive Responding. Cynicism items are statements of belief, Hostile Affect items reflect emotional experiences, and Aggressive Responding items tap behavior. Each subscale score was computed by taking the sum of its component items that were rated as either *true* (1) or *false* (0). Overall, Ho was computed by taking the sum of the

three subscale scores, with higher scores reflecting higher dispositional hostility.

Dispositional optimism was assessed by the Life Orientation Test (LOT; Scheier & Carver, 1985). The LOT is a 10-item scale with two filler items: four positively worded items and four reverse-coded items. Participants indicated their degree of agreement with statements such as "In uncertain times, I usually expect the best," using a 5-point response scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Negatively worded items were reversed, and a single score was obtained such that higher scores reflect higher dispositional optimism.

Anger Recall Task

Instructions for the anger recall task were to recall a time, sometime in the past, when the participant felt very angry toward another person. It was emphasized that this should be a situation or incident that still makes them angry when they think about it. After a 1-min period for preparation, participants were asked to describe verbally the event for approximately 4 min. If the participant was unable to complete his or her story before the end of the task, then the experimenter used a series of standardized probes to assist participants in recalling the events, such as:

Try to think of anything else you can recall that happened back then, and tell me some more about it; Tell me about any physical sensations you were aware of when you were the angriest; What aspect of the situation made you the maddest?

Cardiovascular Measures

Blood pressure and heart rate were determined at 1-min intervals using a Critikon automatic vital signs monitor (Critikon, Inc., Tampa, FL).

Procedure

After undergoing screening to exclude those with medical or psychiatric disorders or current medication use and giving informed consent, participants reported to the General Clinical Research Center during the early afternoon. All participants underwent a psychophysiological protocol, during which blood pressure and heart rate were monitored at 1-min intervals. The protocol began with a 5-min rest period, followed by 5 min of reading from a neutral text, followed by a 5-min anger recall task. An additional 5-min rest period followed the anger recall task.

Data Reduction

Blood pressure and heart rate data were averaged for the baseline period and the anger recall task. For the baseline period, the last six readings were averaged; for the anger recall task, the last four readings were averaged. For CV recovery, excursions used by Neumann et al. (2004) were used to estimate the area under the recovery curve minus the baseline for each participant and each CV measure, where $\text{area} = 0.5 \times \text{fixed time interval} [(CV \text{ measure at Time 1}) + (2 \times CV \text{ measure at Time 2}) + (2 \times CV \text{ measure at Time 2}) + \dots + (2 \times CV \text{ measure at last time point})] - (\text{baseline CV measure}) \times \text{fixed time interval}$. In the present study, we used a fixed time interval of 1 min and made use of all

the five readings taken during the recovery period in these calculations. (Note that the last reading of the anger recall period was not used because of 37 missing data points.)

Data were screened for outliers and the absence of multicollinearity and singularity. Normality, linearity, and homoscedasticity of residuals were also examined. A multivariate outlier with Mahalanobis distance = 73.94 ($p < .001$) was removed, leaving 164 participants. Gender, race, and SES were recoded as yes (1) or no (0) according to the respective dichotomies of male, Black, and high SES.

Statistical Analyses

Hierarchical regressions following the recommendations of Cohen, West, Aiken, & Cohen (2003) were conducted to test the hypotheses. For reactivity data, baseline blood pressure values were entered as the first step, followed by the covariates of age, gender, body mass index (BMI), and SES in the second step; the third step included the main effects of race, perceived discrimination, and either cynicism or optimism; and the fourth included the two-way interactions. Finally, the three-way interactions were entered in the last step. Regressions for recovery data were similar to those outlined for the reactivity data save for the exclusion of baseline values, given that the computation of recovery excursions controlled for baseline values. All independent variables were mean centered before they were entered into the regressions. Cases with missing values were excluded from these analyses. Simple slope analyses were conducted by testing whether the regression of the CV parameter on perceived discrimination at representative levels ($\pm 1 SD$) of hostility or optimism was significantly different from zero. Standard errors for these slopes were calculated on the basis of the formula in Aiken & West (1991).

Results

Preliminary Analyses

Sample characteristics are presented in Table 1. As a manipulation check, mixed analyses of covariance (ANCOVAs), with

race as the between-subject variable; time (Time 1 = baseline, and Time 2 = task) as the repeated measure; and age, gender, SES, and BMI as covariates, were conducted. These covariates were selected, as they have consistently been found to covary with CV parameters. There were significant increases in SBP, $F(1, 152) = 96.27, p < .0001$; diastolic blood pressure (DBP), $F(1, 152) = 82.59, p < .0001$; and heart rate (HR), $F(1, 152) = 94.58, p < .0001$, from baseline to task. There were significant interactions between race and time for DBP, $F(1, 152) = 5.85, p < .05$, and HR, $F(1, 152) = 7.43, p < .01$, but not for SBP, $F(1, 152) = 3.06, p = .085$. From Table 2, it can be seen that Whites had more acute DBP and HR responses to the task compared with Blacks.

Race and gender effects on psychosocial measures were examined using ANOVAs. Blacks reported more perceived discrimination in the past year compared with Whites, $F(1, 160) = 11.41, p < .001$. Blacks also reported more lifetime perceived discrimination than Whites, $F(1, 160) = 10.93, p < .001$. There was a main effect of race for overall hostility scores, $F(1, 160) = 18.23, p < .001$, with Blacks reporting more hostility than Whites. Men reported higher levels of hostility than women, $F(1, 160) = 10.66, p < .001$. There was no Race \times Gender effect for hostility. Blacks, $F(1, 160) = 15.59, p < .001$, and men, $F(1, 160) = 6.16, p < .01$, both reported higher cynicism levels. Whereas overall Hostility and the Cynicism subscale had a high alpha level ($\alpha = .84$), the other subscales had low reliability ($\alpha = .41$ and $.38$). We therefore focused our analyses on the Cynicism subscale. There were no race or gender effects for the LOT.

Correlations shown in Table 3 reveal that for Blacks, overall hostility and the individual subscales of hostility (except for hostile affect) were nonsignificantly related to reports of past-year and lifetime discrimination. For Whites, there were no significant correlations between hostility and past discrimination. There was no relation between optimism and past discrimination for Blacks or Whites.

Cardiovascular Reactivity

As predicted, results reveal a three-way interaction effect of race, cynicism, and perceived discrimination (past year) on HR

Table 1
Sample Characteristics Across All Participants and by Race

Characteristic	Total (N = 164)			White (n = 71)			Black (n = 93)		
	M	SD	a	M	SD	a	M	SD	a
Age	33.96	8.56		36.30	7.74		32.05	8.70	
Male (%)	0.55	0.50		0.55	0.50		0.56	0.50	
High SES (%)	0.60	0.49		0.69	0.47		0.53	0.50	
Body mass index	26.31	5.35		25.64	4.24		26.82	6.03	
Years of education	14.57	2.61		15.51	2.75		13.85	2.25	
Perceived discrimination in past year	0.89	0.48	.93	0.74 ^a	0.37	.93	1.00 ^a	0.53	.92
Perceived discrimination in life	1.02	0.55	.94	0.85 ^a	0.40	.93	1.14 ^a	0.62	.94
Overall hostility	10.10	5.13	.84	8.28 ^a	4.62	.80	11.49 ^a	5.08	.83
Cynicism	5.34	3.57	.84	4.15 ^a	3.32	.82	6.25 ^b	3.50	.82
Hostile affect	1.55	1.20	.41	1.35	1.23	.47	1.71	1.17	.34
Aggressive responding	3.80	1.65	.38	2.76 ^b	1.49	.40	3.54 ^b	1.69	.34
Life Orientation Test (optimism)	3.88	0.55	.79	3.89	0.56	.84	3.87	0.55	.74

Note. SES = socioeconomic status.

^a Significant group differences at $p < .001$. ^b Significant group differences at $p < .01$.

Table 2
Baseline, Task, and Recovery Means and Standard Deviations for Cardiovascular Parameters

Parameter	Baseline	Task	Recovery (min)					Recovery excursion
			1	2	3	4	5	
White								
SBP (mmHg)								
<i>M</i>	108.95	124.52	115.09	111.94	110.35	111.26	109.84	392.00
<i>SD</i>	10.88	16.17	12.47	11.82	12.84	11.20	10.88	41.33
DBP (mmHg)								
<i>M</i>	66.96	76.48	67.34	67.34	66.24	65.13	65.82	231.39
<i>SD</i>	8.56	10.10	8.64	8.71	8.94	9.21	9.53	31.75
HR (bpm)								
<i>M</i>	68.99	81.28	70.59	70.68	71.26	70.93	71.10	250.28
<i>SD</i>	11.49	13.66	11.98	12.20	11.82	12.19	12.33	42.28
Black								
SBP (mmHg)								
<i>M</i>	111.71	123.91	116.37	114.30	113.30	112.76	111.82	398.74
<i>SD</i>	11.69	14.44	13.97	13.67	12.91	12.90	13.48	46.75
DBP (mmHg)								
<i>M</i>	66.64	74.65	67.36	67.17	65.50	66.48	65.52	231.88
<i>SD</i>	7.80	9.36	8.61	8.36	7.68	7.68	7.95	27.54
HR (bpm)								
<i>M</i>	69.26	78.43	69.84	69.52	69.33	69.71	70.48	244.68
<i>SD</i>	11.79	12.41	11.69	11.90	11.60	12.04	12.32	41.07
Total								
SBP (mmHg)								
<i>M</i>	110.52 ^a	127.18 ^a	115.82	113.28	112.03	112.11	110.96	395.82
<i>SD</i>	11.40	15.16	13.32	12.92	12.92	12.18	12.42	44.69
DBP (mmHg)								
<i>M</i>	66.78 ^a	74.66 ^a	67.35	67.24	65.82	65.90	65.65	231.66
<i>SD</i>	8.11	9.70	8.60	8.48	8.23	8.73	8.64	29.34
HR (bpm)								
<i>M</i>	69.14 ^a	79.66 ^a	70.16	70.02	70.16	70.24	70.75	247.11
<i>SD</i>	11.63	13.00	11.78	12.01	11.70	12.08	12.28	41.56

Note. Recovery excursions are estimates of the area under the recovery curve minus the baseline. SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; bpm = beats per minute.

^a Significant group differences at $p < .001$.

reactivity, $\Delta F(1, 145) = 5.29, p < .05, \Delta R^2 = .01$. The plot of this interaction is presented in Figure 1. Simple slope analyses indicate that the slopes for low cynicism were significant for Blacks, $t(80) = 2.94, p < .01$, and Whites, $t(58) = 3.01, p < .01$. There was also a significant three-way interaction found for race, cynicism, and lifetime discrimination on HR reactivity, $\Delta F(1, 145) = 4.54, p < .05, R^2 = .01$. In both cases, HR reactivity increased with high discrimination only in participants who were low in cynicism; this effect was more pronounced in Blacks.

Although the predicted two-way interaction was not significant for perceived discrimination and optimism, there was a three-way interaction effect of race, optimism, and perceived discrimination (past year) on DBP reactivity, $\Delta F(1, 144) = 5.64, p < .05, R^2 = .01$. The plot of this interaction is presented in Figure 2. Simple slope analyses indicate that the slopes for high optimism were significant for Blacks, $t(79) = 2.91, p < .01$, and Whites, $t(58) = 2.93, p < .01$. The three-way interaction effect of race, optimism, and perceived discrimination (lifetime) on DBP reactivity was also

Table 3
Correlations of Perceived Discrimination, Hostility Scales, and Optimism

Variable	1	2	3	4	5	6	7
1. Perceived discrimination in past year	—	.86***	.10	.11	.07	.02	.06
2. Perceived discrimination in life	.90***	—	.15	.17	.08	.02	-.03
3. General hostility	.10	.11	—	.92***	.56***	.59***	-.33**
4. Cynicism	.04	.07	.91***	—	.36**	.33**	-.27*
5. Hostile affect	.22*	.21*	.60***	.35***	—	.12	-.26*
6. Aggressive responding	.07	.03	.71***	.43***	.37***	—	-.21
7. Life orientation	-.02	.02	-.43***	-.39***	-.28**	-.27**	—

Note. Correlations above the diagonal are for White participants, and correlations below the diagonal are for Black participants.

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

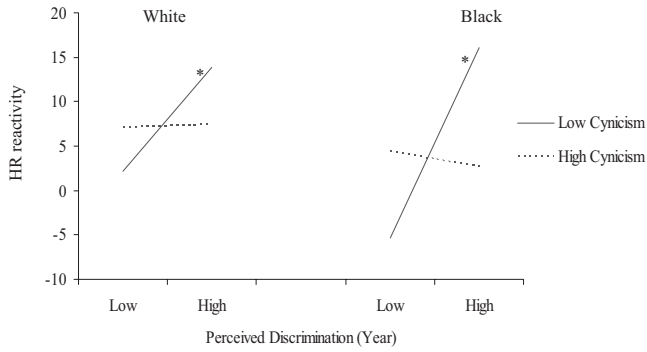


Figure 1. Effect of race, cynicism, and perceived discrimination on heart rate (HR) reactivity. Simple slopes were significant at $*p < .01$.

significant, $\Delta F(1, 144) = 4.46, p < .05$. In both cases, DBP reactivity increased with high discrimination only in participants who were high in optimism; this effect was more pronounced in Blacks.

Cardiovascular Recovery

There was a three-way interaction effect of race, cynicism, and perceived discrimination (past year) on HR recovery, $\Delta F(1, 145) = 3.81, p < .05, R^2 = .02$. From Figure 3, it can be seen that HR recovery was slower in participants with high discrimination and low cynicism, with Blacks showing a more acute relationship. The three-way interaction of race, cynicism, and perceived discrimination (lifetime) on HR recovery was marginal, $\Delta F(1, 145) = 3.51, p = .063, R^2 = .02$.

There was a significant three-way interaction effect of race, optimism, and perceived discrimination (past year) on DBP recovery, $\Delta F(1, 144) = 5.92, p < .05, R^2 = .03$. The plot of the interaction is presented in Figure 4. This three-way interaction on DBP recovery was replicated with perceived discrimination (lifetime), $\Delta F(1, 144) = 6.20, p < .01, R^2 = .03$. DBP recovery was slower for those participants who had high discrimination and

were high in optimism, and this effect was more pronounced in Blacks.

Discussion

The aims of the present study were to examine how self-reported, prior exposure to discrimination interacts with certain dispositions to predict physiological reactivity and recovery during an acute stressor. We found that the way in which perceived discrimination affected reactivity and recovery depended on two primary factors: (a) whether participants were generally mistrustful of other people or optimistic about their futures or (b) whether participants were Black or White. These findings suggest that the CV ramifications of experiencing discrimination are dependent on aspects of personality that may be related to how individuals appraise and cope with stressors as well as minority or majority status in society.

Our cynicism findings were divergent from what most theoretical models in hostility research would predict. The transactional model (Smith & McCain, 1994), for example, states that mistrust and expectations of hostility from others creates a hostile, stressful environment that exacerbates stress in daily life and elevates chronic psychophysiological responses to stressors. In this model, hostile individuals not only react excessively to stressors but also create additional stressors through their attitudes and actions. Others have suggested that hostile individuals experience anger more frequently and more intensely than their less hostile counterparts, leading to exaggerated CV and neuroendocrine responses to stress (Williams, Barefoot, & Shekelle, 1985). This theory further proposes that mistrust of others leaves them constantly "on guard," vigilant for signs of impending mistreatment by others. Such hypervigilance is accompanied by acute increases in blood pressure, heart rate, and circulating levels of stress hormones in response to stress. On the basis of these models, we expected that high hostility would be related to experiences of discrimination, either as a consequence of or as a factor that may influence the tendency to perceive or report such experiences. We instead found that for both Blacks and Whites, cynicism was not significantly related to reports of past-year or lifetime discrimination. These

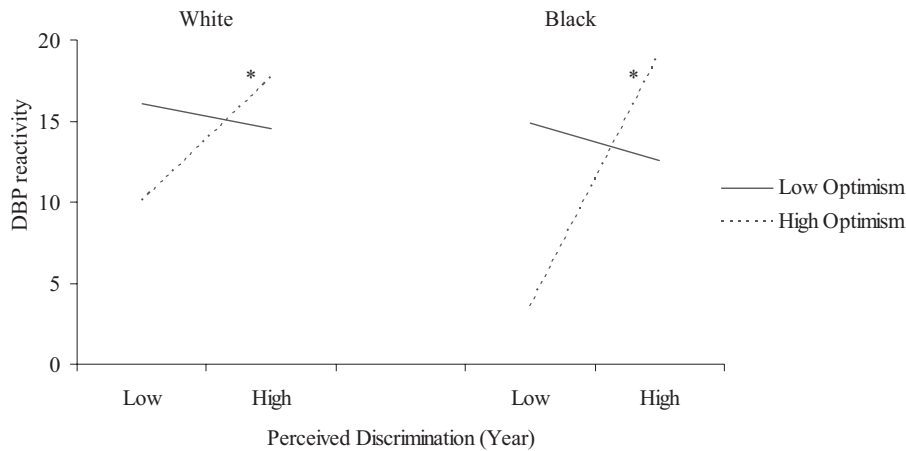


Figure 2. Effect of race, optimism, and perceived discrimination (past years) on diastolic blood pressure (DBP) reactivity. Simple slopes were significant at $*p < .01$.

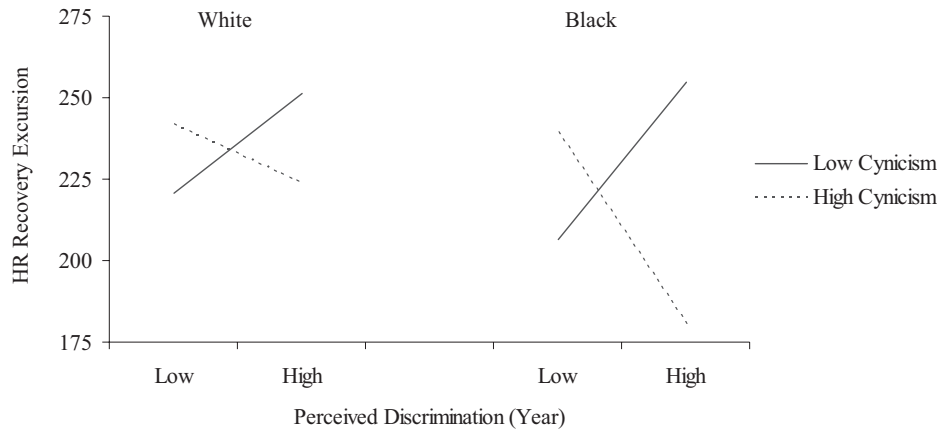


Figure 3. Effect of race, cynicism, and perceived discrimination (past years) on heart rate (HR) recovery.

findings caution against a potential interpretation of the data that angry people may be more sensitive to experiences of discrimination and more likely to report it. These findings, however, do underscore the importance of understanding how perceived discrimination interacts with dispositional factors to have significant influences on physiological responding.

The optimism models were similarly counterintuitive. High optimists were the most affected by past discrimination, and most acutely among Blacks. Past literature on optimism and positive emotions more generally might predict that when people have an affirmative outlook on life or a tendency to experience positive emotion, stressors such as discrimination would be less likely to impact responses to subsequent stressors. Optimism is associated with the ability to cope better and recover faster from certain health-related stressors (Scheier & Carver, 1985). Even unrealistic optimism, in terms of believing to have greater control over environmental events than is actually the case or viewing the future as being brighter than base-rate data would predict, is theorized by some to be a generally adaptive strategy to nonconsciously or consciously adopt (Taylor & Brown, 1988). The

present findings, however, may reflect overly high expectations that are not met. Moderate levels of illusory optimism are adaptive, but at higher levels, adjustment may be compromised (see Diener, Colvin, & Pavot, 1991).

There is evidence that a higher level of lifetime exposure to discrimination is related to increases in the likelihood that future occurrences will be perceived as threatening or harmful (Brondolo et al., 2005). One interpretation of these findings is that CV responses are most heightened when life experiences with discrimination are contrary to expectations. Those who are highly cynical and thus already have negative, untrusting attitudes and beliefs may expect life to be unfair to some extent. Thus, when discriminatory events do occur, it may not be as stressful of an experience as for those who were relatively less cynical. In this way, having a predisposition toward perceiving bias may be protective. Indeed, it was low cynicism rather than high that had a reliable positive relationship between perceived discrimination and HR reactivity. This kind of dissonance that people may experience when expectations are contrary to reality was reflected in the optimism models as well, with high

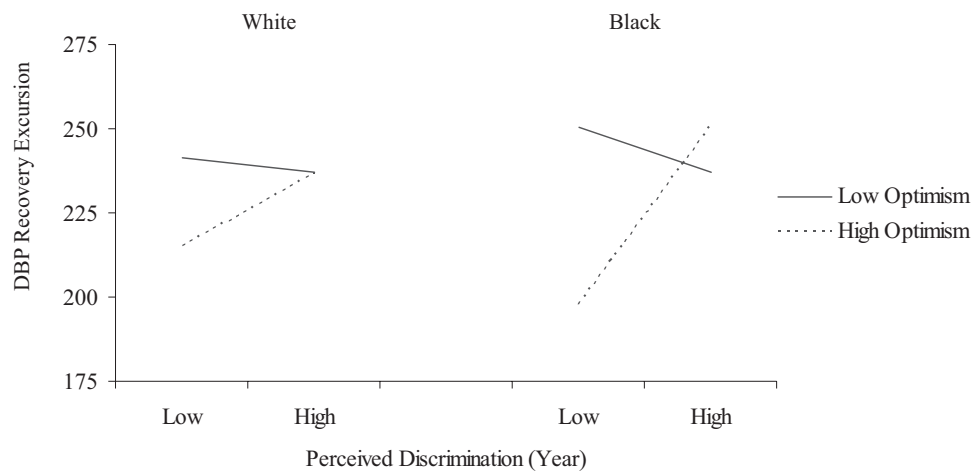


Figure 4. Effect of race, optimism, and perceived discrimination (past years) on diastolic blood pressure (DBP) recovery.

optimists having higher DBP reactivity and slower recovery when past discrimination was high.

Note that the Perceived Racism Scale was modified to be a measure of frequency of exposure to discrimination in general so it would be relevant to both Blacks and Whites. Although the pattern of reactivity and recovery effects was similar for Blacks and Whites, Black participants reporting discrimination and either low cynicism or high optimism had heightened reactions to the acute stressor compared with Whites. We were unable to determine whether there were racial/ethnic differences in the characteristics of reported discrimination experiences. We might hypothesize, for example, that Black participants who report high discrimination have had more intense, more hurtful, or more uncontrollable events occur to them than the White participants. These discriminatory events may then have a stronger influence on responses to acute stressors for Blacks. There is some evidence that racial discrimination is a distinct form of stress and accounts for distress symptoms after controlling for other stressors and SES (Klonoff, Landrine, & Ullman, 1999). It would be important to investigate in future research not just frequency of discriminatory experiences but affective reactions to such events. In addition, although past-year and lifetime discrimination were measured, our results are most consistent with past-year discrimination, though the pattern of effects is the same for lifetime discrimination in the models.

The numerous studies in which it was found that exaggerated CV responding to stress is a marker or mediator in the development of CHD and hypertension (e.g., Barnett, Marshall, & Sayer, 1997; Manuck, Cohen, & Kaplan, 1994; Manuck, Marsland, & Wood, 1995) further highlights the importance of the present results. Given that Blacks tend to have elevated rates of hypertension as compared with other racial/ethnic groups, perceived discrimination and dispositions may play a significant role in explaining these disparities. The present findings suggest that Blacks who are more trusting and optimistic may be more adversely affected by experiences of discrimination. However, these findings do not imply that intervention strategies should be designed to reduce Black's optimism or increase their cynicism but instead suggest that the benefits of optimism (in particular) may be situationally dependent, particularly for Blacks (among whom optimism has not often been studied).

Limitations

Though the use of laboratory-induced stressors rather than "real-world" stressors may be subject to issues of limited generalizability, a review by Linden, Rutledge, and Con (1998) indicates that discussing an anger-provoking event shows a relatively high level of generalizability and may be more representative of daily life stressors than are the cognitive and physical tasks (e.g., mirror tracing or cold pressor tasks) often used in assessing CV responding. Researchers have argued, however, that laboratory reactivity may be inherently limited in its ability to model the multidimensional nature of real-life responding to stress (Schwartz, Gerin, & Davidson, 2003). Future research in this area would benefit from a focus on observations made in the natural environment (e.g., Matthews, Salomon, Kenyon, & Zhou, 2005) as well.

Conclusions

The complex relationship between the frequency of past experiences with discrimination and potential moderators, such as individual differences in cognitive appraisals of the events, is just beginning to be explored. The strength of our findings suggests that hostility and optimism are important variables to consider in developing an understanding of the effects of discrimination on physiological responding.

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