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Experiencing Discrimination Increases Risk Taking

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Abstract

Prior research has revealed racial disparities in health outcomes and health-compromising behaviors, such as smoking and drug abuse. It has been suggested that discrimination contributes to such disparities, but the mechanisms through which this might occur are not well understood. In the research reported here, we examined whether the experience of discrimination affects acute physiological stress responses and increases risk-taking behavior. Black and White participants each received rejecting feedback from partners who were either of their own race (in-group rejection) or of a different race (out-group rejection, which could be interpreted as discrimination). Physiological (cardiovascular and neuroendocrine) changes, cognition (memory and attentional bias), affect, and risk-taking behavior were assessed. Significant Participant Race × Partner Race interactions were observed. Cross-race rejection, compared with same-race rejection, was associated with lower levels of cortisol, increased cardiac output, decreased vascular resistance, greater anger, increased attentional bias, and more risk-taking behavior. These data suggest that perceived discrimination is associated with distinct profiles of physiological reactivity, affect, cognitive processing, and risk taking, implicating direct and indirect pathways to health disparities.

Keywords

prejudice, risk taking, emotions, intergroup dynamics, neuroendocrinology

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Rejection is a powerful aversive experience. In the short term, it affects emotions, thoughts, and behavior (K. D. Williams, 2001), and in the long term, it can influence physical (Cacioppo, Hawkley, & Berntson, 2003) and mental (K. D. Williams, 2001) health. However, not all types of rejection have the same effects. Rejection by out-group members can be interpreted as discrimination, which may set in motion a cascade of attributions, emotions, and behaviors distinct from those associated with rejection by in-group members (Crocker, Voelkl, Testa, & Major, 1991; Mendes, Major, McCoy, & Blascovich, 2008). We explored the effects of social rejection by in-group and out-group members, with two specific goals. Our first goal was to measure the physiological consequences of in-group and out-group rejection. Our second goal was to examine how these different responses to rejection influenced risk-taking behavior. We predicted that, because discrimination typically evokes anger and approach motivation, out-group rejection would lead to more risk taking than in-group rejection would.

Several lines of research have examined the physiological consequences of discrimination in an attempt to understand health disparities between Whites and Blacks (Pascoe & Smart-Richman, 2009). Large-scale epidemiological studies, for example, have shown that Black adults tend to have higher resting blood pressure than do their age-matched White counterparts (Krieger & Sidney, 1996), and that adults who are Black or of lower socioeconomic status have, on average, flatter (i.e., more dysregulated) diurnal cortisol slopes than do adults who are White or of higher socioeconomic status (Fuller-Rowell, Doan, & Eccles, 2012). Laboratory-based studies have shown that participants who experience, view, or recall an episode of discrimination are angrier, exhibit a stronger cardiac reaction, and have a slower recovery profile compared with those who are not exposed to discrimination (e.g., Guyll, Matthews, & Bromberger, 2001; Mendes et al., 2008).

However, the data on acute responses to discrimination are not all straightforward, and some studies have yielded inconclusive results (e.g., Brondolo, Rieppi, Kelly, & Gerin, 2003).

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Even less consistent are results from studies on the link between experiences of discrimination and hypothalamic-pituitary-adrenal (HPA) activation, specifically, increases in cortisol. For example, in Fuller-Rowell et al.'s (2012) study, Black adults who perceived more discrimination had *healthier* diurnal cortisol cycles.

There is certainly reason to speculate that discrimination acutely activates the HPA system—one of two primary stress systems. For example, studies of nonhuman primates in stable social hierarchies have shown that subordinate baboons, compared with dominant baboons, exhibit greater HPA reactivity, higher basal cortisol levels, slower responses to stressors, and impaired sensitivity of the HPA axis to negative-feedback regulation (Sapolsky, 1982). In humans, HPA activation has been linked to loss of social standing (Mehta, Jones, & Josephs, 2008), negative social feedback (Koslov, Mendes, Pajtas, & Pizzagalli, 2011), and feelings of shame (Dickerson & Kemeny, 2004). Indeed, a meta-analysis of data on cortisol reactivity showed that increases in cortisol were most consistently linked to situations in which "an important aspect of the self-identity is or could be negatively judged by others" (Dickerson & Kemeny, 2004, p. 358).

Sapolsky's (1982) research on baboons and the cortisol meta-analysis (Dickerson & Kemeny, 2004) suggested that perceiving or experiencing discrimination may activate the HPA axis, which may be implicated in observed race-based health disparities. However, we view this perspective as tenuous. First, although rejection clearly engenders feelings of shame, discrimination based on uncontrollable factors (e.g., race) typically elicits not shame but, rather, anger (Gibbons et al., 2010; Smart-Richman & Leary, 2009). At a neurobiological level, whereas shame may activate the HPA axis (Dickerson & Kemeny, 2004), anger tends to elicit activation of the sympathetic adrenal-medullary (SAM) axis (Stemmler, 2004). Though the HPA and SAM axes are relatively independent, increases in cortisol tend to be associated with reduced activity in the sympathetic nervous system (Golczynska, Lenders, & Goldstein, 1995; Pavcovich & Valentino, 1997).

Second, previous work showed that an acute experience of out-group rejection (i.e., discrimination) was associated with increased cardiac activity (specifically, cardiac output) and a decline in vasculature resistance (the primary determinant of blood pressure)—a profile of responses linked to *challenge* states (Mendes et al., 2008). In contrast, same-race rejection was associated with reduced cardiac output (reduced cardiac efficiency) and increased vasculature resistance—a profile of responses linked to *threat* states. Though these cardiovascular profiles are not perfect proxies for neuroendocrine activity, theoretically, the pattern of responses to threat states is more likely to be associated with increases in cortisol than is the pattern of responses to challenge states. Therefore, we anticipated that social rejection from same-race partners would increase feelings of shame, engender threat reactivity, and activate the HPA axis, leading to cognitive consequences of HPA activation (e.g., short-term-memory impairment), whereas cross-race rejection would be associated with increased anger and greater challenge responses.

As noted, the second goal of this work was to examine how out-group rejection (i.e., discrimination) influences behavior, specifically, risk-taking behavior. A large corpus of research on racial disparities in health has suggested that Blacks have worse health outcomes and engage in more risky health-related behaviors, such as substance abuse, overeating, and smoking, than their White counterparts do (e.g., Gibbons, Gerrard, Cleveland, Wills, & Brody, 2004; Hertz, Unger, Cornell, & Saunders, 2005; D. R. Williams, Neighbors, & Jackson, 2003). In one longitudinal study, Black adolescents' self-reported experiences of discrimination predicted their substance use over time, and this relation was mediated by anger (and reduced self-control; Gibbons et al., 2010). A complementary lab study showed that imagining an experience of discrimination increased the accessibility of words associated with substance use. And again, anger mediated this effect.

Anger may be an especially important emotion to consider when examining behaviors associated with risk taking. For example, dispositionally angry people and people made angry through the writing of vignettes have been shown to express more optimistic risk estimates and choose riskier options than fearful individuals do (Lerner & Keltner, 2001). Furthermore, approach motivation resulting from the experience of anger can lead to improvements in performance (Lerner & Tiedens, 2006). In the same-race- and cross-race-rejection study cited earlier (Mendes et al., 2008), participants who experienced out-group rejection (i.e., discrimination) showed more anger and performed better on a word-finding task than did participants who experienced in-group rejection, a pattern indicating that out-group rejection led to more approach-oriented behavior.

In the study reported here, we examined the effects of in-group and out-group social rejection on physiological reactivity, cognitive and affective outcomes, and risk taking. We anticipated that, compared with out-group rejection, in-group rejection would be associated with greater cortisol increases, threat reactivity, increased shame, and memory impairments, whereas out-group rejection, compared with in-group rejection, would be associated with more approach responses (consistent with challenge states), greater anger, greater vigilance for danger, and more risk-taking behavior.

To test these predictions, we induced social rejection by giving participants negative feedback while they completed a computer-based interaction task. We manipulated whether Black and White participants thought they were interacting with partners who were the same race as they were or a different race. Immediately after the interaction, participants completed cognitive tasks and a measure of risk behavior. We measured participants' cortisol and cardiovascular reactivity throughout the study and coded their behavior during interactions for displays of anger and shame.

Method

Participants

Ninety-one participants (55% females, 45% males; 54% Whites, 46% Blacks; mean age = 24.11 years, *SD* = 6.11, age range = 18–39) were recruited from the Cambridge, Massachusetts, area and were compensated for their participation with 2 credit hours or $30. Fifty-five percent of participants were students, and 45% were community members (race and student status were unrelated, $p > .50$). Participants were excluded if they were hypertensive, had a pacemaker, took cardiac medications, or were pregnant.

Procedure

Upon arriving at the laboratory, each participant provided consent, completed an initial memory task (the Wechsler Memory Scale–Third Edition, WMS; Wechsler, 1997), and then selected one of six avatars to represent himself or herself during the study (the race and sex of all six avatars matched the race and sex of the participant; see Fig. 1). The experimenter then collected the first of three 1-ml saliva samples. Following saliva collection, the experimenter attached sensors to measure cardiovascular responses and the participant then relaxed alone for a 5-min period so that his or her baseline cardiovascular responses could be measured. Afterward, the experimenter explained that the study concerned "how the nature of communication has changed now that our social lives are increasingly moving online." The participant was told that 2 other participants (identified as Participants 1 and 3; the actual participant was identified as Participant 2) in different rooms were also completing the study and that the 3 participants would be communicating via Gmail's chat program. The responses of Participants 1 and 3 were controlled by a research assistant in an adjacent room. These partners always appeared to be the same sex as the participant, but we manipulated whether they were represented by Black or White avatars (the race of each participant's partners was randomly determined).

At this point, the experimenter explained that 2 of the participants would take turns giving 5-min speeches about their strengths and weaknesses and discussing their opinions regarding various topics in four 2-min discussions, and that the participants not speaking would provide feedback on the speeches and discussions as they happened via the chat program. The experimenter further indicated that the participant who was not chosen to take a turn speaking would be the moderator, who would choose who spoke first and score the

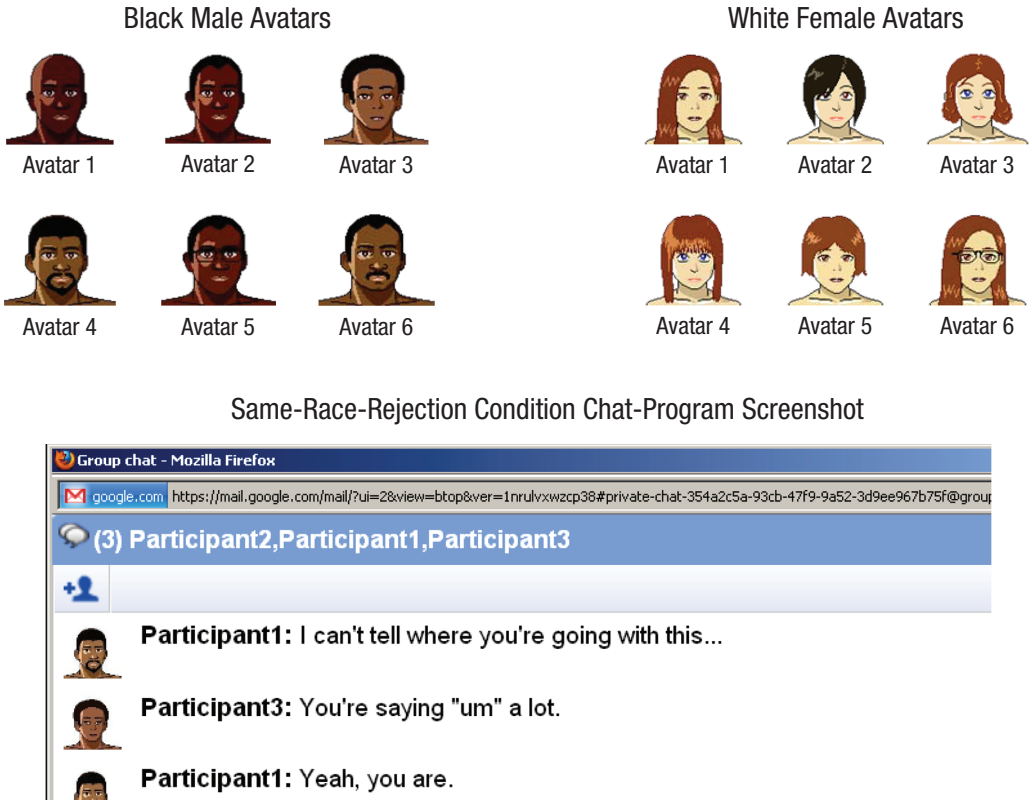

Fig. 1. Examples of avatars that could be selected by Black male participants and by White female participants (top) and a screenshot of the chat program (bottom) showing reactions to the speech of a Black male participant in the same-race-rejection condition.

speakers' performances. The actual participant was always chosen to speak first by the moderator.

The participant had 3 min to prepare a speech and then was instructed to begin. Throughout the speech, the participant received rejecting feedback via the chat program. A research assistant, responding as each of the two avatars, provided the feedback in real time using a list of negative statements; in the interest of believability, comments were tailored to reflect the content of each participant's speech (e.g., "Someone's a little high on themselves" when a participant said something positive about himself or herself; see Fig. 1). Next, the participant's partners ostensibly selected four "hot topics" from a list of topics provided for the participant to discuss (e.g., "Are big-box stores like Walmart good or bad for a community?"). The selected topics appeared in the chat program one at a time, and the participant was instructed to discuss each topic for 2 min until a new topic appeared. Again, the research assistant (in the role of the purported partners) provided negative feedback in real time, questioning the rationale of the participant's arguments, the quality of the participant's speaking style, and the persuasiveness of the participant's speech.

When the speech and discussions were completed (20 min after the participant had begun giving his or her speech), the participant provided the second saliva sample, and the experimenter explained that all participants in the group would perform a set of cognitive tasks before the next participant began his or her speech. At this point, the participant completed a delayed-recall measure, an emotional Stroop task (a measure of vigilance), and the Columbia Card Task (in fixed order); following these measures, the third saliva sample was collected (40 min after the participant had begun giving his or her speech). The participant was then informed that the study was over, probed for suspicion, and fully debriefed.

Measures[1]

Cardiovascular reactivity. Electrocardiography (ECG) and impedance cardiography (ICG) signals were collected continuously, starting at the baseline measurement and ending after the interaction. Blood pressure was obtained using a Colin Prodigy monitor (Mediana Tech, http://medianatech.com/index.aspx) programmed to assess blood pressure responses at predetermined time intervals. Reactivity scores were computed by subtracting responses from the final minute of the baseline assessment at the beginning of the experiment (the minute during which participants in similar experiments are typically the most relaxed) from those collected during the 1st minute of the speech and the 1st minute of the discussion task (the minutes during which participants in similar experiments are typically the most reactive). Analyses focused on two measures that best distinguish approach (challenge-response) states and withdrawal (threat-response) states: cardiac output (CO) and total peripheral resistance (TPR; Mendes, 2009).

Neuroendocrine reactivity. To measure neuroendocrine reactivity, we assessed participants' cortisol levels using the three 1-ml saliva samples collected over the course of the experiment. Reactivity scores were computed by subtracting cortisol levels after the speech and at the end of the experiment from the baseline levels measured at the beginning of the experiment.

Affective displays. Three female research assistants (two White, one biracial Black-White) unaware of the partners' race coded the videotaped speech and discussions for each participant, using coding categories developed to classify observable anger (approach behavior) and shame (withdrawal behavior). Interrater reliability was good to excellent (αs = .75–.89). Three items were used to compute composite scores for anger, and three items were used to compute composite scores for shame. The anger composite included displays of hostility, tension, and general anger behavior (α = .72); displays of hostility and tension were coded on scales from 1 (*not at all*) to 5 (*a great deal*), and general anger behavior was coded on a scale from 1 (*low level*) to 6 (*high level*). The shame composite included displays of disengagement, apologetic behavior, and general shame behavior (α = .81); disengagement was coded on a scale from 1 (*not at all*) to 5 (*a great deal*), and apologetic behavior and general shame behavior were coded on scales from 1 (*low level*) to 6 (*high level*).

Recall memory. Delayed recall was measured by having participants freely recall a story (from the WMS) that had been read to them at the beginning of the experiment. The delayed-recall task occurred approximately 1 hr after the story had been read and followed the rejection manipulation. Free-recall responses concerning the story's details and themes were recorded and scored as outlined by the WMS manual (Wechsler, 1997).

Attentional bias. An emotional Stroop task (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002) was used to measure vigilance for emotionally negative information. Participants were asked to name the print color (red, green, or blue) of words as quickly and accurately as possible. Words were presented in two lists (a negative list and a neutral list) of 100 words each. An experimenter who was blind to condition recorded the number of errors each participant made and how long it took him or her to name the print color of all the words on each list. An interference score was computed by subtracting the time it took a participant to name the color of all the words on the neutral list from the time it took him or her to name the color of all the words on the negative list.

Risk-taking measure. Risk taking was assessed using a computerized card game, the Columbia Card Task, hot version (Figner, Mackinlay, Wilkening, & Weber, 2009). On each trial in this task, participants are presented with 32 cards and with three pieces of information, which vary across trials. The participants decide how many cards to turn over in hopes of earning as many points as possible; points are earned by turning over a gain card and lost by turning over a loss card. The

pieces of information that vary across trials are the probability of loss (i.e., the number of loss cards in the array—1 or 3), the amount of loss (i.e., the number of points lost by turning over a loss card—250 or 750), and the amount of gain (i.e., the number of points gained by turning over a gain card—10 or 30); these variables are independently randomized over 24 trials.

If a participant chose a loss card, the loss amount was subtracted from his or her score, and the trial ended. Because the loss cards represented an artificial ceiling on behavior, we analyzed the number of cards turned over on nonloss trials. Risk was operationalized as the number of cards turned over during these trials.

Data analysis

Because of computer problems, 2 participants' cardiovascular data and 8 participants' risk-taking data were lost. Additionally, 2 color-blind participants did not complete the Stroop task. Data were analyzed using 2 (participant race: White vs. Black) × 2 (partner race: White vs. Black) analyses of covariance (ANCOVAs) with the race variables entered as between-subjects factors and sex entered as a covariate. We predicted that participant race and partner race would interact, such that cross-race interactions would differ from same-race interactions. In the interest of space and interpretability, we present results for observed interactions as comparisons of same-race and cross-race conditions.

Results

Physiological reactivity

Cardiovascular reactivity. ANCOVAs examining CO reactivity during the speech and discussion tasks yielded no main effects but significant interactions—speech task: $F(1, 84) = 4.32$, $p = .041$, $d = 0.45$; discussion task: $F(1, 84) = 4.56$, $p = .036$, $d = 0.47$. Participants rejected by cross-race partners exhibited larger CO increases than did participants rejected by same-race partners (Fig. 2a). Analyses of TPR reactivity during the two tasks also revealed significant interactions—speech task: $F(1, 84) = 6.26$, $p = .014$, $d = 0.55$; discussion task: $F(1, 84) = 8.19$, $p = .005$, $d = 0.63$. Participants who experienced cross-race rejection exhibited significantly lower TPR reactivity than did participants who experienced same-race rejection (Fig. 2b). Taken together, these results imply that, compared with in-group rejection, out-group rejection was associated with lower TPR reactivity and greater CO reactivity, a pattern indicating more physiological approach (i.e., challenge) responses to discrimination.

Neuroendocrine reactivity. We next examined changes in cortisol levels as a function of participant and partner race. Again, there was a significant interaction, $F(1, 86) = 4.51$, $p = .037$, $d = 0.46$. Participants who were rejected by in-group members had significantly greater increases in cortisol immediately after the interaction tasks than did participants who experienced out-group rejection (Fig. 2c). This trend persisted into the recovery period, albeit with a smaller effect size and a nonsignificant difference between conditions, $F(1, 86) = 2.72$, $p = .10$, $d = 0.36$.

Affective displays

Displays of anger and shame were analyzed using a 2 (emotion: anger vs. shame) × 2 (participant race) × 2 (partner race) mixed analysis of variance (ANOVA) with emotion entered as a within-subjects variable. This analysis yielded a significant three-way interaction, $F(1, 86) = 7.30$, $p = .008$, $d = 0.58$. Figure 3 presents the results separately for displays of anger and displays of shame.

As predicted, analysis of participants' displays of anger revealed a significant interaction, $F(1, 86) = 5.64$, $p = .020$, $d = 0.51$. Cross-race rejection led to more observed anger than did same-race rejection. Analysis of displays of shame revealed a significant main effect of participant race, such that White participants displayed more shame than Black participants did, $F(1, 86) = 6.45$, $p = .013$, $d = 0.55$; this analysis also revealed an interaction trend, $F(1, 86) = 2.61$, $p = .109$, $d = 0.35$. We had predicted that same-race rejection would be associated with more shame behavior than cross-race rejection would. Simple contrasts revealed that, as predicted, Black participants exhibited more displays of shame when rejected by same-race partners ($M = 0.86$, $SD = 0.29$) than when rejected by cross-race partners ($M = 0.64$, $SD = 0.28$), $F(1, 86) = 4.10$, $p = .046$, $d = 0.44$. By contrast, White participants' level of shame-related behavior did not differ as a function of partner race, $F < 1$ (overall $M = 0.97$, $SD = 0.43$).

Recall memory

Analysis of story recall yielded no main effects but a marginal Participant Race × Partner Race interaction, $F(1, 86) = 3.41$, $p = .07$ $d = 0.40$. Participants rejected by same-race partners recalled marginally less story content ($M = 16.49$, $SD = 5.37$) than did their cross-race-rejection counterparts ($M = 18.41$, $SD = 5.36$). This pattern is consistent with previous findings showing that increases in cortisol affect low-affinity receptors in the hippocampus, thereby impairing memory (e.g., Lovallo & Thomas, 2000; Sapolsky, 2003). Indeed, cortisol reactivity at the third saliva-sample collection was negatively correlated with recall, $\beta = -0.21$, $p = .043$.

Attentional bias

An analysis of performance on the emotional Stroop task yielded a significant interaction, $F(1, 84) = 4.05$, $p = .047$, $d = 0.44$. Consistent with the idea that discrimination engenders vigilance, results showed that cross-race rejection was associated with greater attentional bias ($M = 2.54$, $SD = 6.52$) than in-group rejection was ($M = -0.52$, $SD = 7.12$). Thus, being rejected by partners who were members of a racial out-group

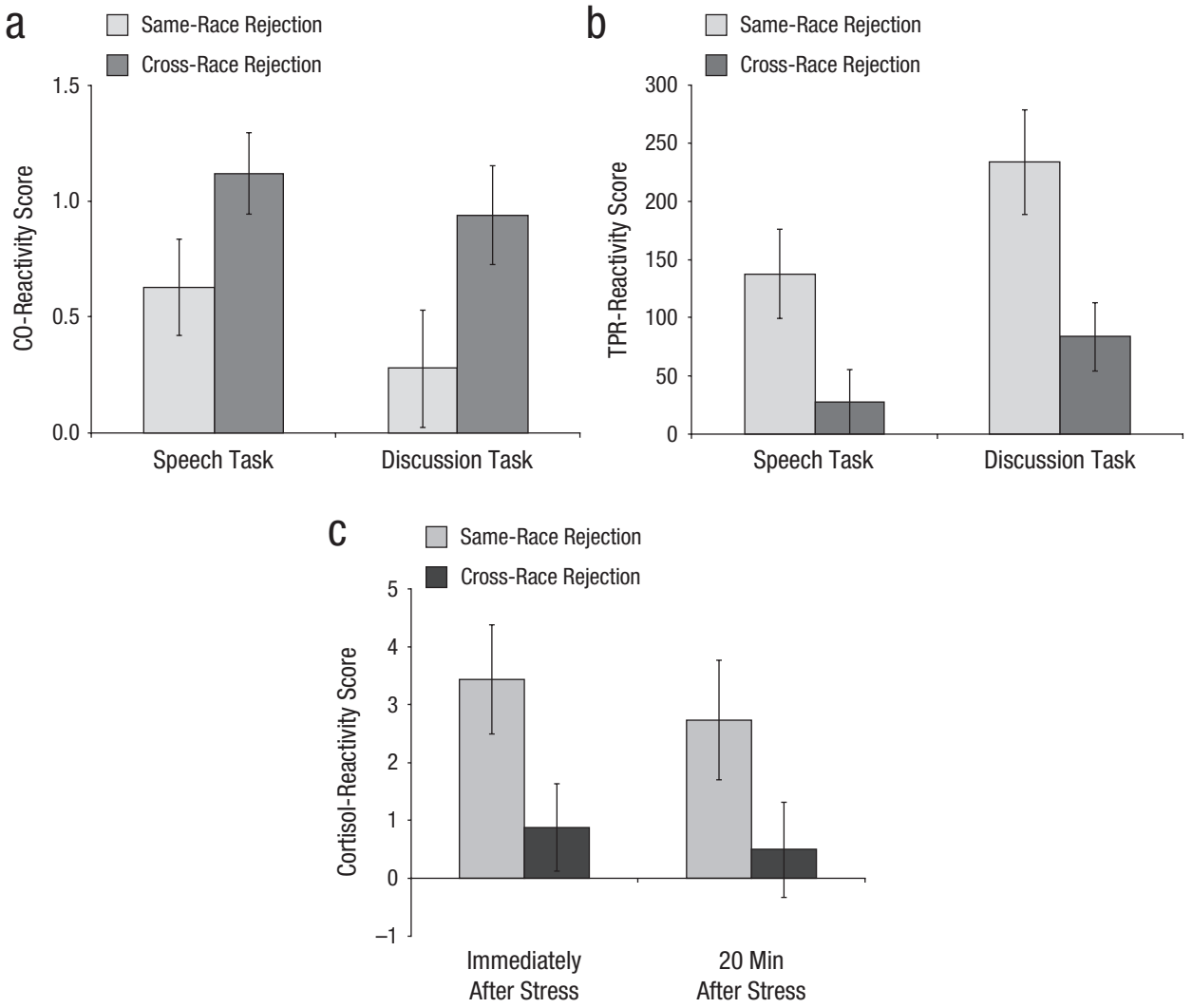

Fig. 2. Cardiac-output (CO) reactivity (a), total-peripheral-resistance (TPR) reactivity (b), and cortisol reactivity (c) as a function of measurement occasion and type of rejection. For CO and TPR, reactivity during the speech task and discussion task is shown. For cortisol, reactivity immediately following the speech task and 20 min later is shown. Error bars represent ±1 *SE*.

increased vigilance for emotionally negative information, as demonstrated by greater attentional capture by emotionally negative words than by neutral words in the Stroop task. Furthermore, this result cannot be attributed to a speed-accuracy trade-off because neither participant race nor partner race influenced error rates for either list (negative list: $M = 0.80$, $SD = 0.93$; neutral list: $M = 0.91$, $SD = 0.97$), $ps > .20$.

Risk taking

We expected that cross-race rejection—which, relative to same-race rejection, was associated with more approach responses—would also be associated with increased risk taking. To test this hypothesis, we analyzed the mean number of cards each participant turned over across all nonloss trials of the Columbia Card Task. This analysis revealed a Participant Race × Partner Race interaction, $F(1, 78) = 4.93$, $p = .029$, $d = 0.50$. Participants rejected by cross-race partners engaged in riskier behavior (i.e., they turned over more cards; $M = 12.06$, $SD = 4.87$) than did those rejected by same-race partners ($M = 10.18$, $SD = 3.37$).

To further explore the processes underlying risk taking, we regressed the number of cards each participant had turned over on the cost/reward variables (number of loss cards, loss amount, and gain amount) nested within participants. We then examined which of these variables influenced decisions. For the sake of interpretability, we present results separately for the same-race and cross-race conditions.

Same-race rejection. Participants rejected by same-race partners turned over fewer cards when there were more loss cards in an array (3 vs. 1), $\beta = -0.42$, $p < .001$, and when the

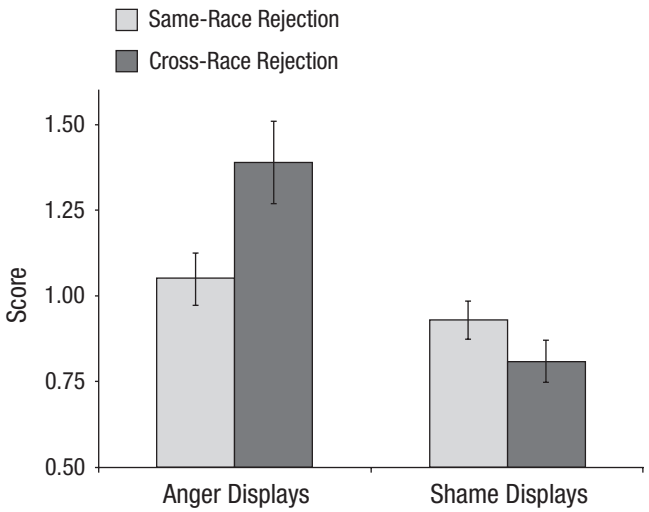

Fig. 3. Scores for displays of anger and shame during the speech and discussion tasks combined as a function of type of rejection. Error bars represent ±1 *SE*.

loss amount was greater (750 points vs. 250 points), $\beta = -0.18$, $p = .002$. Differences in gain amount did not significantly influence the number of cards participants turned over, $\beta = 0.08$, $p = .23$.

Cross-race rejection. As did participants rejected by same-race partners, participants rejected by cross-race partners turned over fewer cards when the probability of loss was higher, $\beta = -0.39$, $p < .001$, and when the loss amount was higher, $\beta = -0.15$, $p = .012$. However, for this group of participants, gain amount was associated with risk behavior, $\beta = 0.15$, $p = .012$. When gain cards were of higher value, participants who experienced cross-race rejection engaged in riskier behavior (i.e., they turned over more cards). Compared with participants who were rejected by same-race partners, those who were rejected by cross-race partners were more sensitive to rewards (gain amount), $z = 1.95$, $p = .051$, but the type of rejection had no impact on attention to costs (loss probability or loss amount), ps > .24 (Meng, Rosenthal, & Rubin, 1992). Thus, cross-race-rejection participants took more risks than same-race-rejection participants did and also exhibited increased reward sensitivity.

Discussion

There are three noteworthy findings from this work. First, cross-race rejection, compared with same-race rejection, elicited a distinct profile of physiological reactivity—specifically, lower cortisol reactivity, larger CO increases, and decreased vascular resistance (i.e., lower TPR reactivity). Participants exhibited more anger behavior following cross-race rejection than following same-race rejection. These findings are consistent with research on the effects of discrimination suggesting that anger is the dominant emotional response to perceived or experienced racial bias. Second, our results show that reactions to cross-race rejection extend to cognitive processes such as attentional bias and memory. Our finding that cross-race rejection, compared with same-race rejection, led to better memory is consistent with decades of research showing that increases in cortisol can impair memory. Finally, cross-race rejection led to more risk-taking behavior than did same-race rejection. An ancillary analysis revealed that, compared with same-race rejection, cross-race rejection was associated with greater reward sensitivity, and these effects were at least partially mediated by the changes in cardiovascular reactivity (see the Supplemental Analyses section in the Supplemental Material for details). Consistent with previous work (e.g., Gibbons et al., 2010), this research shows that experiences of discrimination not only increase individuals' willingness to take risks but also can directly lead to risky behavior.

Cross-race rejection also increased vigilance for emotionally negative information. Vigilance facilitates the detection of danger and helps individuals respond effectively to stressors. However, once discrimination is perceived, attentional vigilance increases the likelihood of increased sensitivity to threat cues; in some cases, this sensitivity may be adaptive, but in others, it may lead to "false alarms," or the detection of bias during ambiguous situations (Wang, Leu, & Shoda, 2011). Considering that bias for emotionally negative information reinforces feelings of anxiety and is linked to a host of clinical conditions (e.g., Mathews & MacLeod, 2002; McNally et al., 1994), future research might consider the mental-health consequences of vigilance resulting from perceived discrimination.

Taken together, our data are consistent with the idea that out-group social rejection influences physiological responses, behavior, and cognition. It might seem surprising that physiological responses were affected by social rejection that involved no face-to-face interactions but, rather, only minimal, computer-based interaction. These findings are potentially important, given that people's social lives are increasingly moving online via social-networking outlets such as Facebook, Twitter, and Google+. One might think that instances of social rejection that occur online (e.g., cyber-bullying) should be less potent than face-to-face encounters during which similarly negative feedback is received. However, in our experiment, rejection over a chat program produced patterns of physiological reactivity similar to those that have previously been observed in situations involving face-to-face negative evaluations (e.g., Mendes et al., 2008). Because computers provide users with a degree of anonymity, people might provide negative feedback with increased frequency when they are online. This typically anonymous feedback might be more vitriolic than it would be if the commentators were accountable for their feedback, as they would be in a direct, face-to-face interaction. Thus, seemingly innocuous negative comments can potentially have deleterious effects for targets whether the feedback is given over a computer or during "real-world" interactions.

It is important to not overlook our findings concerning same-race rejection, which was associated with distinct physiological and cognitive profiles. Compared with participants rejected by members of a different race, participants rejected by members of their own race exhibited greater increases in cortisol, less efficient CO, increased vascular resistance (i.e., increased TPR reactivity), and impaired memory. From a physiological perspective, this pattern of reactivity has been linked to accelerated "brain aging," cognitive decline, and early risk for Alzheimer's disease (Jefferson et al., 2010). Thus, our research suggests that social rejection stemming from different sources (members of one's own race vs. members of a different race) may trigger distinct physiological pathways and possibly, if experienced chronically, distinct diseases (Leventhal & Patrick-Miller, 2000). An important avenue for future research might be to examine the contexts and populations that are most likely to elicit and experience in-group and out-group rejection, and how responses to these two different kinds of rejection might lead to different behaviors and mental- and physical-health outcomes.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Supplemental Material

Additional supporting information may be found at http://pss.sagepub.com/content/by/supplemental-data

Note

1. Additional details on measures can be found in the Supplemental Measures section of the Supplemental Material available online.

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