Challenge and Threat During Social Interactions With White and Black Men

Wendy Berry Mendes, Jim Blascovich, Brian Lickel and Sarah Hunter

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Wendy Berry Mendes
Jim Blascovich
University of California, Santa Barbara

Brian Lickel
University of Southern California

Sarah Hunter
RAND Corporation

This research examined the extent to which minority or "devalued" group members engendered threat reactions from interaction partners. Participants' cardiovascular responses marking challenge and threat were obtained during social interactions with White or Black confederates who described their background as either socioeconomically advantaged or disadvantaged. Main effects for race and status were found. When interacting with Black or disadvantaged confederates, participants exhibited cardiovascular threat responses, whereas participants interacting with White or advantaged confederates primarily exhibited cardiovascular challenge responses. Consistent with cardiovascular responses, participants paired with White partners performed better during a cooperative task than participants paired with Black partners. In contrast to the physiological and behavioral indicators, self-reports indicated greater liking and more agreement with positive statements for Black partners than White partners. These findings demonstrate the value of multiple and less consciously controlled measures for the study of intergroup relations.

Many theorists have hypothesized that responses such as anxiety, stress, and threat underlie the negative or awkward reactions that occur during intergroup encounters (Gaertner & Dovidio, 1986; Gundykunst, 1984; Stephan & Stephan, 1985, 2000). However, the precise nature of these negative reactions during intergroup interactions has proven difficult to identify methodologically. Various concerns of interactants may inhibit or distort self-report responses within intergroup contexts, particularly if the reactions are negatively valenced (Gugliemi, 1999). In addition, the discrepancy between expressed and felt reactions may operate below conscious awareness (Greenwald & Banaji, 1995).

Arguably, psychophysiological measurements provide a means to circumvent distortions in perceivers' responses to intergroup interactions (Blascovich, 2000; Cacioppo, Tassinary, & Bernston, 2000; Gugliemi, 1999). Physiological measures have several advantages over self-report measures in this regard. Specifically, they are continuous, covert, and online (Blascovich, 2000). These qualities allow researchers to track changes indexed by physiological responses during behavioral episodes such as those involving intergroup encounters. Furthermore, the use of less consciously controlled measures reduces concerns regarding demand characteristics and self-presentational issues that can be evoked during an intergroup interaction. Because of these qualities, physiological measures can provide less contaminated assessments of the effect of intergroup encounters.

In a recent review of the applicability of psychophysiological measures to the study of prejudice and inter-

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group research, Gugliemi (1999) concluded that the limitations of self-report instruments might be overcome by the use of appropriate physiological indexes. Although the study of physiological reactions during intergroup encounters is not new (e.g., Rankin & Campbell, 1955), recent advances in physiological technology coupled with greater sophistication regarding psychophysiological theory has advanced our understanding of the meaning of the physiological responses that occur within an intergroup context. Several recent research efforts demonstrate these advances by employing psychophysiological markers to study reactions to minority group members.

Employing facial electromyography (EMG), Vanman and colleagues (Vanman, Paul, Ito, & Miller, 1997) assessed affective reactions of participants on exposure to White and Black targets. These researchers found evidence for more negative affect (increased corrugator supercilli and decreased zygomaticus major activity) displayed by White participants when exposed to photographs of Black faces compared to White faces. Capitalizing on recent advances in functional magnetic resonance imaging (fMRI) techniques, Hart and colleagues (Hart, Whalen, Shin, McInerney, & Fischer, 2000) examined activation of neural substrates on exposure to ingroup versus outgroup faces. After an initial familiarization with pictures of Black and White faces, participants displayed more amygdala activation when presented with outgroup faces relative to ingroup faces. Also using fMRI techniques and focusing on activation of the amygdala, Phelps and colleagues (Phelps et al., 2000) found that during presentation of unfamiliar Black faces, greater amygdala activation was positively correlated with implicit measures of racial bias (e.g., implicit associates test and startle eyeblink).

The importance of these studies notwithstanding, the aforementioned research programs suffer somewhat from a lack of ecological validity. In the Vanman experiments, participants imagined interacting with the person they viewed in a series of photographs, and in the fMRI experiments, participants viewed photographs while enclosed in a magnet for brain imaging. As Gugliemi (1999) describes, the "artificiality of experimental conditions is likely to be particularly problematic in prejudice research as participants affective responses may be dampened, or simply different, when the situation bears little resemblance to real life" (p. 133). Thus, experiments involving live face-to-face encounters can strengthen the ecological validity of studies examining intergroup relations. Also, actual interactions can increase the affective intensity of participants allowing for more powerful assessments of key theoretical variables (Stemmler, 1989).

One major obstacle in using physiological measurements for the study of intergroup relations has been the limits of the specificity regarding the psychological meaning of the physiological responses (Blascovich & Kelsey, 1990; Gugliemi, 1999; cf. Hart et al., 2000; Phelps et al., 2000; Vanman et al., 1997). As noted by Cacioppo et al. (2000), meaningful physiological indexes are ones in which the physiological responses share a one-to-one correspondence with a psychological construct. Blascovich, Tomaka, and their colleagues (Blascovich & Tomaka, 1996; Tomaka, Blascovich, Kelsey, & Leitten, 1993) have identified physiological makers that index the psychological states of challenge and threat, which provide a means of assessing perceivers' coping responses. Here, we relied on these cardiovascular (CV) markers to examine physiological responses that occur during face-to-face interactions with Black and White men.

Challenge and Threat

Social psychologists (e.g., Blascovich & Mendes, 2000; Blascovich & Tomaka, 1996; Quigley, Feldman Barrett, & Weinstein, in press; Tomaka et al., 1993) have framed challenge and threat as motivational states that result from evaluations of situational and task demands relative to personal resources to cope. Challenge and threat are context-bound occurring only in motivated performance situations, which are defined as situations that are goal-relevant to the performer, require instrumental cognitive responses, and are active rather than passive (Blascovich & Mendes, 2000). Examples of motivated performance situations include speech delivery, test taking, interpersonal negotiations, and cooperative and competitive task performance.

In validational studies, individuals with higher demand relative to resource appraisals were characterized as threatened; individuals with lower demands relative to resource appraisals were characterized as challenged (Tomaka et al., 1993). In later iterations of the theory (Blascovich & Mendes, 2000), demand evaluations were broadened to include perceptions of danger, uncertainty, and required effort, and resource evaluations included perceptions of knowledge and abilities relevant to situational performance as well as dispositional characteristics and external support. Although it is possible in a given situation that one of these elements can trigger high overall demand or resource evaluations, similar to the argument by Lazarus and colleagues (Lazarus, DeLongis, Folkman, & Gruen, 1985) that "no single variable . . . can stand for stress" (p. 777), we simultaneously consider all perceptual elements and their potentially additive or synergistic effects.

Incorporating Obrist's (1981) work on cardiac engagement during active coping situations and Dienstbier's (1989) theory on physiological toughness,

we have identified and validated specific patterns of cardiovascular responses associated with challenge and threat (see Blascovich & Mendes, 2000; Blascovich & Tomaka, 1996, for reviews). Following Dienstbier (1989), challenge is marked by activation of the sympathetic-adrenal-medullary (SAM) axis, which enhances cardiac performance, particularly left ventricular contractility and cardiac output, and decreases systemic vascular resistance. Threat is marked by activation not only of the SAM axis, again increasing contractility, but also by activation of the pituitary-adrenal-cortical (PAC) axis, which inhibits decreases in systemic vascular resistance.

We use three cardiovascular responses to differentiate challenge and threat. Specifically, we examine left-ventricular contractility (VC), which is indexed by a decrease in pre-ejection period—the time from the initiation of left ventricular contraction until the aortic valve opens. (For ease of interpretation, we multiply pre-ejection period reactivity by –1 so that decreases in pre-ejection period correspond to increases in contractility.) We examine changes in cardiac output (CO), which is the amount of blood being pumped by the heart expressed in liters per minute. We also examine changes in total peripheral resistance (TPR), which is the amount of overall vasoconstriction or vasodilation occurring in the periphery.[1]

Challenge responses are confirmed when VC and CO increase from baseline coupled with a decrease in TPR (or vasodilation); threat responses are confirmed when VC increases (although typically not as great as increases during challenge), there is no change or a decrease in CO,[2] and there is no change or an increase in TPR. These markers have been used successfully to investigate challenge and threat processes in many areas, including stigma (Blascovich, Mendes, Hunter, Lickel, & Kowai-Bell, 2001), social facilitation (Blascovich, Mendes, Hunter, & Salomon, 1999), social comparisons (Mendes, Blascovich, Major, & Seery, 2001), and dispositions (Tomaka et al., 1999). Assuming that an intergroup encounter fits the requisite motivated performance situation, challenge and threat markers might be particularly well suited for the examination of responses that occur during an intergroup interaction.

Challenge and Threat During Intragroup and Intergroup Interactions

We have recast extant intergroup theories into our challenge and threat model of demands and resources to formulate predictions regarding what would occur during an intergroup encounter (for a more in-depth discussion, see Blascovich, Mendes, Hunter, & Lickel, 2000). Many theories suggest that intergroup interactions result in an increase in perceived demands (via danger, uncertainty, or required effort). Perceived danger may be elicited during an intergroup interaction in several ways. Social dominance theorists (Sidanius & Pratto, 1993) maintain that to the extent that individuals are members of perceived culturally inferior groups, they represent a danger to the dominant or powerful groups in a culture. Other theories suggest that intergroup interactions create anxiety or tension (Devine, Plant, & Buswell, 2000; Stephan & Stephan, 1985, 2000; Wilder, 1993). To the extent that such anxiety represents aversive psychological states, intergroup interactions can be regarded as dangerous. In addition, due to the relative infrequency of outgroup compared to ingroup interactions, uncertainty surrounding an intergroup interaction may be increased (Zubrinsky, 2000).

Finally, required effort during an intergroup interaction also may increase for several reasons. For example, perceivers may devote increased attention to the interaction including their partners' and their own behaviors. This vigilance may increase during an intergroup interaction because the subtle nonverbal cues that govern two-way communication may be unfamiliar in an intergroup setting (Gundykunst, 1984). Another way effort could increase during intergroup interactions would be with the presence of additional or hidden agendas. At one extreme, perceivers may strive to appear unaffected by their intergroup interaction partners so as not to show prejudice against the group (Devine, Evett, & Vasquez-Suson, 1996; Stephan & Stephan, 1985). This requires more effort in terms of self-monitoring on the part of the perceiver. At the other extreme, perceivers may be members of higher status groups than their partners and may seek to justify or preserve this imbalance (Jost & Banaji, 1996; Sidanius & Veniegas, 2000). Such an agenda would require perceivers to strive to perform in a clearly superior fashion to their partner. Finally, because intergroup interactions may evoke relevant negative stereotypes even in nonprejudiced individuals, increased effort may be expended to suppress stereotypes (Devine, 1989; Wyer, Sherman, & Stroessner, 2000).

The perceived resources that one brings to an intergroup encounter may not offset the increased demands and even, in some cases, may be diminished, especially resources associated with knowledge and abilities. Individuals may perceive that they do not know the most appropriate way to communicate during intercultural interactions (Wiseman, 1995). Insofar as individuals perceive outgroup partners to possess different conversational and interpersonal norms than their own group's, they may perceive lower knowledge and abilities in terms of interaction skills with an outgroup member. The consideration of dispositions (e.g., authoritarianism) and external support (e.g., presence of ingroup members) also may come into play during intergroup interactions but are beyond the scope of this article.

Overview and Hypotheses

In sum, we argue that interactions with minority or "devalued" group members involve greater perceived demands and/or fewer perceived resources than interactions with majority group members. Hence, we conducted an experiment to test the general hypothesis that perceivers interacting with minority or devalued others experience threat. We examined the effects of race and socioeconomic status (SES) of an interaction partner by employing Black and White male confederates who described their background as relatively advantaged or disadvantaged. We hypothesized that participants would experience greater threat, indicated by the threat pattern of cardiovascular reactivity, when interacting with devalued (i.e., Black or disadvantaged) than nondevalued (White or advantaged) confederates. We also believed that the combination of two devalued characteristics (i.e., Black and disadvantaged) might instigate greater threat than a single devalued characteristic. Thus, we planned to examine the extent to which multiple devalued characteristics would differ from a single devalued characteristic.

The experimental procedures were designed to mimic a possible meeting between strangers, that is, a participant and confederate met and exchanged some limited but informative background information, spoke about a common topic, and then interacted during a cooperative and interdependent task. Hence, this experiment consisted of three phases: (a) information exchange, during which the participant and partner (confederate) met face-to-face and exchanged background information; (b) speech delivery, during which the participant prepared and delivered a speech on "working together" while the confederate watched via a two-way reciprocal viewing monitor and intercom system, and (c) word-finding task, during which the participant and confederate engaged in a cooperative word-finding task via the viewing monitor. Participants' physiological responses were recorded during phases 2 and 3.

METHOD

Setting and Participants

A social psychophysiology laboratory in the Department of Psychology at the University of California, Santa Barbara, served as the experimental setting. This laboratory contains separate control, participant preparation, and recording rooms as well as physiological recording, audiovisual, and computer equipment. We recruited healthy non-Black male participants from the university who received either course credit or $10. The sample included 64 (48 White, 6 Asian, 9 Latino, and 1 Other) participants whose mean age was 20.2 years ($SD = 1.8$), with a range from 17 to 25.

Measures

Physiological measures. Cardiac and hemodynamic measures were recorded noninvasively using equipment meeting commercial and hospital safety standards and following guidelines established by the Society for Psychophysiological Research (e.g., Sherwood et al., 1990). A Minnesota Impedance Cardiograph (Model 304B), a Cortronics (Model 7000) continuously inflated blood pressure monitor, and a Coulbourn ECG amplifier/coupler (Model S75-11) provided physiological signals. The impedance signals were conditioned using Coulbourn amplifiers (Model S79-02).

Impedance cardiographic (ZKG) and electrocardiographic (ECG) recordings provided continuous measures of cardiac performance. Impedance cardiography employs a tetrapolar aluminum/mylar tape electrode system to provide basal transthoracic impedance (Z0) and the first derivative of basal impedance (dZ/dt). Two pairs of ZKG tape encircle the participant at the neck and the torso and are secured with electrodes. A 4mA AC 100 kHz current is passed through the two outer electrodes and measures basal impedance from the two inner electrodes. The ECG recordings were obtained using a Standard Lead II configuration (right arm, left leg, and a right leg ground). A Cortronics blood pressure monitor provided continuous noninvasive recordings of blood pressure. An interactive software program (Kelsey & Guethlein, 1990) was used to record and score the cardiac and hemodynamic data.

We differentiated challenge and threat on the basis of cardiovascular reactivity (i.e., changes from resting levels), focusing on VC, CO, and TPR. Total peripheral resistance is derived from blood pressure and cardiac output using the formula (mean arterial pressure/cardiac output) $\times$ 80 (Sherwood et al., 1990). TPR is expressed in resistance units and a formal description of these units can be found in Sherwood et al. (1990).

Behavioral. During the last phase of the experiment, the participant and the confederate engaged in a word-finding task similar to the game of Boggle. The task stimulus consisted of a randomly generated 8×8 matrix of letters presented on a computer monitor. The goal of the task is to generate words by linking adjacent letters to form words. The participant and the confederate alternated by finding words and saying them aloud. During this task, we recorded participant responses, tracking number and accuracy of these responses.

Self-Report Ratings

Participants' ratings. Participants completed two posttask questionnaires. The first questionnaire

followed the speech delivery task and included three questions regarding how stressful the task was, how much effort they exerted, and how well they performed. The second questionnaire followed the word-finding task. In addition to the above questions, participants also responded to several questions regarding their "partner" in the study. The participant answered questions regarding how unfriendly, attractive, likable, trustworthy, unhelpful, creative, independent, and unintelligent they thought their partner was and how well they believed their partner performed on the word-finding task. All responses ranged from –4 to +4 (anchored at *strongly disagree* and *strongly agree*). We also queried participants as to whether they had ever played Boggle.

Two questions were asked at the end of the experiment, but prior to debriefing, as manipulation checks. The first open-ended question ascertained the perceived race/ethnicity of the participant's partner and the second question required the participant to respond to how poor or wealthy he thought his partner was on a 9-point scale anchored at –4 (*poor*) to +4 (*wealthy*).

Confederates' ratings. To gauge any overt reactions of the perceiver, confederates completed two identical rating forms, pre- and postinformation exchange, which consisted of three questions regarding the reactions of the participant to the confederate. The questions included the extent to which the participant made eye contact with him and how friendly and positive the participant was. Again, all responses ranged from –4 to +4 (same anchors as above).

Procedures

Prior to the experiment, participants were randomly assigned to interact with a Black or White male confederate. We employed three Black and four White male confederates. Confederates were matched on height, physique, and attractiveness and all completed an extensive training program that focused on creating as much similarity in responses and reactions as possible among the confederates. During the experiment, all confederates dressed in a similar neutral fashion, allowing for ambiguity with regard to perceived SES based on sartorial cues. Finally, confederates were not aware of any of the study's hypotheses.

Initial interaction. Each participant and confederate arrived and waited in front of separate doorways approximately 10 m apart in the hallway outside of the laboratory. The confederate ensured that no interaction took place in the hallway by avoiding eye contact and appearing to study some papers. Two experimenters greeted the participant and the confederate and explained to them that the study involved "interpersonal styles and working together." The experimenters then confirmed that the participant and the confederate did not know each other and explained that they would go to separate rooms to fill out forms but would see each other later.

One of the experimenters escorted the confederate to a preparation room and the other escorted the participant to a separate room. The experimenter then explained that each participant needed to complete a consent form to participate and a background information sheet and then left the participant alone to complete it. The background information sheet queried the participant about his age, hometown, college major, parents' occupations, siblings, hobbies, sports, and extracurricular activities. At this time, the confederate completed the preinformation exchange rating form.

Information exchange. The experimenter escorted the participant to the confederate's preparation room and instructed the participant and the confederate to describe their backgrounds to each other (using the background information sheet as a guide) and left the room. The confederate was instructed to speak first. The confederate introduced himself as Kevin and described his background, thus providing the experimental manipulation of SES. The SES manipulation was designed by pretesting various demographic information to indicate advantaged or disadvantaged SES.

The "advantaged" Kevin claimed he was from Palo Alto, California, where his father was an international lawyer with his own practice, his mother was a Stanford history professor, and his younger sister attended University of California, Los Angeles. In his spare time, he said he played golf and enjoyed snowboarding. Kevin described his summer plans to include working in his father's law office followed by a trip to Europe for a few months. The "disadvantaged" Kevin was from Oakland, California. He claimed his father was not around, his mother worked in a factory but was recently laid off, his older brother drove a taxi, and he had three siblings that lived at home. He said he enjoyed basketball and hanging out with friends and held two part-time jobs. For the summer, he described his plans to include going home to get a job to help his mom out with his siblings.

Following the information exchange, the experimenters came back into the room and one experimenter escorted the participant to his preparation room and the other experimenter stayed with the confederate. At this time, the confederate completed the postinformation exchange rating form.

Speech delivery. We then applied the sensors necessary for physiological recording to the participant and confederate (although the sensors on the confederate were nonoperating). The participant was seated in an upright comfortable upholstered chair with a small tray across his lap. He was given the computer mouse and the

confederate's background information sheet facedown. The experimenter then left the room. Following equipment calibration, 5 min of baseline CV responses were collected during which the participant sat quietly and relaxed.

Next, the participant received audiotaped instructions to review the confederate's background information sheet for 1 min. After this review period, we connected the two chambers via audiovisual equipment so the participant and confederate could see and hear each other over a 27" video monitor. They then received instructions that one of them would be randomly assigned to give a speech on the topic of working together and the other would listen to the speech. The computer then appeared to randomly choose the participant to give the speech and the confederate to listen to it. The participant was told he had 1 min to prepare and 3 min to deliver the speech. The participant was instructed to discuss how well he worked with people in the past, how well he thought his partner worked with people, and how well he thought the two of them would work together. These speech topics were then displayed on the computer monitor for the participant's reference. The experimenter cued the participant when to begin preparation, when to deliver, and when to end the speech. The participant received prompts to elaborate on the speech themes if he stopped talking before the 3-min period expired. Following the speech, the audio and video connection was terminated and the participant completed the postspeech questionnaire. This was followed by a 5-min recovery/rest period.

Word-finding task. After the rest/recovery period, we again connected the audiovisual equipment so that the men could see and hear each other. They then received instructions that they would be working together on a word-finding task by alternating finding words and saying them out loud. They were informed that each would receive a $5 bonus if together they could find 26 words in 4 min.

The participant and confederate received game instructions via audiotape and computer animation displayed on their monitors. After the instructions, an ostensibly randomly generated matrix of letters appeared on the monitor and the participant and the confederate began to alternate calling out words. The participant was instructed to find the first word. The confederate's responses came from a list of more than 60 valid words in the matrix and were guided by timed prompts provided by an unheard and unseen assistant in the confederate's recording room. The timing was devised from extensive pretesting to represent "typical" performance ability.[3] After 4 min, the experimenter informed the dyad that the task was completed, disconnected the audio-video system, and entered the recording room with the postword task questionnaire and manipulation checks.

After the participant completed the questionnaire, the experimenter removed the sensors and probed for suspicion. The experimenter then debriefed, paid, and thanked the participant.

RESULTS

Participant Attrition

We excluded five participants due to suspicion and four due to unscorable physiological data (typically loss of ECG signal from a loose electrode lead). This attrition rate resulted in 56 participants with usable physiological data: 16 interacted with a Black advantaged confederate, 14 interacted with a Black disadvantaged confederate, 13 interacted with a White advantaged confederate, and 13 interacted with a White disadvantaged confederate.

Manipulation Checks

We first determined if the experimental manipulations were successful. First, none of the participants misidentified the race of their partner. Second, advantaged confederates were rated significantly above the midpoint on the socioeconomic background scale, $M = 2.6$, $t(28) = 10.6$, $p < .0001$, whereas disadvantaged confederates were rated significantly below the midpoint on the same scale, $M = -1.1$, $t(26) = -4.89$, $p < .0001$. Hence, both manipulations, regarding the race and SES of the confederates, were successful.

Cardiovascular Measures

Scoring and analytic strategy. Mean VC, CO, and TPR values were calculated for each minute within each rest and task period. Univariate outliers were transformed by assigning the deviant raw score to a value one unit larger or smaller than the next most extreme score (Tabachnick & Fidell, 1996).[4] Our analytic strategy included four steps. First, we tested for baseline resting differences between conditions. Second, we confirmed that the tasks were goal relevant by testing HR reactivity against zero. Third, we performed MANOVA analyses to examine the effect of partner's race and SES on relative differences in CV reactivity, indicating challenge and threat (VC, CO, and TPR) for each task. Last, we examined reactivity from each cardiovascular measure in terms of changes from baseline to determine absolute challenge and threat reactivity.[5]

Baseline differences. A MANOVA tested baseline physiological responses (VC, CO, and TPR) by condition to determine any initial effects of partner's race or SES. This analysis revealed no significant effects or interaction for the race or perceived SES of the confederate, $F(3, 50) = 1.53$, *ns*; SES: $F(3, 50) = 0.61$, *ns*; Race × SES:

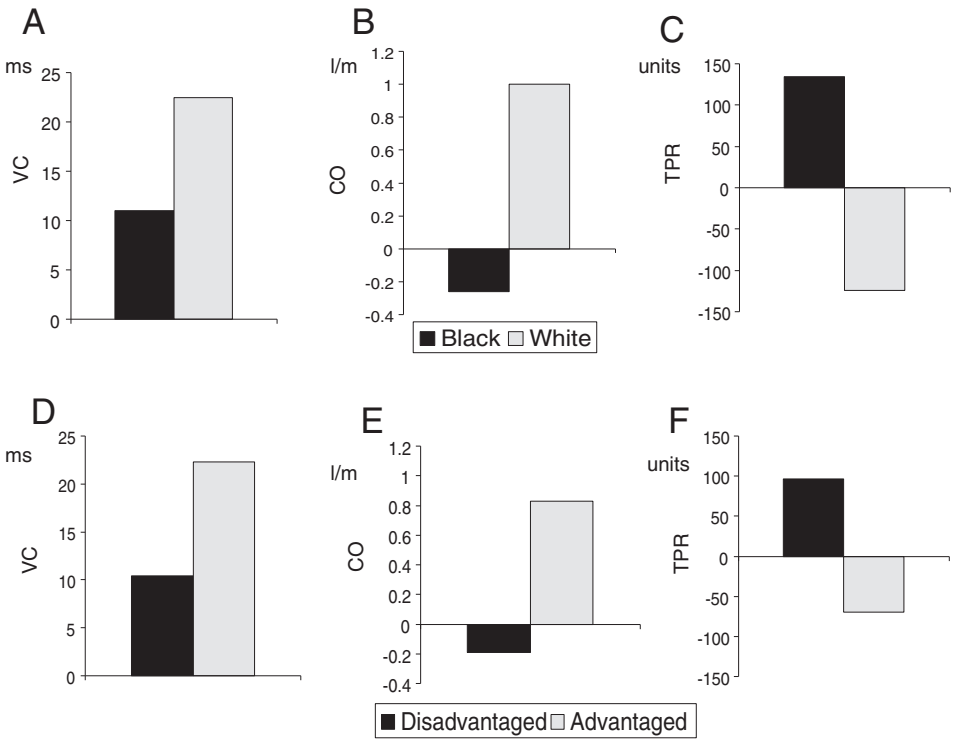

Figure 1 Cardiovascular responses from the first minute of the speech delivery task.
NOTE: All variables are expressed as change scores from resting levels of responses. Ventricle contractility is expressed in milliseconds per minute, cardiac output in liters per minute, and total peripheral resistance in resistance units. Graphs A to C depict cardiovascular responses by partner's race; graphs D to F depict cardiovascular responses by partner's status. VC = ventricular contractility, CO = cardiac output, TPR = total peripheral resistance.

$F(3, 50) = 1.40$, *ns*. As is typical when baseline responses do not differ among levels of between-subjects factors, reactivity scores (differences from baseline) were used as the primary dependent variables (Kamarck et al., 1992). Reactivity scores were calculated for each cardiovascular measure by subtracting the average value from the last minute of the rest period from the average value from the first minute of the speech delivery and word-finding tasks.

Goal relevance. Univariate tests were conducted to determine goal relevance during the speech and word-finding tasks by experimental condition. For both tasks, we observed significant increases in HR reactivity for all conditions (speech delivery: all ps < .0001; word-finding task: all ps < .001). Mean HR reactivity by condition during the speech task demonstrated significant task engagement for all conditions: Black-advantaged $M = 22.2$ ($SD = 9.8$), Black-disadvantaged $M = 17.5$ ($SD = 11.3$), White-advantaged $M = 22.6$ ($SD = 7.4$), White-disadvantaged $M = 18.4$ ($SD = 8.1$). Mean HR reactivity by condition during the word-finding task also confirmed significant engagement: Black-advantaged $M = 15.0$ ($SD = 9.7$), Black-disadvantaged $M = 10.5$ ($SD = 9.4$), White-advantaged $M = 11.6$ ($SD = 7.3$), White-disadvantaged $M = 7.2$ ($SD = 6.6$). Once goal relevance was confirmed, we examined CV reactivity associated with challenge and threat distinctions.

Challenge and threat: Speech delivery. We predicted that participants interacting with disadvantaged and/or Black confederates would exhibit cardiovascular reactivity indicating threat responses, whereas participants interacting with advantaged and/or White partners would exhibit reactivity consistent with challenge responses. To test for relative differences in cardiovascular responses between groups we used a MANOVA with CV reactivity (VC, CO, and TPR) from the first minute of speech as the dependent variables and partner's race and SES and their interaction as the independent variables. This analysis yielded two significant multivariate main effects for race and SES and a nonsignificant interaction. The main effects are depicted in Figure 1.[6]

The multivariate effect for race, $\eta^2 = .21$, $F(3, 49) = 4.11$, $p < .01$, was due to the significant contribution of all three CV reactivity variables—VC: $F(1, 54) = 6.33$, $p < .02$; CO: $F(1, 54) = 9.78$, $p < .003$; TPR: $F(1, 54) = 7.90$, $p < .007$. Thus, as predicted, participants delivering speeches to Black confederates exhibited, on average, less VC, lower CO, and greater TPR than participants delivering speeches to White confederates. To confirm absolute

challenge and threat patterns of reactivity, we conducted univariate tests of each CV response to determine if reactivity differed from zero (i.e., baseline). Table 1 displays the group means and univariate tests of these analyses confirming that participants delivering speeches to Black confederates exhibited threat responses; in contrast, participants delivering speeches to White confederates exhibited challenge responses.

The multivariate main effect for SES also was significant, $\eta^2 = .17$, $F(3, 49) = 3.43$, $p < .03$. All three cardiovascular variables contributed to the multivariate effect, VC: $F(1, 54) = 6.33$, $p < .02$; CO: $F(1, 54) = 9.78$, $p < .003$; TPR: $F(1, 54) = 7.90$, $p < .007$. As predicted, participants delivering a speech to disadvantaged confederates relative to advantaged confederates exhibited less VC, lower CO, and greater TPR. Tests of absolute reactivity (presented in bottom half of Table 1) confirm that participants speaking to disadvantaged confederates exhibited cardiovascular responses consistent with threat reactivity. Participants speaking to advantaged confederates exhibited two of the three predicted responses, indicating challenge responses. Although the mean TPR was negative, as is expected with challenge responses, the TPR reactivity did not significantly differ from zero.

Although the examination of cardiovascular reactivity associated with challenge and threat theory are intentionally circumscribed, that is, we a priori identify specific CV reactivity associated with the psychological states of challenge and threat, other researchers examine additional CV reactivity in their studies of physiological responses that co-occur with psychological states (e.g., Gallo, Smith, & Kircher, 2000; Wright & Kirby, 2001). Therefore, we also analyzed participants' systolic and diastolic blood pressure (SBP and DBP) reactivity during the speech task as a function of their partners' characteristics.

Consistent with challenge and threat reactivity, we observed significant differences in participants blood pressure changes based on their partners' race. During the speech task, participants delivering speeches to Black partners exhibited significantly higher SBP ($M = 6.34$) than participants paired with White partners ($M = 0.35$), $F(1, 54) = 4.44$, $p < .05$. Although DBP reactivity among participants speaking to Black partners was higher ($M = 4.44$) than those paired with White partners ($M = 1.31$), this difference was not significant, $F(1, 54) = 2.10$, $p = .15$. Blood pressure data from the speech delivery task did not differ significantly by confederates' perceived SES (both Fs < 1).

Challenge and threat: Word-finding task. The MANOVA testing relative differences using CV reactivity from the first minute of the word-finding task yielded two significant main effects and no interaction (main effects are depicted in Figure 2). The multivariate main effect for race was significant, $\eta^2 = .35$, $F(3, 49) = 8.74$, $p < .0001$, as was the main effect for SES, $\eta^2 = .20$, $F(3, 49) = 4.17$, $p < .01$. The multivariate Race × SES interaction was not significant ($F < 1$).

TABLE 1: Means and Univariate Tests of Cardiovascular Reactivity During the Speech Delivery Task

Cardiovascular Responses During the Speech Task	*Confederates' Race*	
	Black (threat)	*White (challenge)*
VC	↑ *11.0****	↑ *22.5****
CO	Ø/↓ *–0.26*	↑ *1.00***
TPR	Ø/↑ *134.5***	↓ *–124.6**
SBP	6.3	0.3
DBP	4.4	1.3
	Confederates' Status	
	Disadvantaged (threat)	*Advantaged (challenge)*
VC	↑ *10.4****	↑ *22.3****
CO	Ø/↓ *–0.19*	↑ *0.83**
TPR	Ø/↑ *96.9*†	↓ –69.8
SBP	4.2	2.8
DBP	2.9	3.0

NOTE: All condition means were tested against zero to determine significant increases or decreases from baseline. Symbols represent the predicted direction of cardiovascular responses indicating challenge and threat. Numbers appear in italics if they are consistent with the predicted reactivity. VC = ventricular contractility, CO = cardiac output, TPR = total peripheral resistance, SBP = systolic blood pressure, DBP = diastolic blood pressure, ↑ = significant increases from baseline, ↓ = significant decreases from baseline; Ø = no significant increases or decreases from baseline.
† < .10. *$p < .05$. **$p < .01$. ***$p < .001$.

Follow-up univariate analyses to the race main effect yielded a significant contribution from all three CV variables: VC, $F(1, 54) = 5.85$, $p < .02$; CO, $F(1, 54) = 10.43$, $p < .0001$; TPR, $F(1, 54) = 27.27$, $p < .0001$. Participants cooperating with Black confederates relative to participants cooperating with White confederates exhibited less VC, lower CO, and increased TPR. In terms of absolute reactivity, Table 2 displays the group means along with the univariate tests confirming the predicted effects. Participants completing the word-finding task with White confederates exhibited significant increases in VC and CO and a significant decrease in TPR, consistent with challenge reactivity. Participants interacting with Black confederates exhibited increased VC, no change in CO, and significant increases in TPR, a pattern consistent with threat reactivity.

Further examination of the multivariate main effect for SES yielded significant contribution of all cardiovascular variables: VC, $F(1, 54) = 9.60$, $p < .005$; CO, $F(1, 54) = 9.05$, $p < .005$; TPR, $F(1, 54) = 8.36$, $p < .006$. As can be seen in the bottom half of Figure 2, participants cooper-

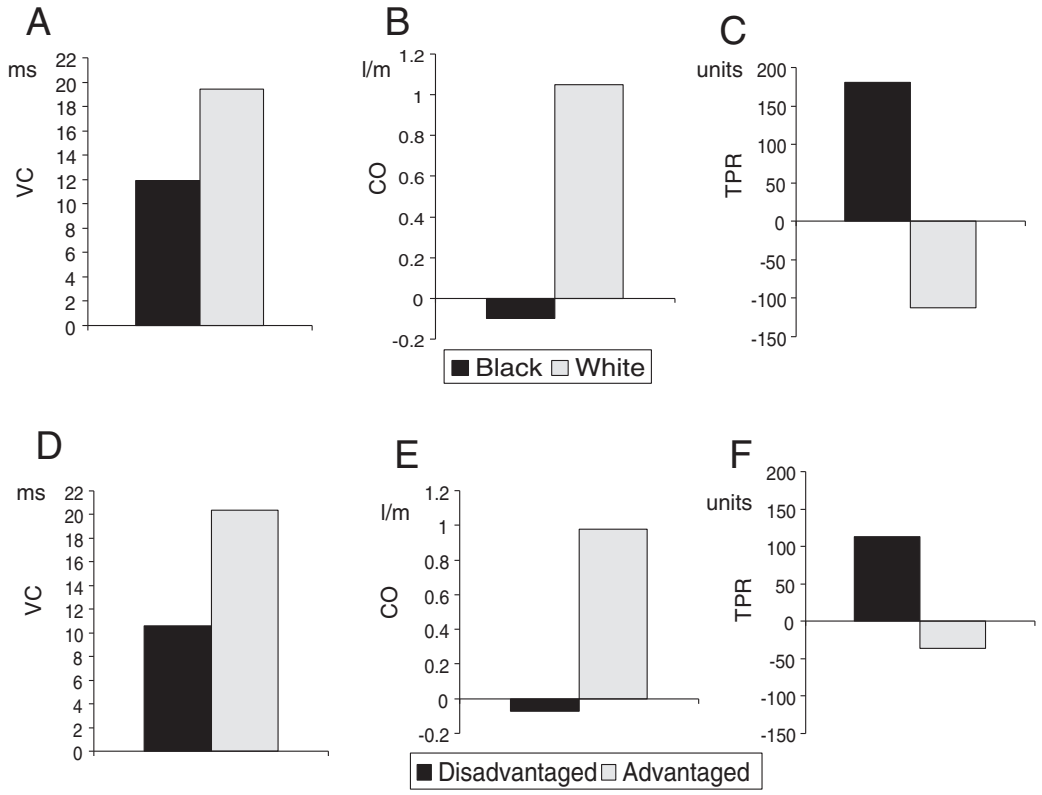

Figure 2 **Cardiovascular values from the first minute of the word-finding task. A to C depict cardiovascular responses by partner's race; D to F depict cardiovascular responses by partner's status. VC = ventricular contractility, CO = cardiac output, TPR = total peripheral resistance.**

ating with disadvantaged confederates exhibited less VC, lower CO, and greater TPR than participants cooperating with advantaged confederates. In addition, absolute reactivity for each measure indicated that all predictions regarding the direction of CV reactivity were confirmed for participants interacting with disadvantaged partners. These participants exhibited significant threat responses during the word-finding task, increased ventricle contractility, no change in CO, and increased TPR (see bottom half of Table 2). Similar to the results from the speech task, results from participants interacting with advantaged participants conformed to the predicted results on two of the three indicators (VC and CO). Again, although mean TPR reactivity was negative, the average decline in TPR did not differ significantly from zero.

Consistent with the challenge and threat indicators, blood pressure data from the word-finding task also differed significantly (or yielded a marginal effect) by race of the confederate: SBP, $F(1, 54) = 3.01$, $p < .10$; DBP, $F(1, 54) = 8.69$, $p < .005$. Participants cooperating with Black partners exhibited higher SBP and DBP (Ms = 12.1, 9.5) than participants cooperating with White partners (Ms = 6.0, 2.6). Blood pressure differences by partner's status yielded marginal effects for SBP and DBP, $F(1, 54) = 2.85$, $p < .10$; $F(1, 54) = 2.74$, $p < .10$, respectively. Participants cooperating with disadvantaged partners exhibited greater SBP ($M = 12.1$) increases than participants cooperating with advantaged partners ($M = 6.3$). However, DBP reactivity differed in the opposite direction as a function of partners' SES (disadvantaged: $M = 4.0$; advantaged: $M = 8.1$).

Additivity of devalued characteristics. Because the pattern of analyses suggests an additivity of main effects, we reasoned that multiple devalued characteristics might operate in an additive fashion. Specifically, we explored whether a partner with one devalued characteristic was significantly more threatening than a partner with no devalued characteristics. In addition, we explored whether two devalued characteristics may be significantly more threatening than one devalued characteristic, that is, we reasoned that as an interaction partner embodied more devaluing characteristics the more threatening the interaction with that partner might be perceived. Therefore, we conducted two contrasts. The first contrast examined if partners with no devaluing characteristics (i.e., White-advantaged) engendered significantly less threat (i.e., greater challenge) than partners with one valued characteristic and one devalued characteristic (i.e., Black-advantaged or White-

TABLE 2: Means and Univariate Tests of Cardiovascular Reactivity From the Word-Finding Task

Cardiovascular Responses During the Word-Finding Task	*Confederates' Race*	
	Black (threat)	*White (challenge)*
VC	↑ *11.9***	↑ *19.4****
CO	Ø/↓ *0.1*	↑ *1.05****
TPR	Ø/↑ *180.5****	↓ *–112.4**
SBP	12.1	6.0
DBP	9.5	2.6
	Confederates' Status	
	Disadvantaged (threat)	*Advantaged (challenge)*
VC	↑ *10.6****	↑ *20.4****
CO	Ø/↓ *–0.07*	↑ *0.98***
TPR	Ø/↑ *112.6**	↓ –36.4
SBP	12.1	6.3
DBP	4.0	8.1

NOTE: All condition means were tested against zero to determine significant increases or decreases from baseline. Symbols represent the predicted direction of cardiovascular responses indicating challenge and threat. Numbers appear in italics if they are consistent with the predicted reactivity. VC = ventricular contractility, CO = cardiac output, TPR = total peripheral resistance, SBP = systolic blood pressure, DBP = diastolic blood pressure, ↑ = significant increases from baseline, ↓ = significant decreases from baseline; Ø = no significant increases or decreases from baseline.
*$p < .05$. **$p < .01$. ***$p < .001$.

disadvantaged). The second contrast compared the participants interacting with singly devalued partners to those interacting with partners with two devalued characteristics (i.e., Black-disadvantaged). Because these contrasts are not orthogonal, we set the alpha level at .025 per multivariate contrast. Reactivity means during the word-finding task by partner's devaluing characteristics are depicted in Figure 3.

The first analysis (nondevalued vs. singly devalued) yielded a significant multivariate effect, $\eta^2 = .32$, $F(3, 38) = 6.23$, $p < .002$. All cardiovascular variables contributed to the multivariate effect: VC, $F(1, 41) = 11.22$, $p < .002$; CO, $F(1, 41) = 12.89$, $p < .0009$; TPR, $F(1, 41) = 15.97$, $p < .0003$. This result confirmed that participants interacting with nondevalued partners exhibited less threat (i.e., greater challenge) than participants interacting with singly devalued partners. The second analysis (singly devalued vs. doubly devalued) did not yield a statistically significant multivariate effect, $\eta^2 = .13$, $F(3, 38) = 1.92$, $p < .14$. However, univariate analyses revealed that TPR reactivity did differ in the predicted direction among participants interacting with singly versus doubly devalued partners. We observed greater TPR among participants who interacted with a doubly devalued partner (i.e., disadvantaged Black) compared to participants who interacted with a singly devalued partner (i.e., advantaged-Black or disadvantaged-White), $F(1, 41) = 6.05$, $p < .02$.

Performance

Approximately one third (32%) of the participants reported prior experience playing the Boggle game. We first examined whether participants reported prior experience with the word-finding task equivalently across experimental conditions. Participants' reported experience with Boggle was not related to either the race or status of their partner (χ^2s < 1). Because task familiarity can affect performance scores, we included participants' reported experience with Boggle as an independent variable when analyzing performance differences across groups.

The number of words generated during the word-finding task ranged from 4 to 24, was normally distributed (skewness = .26), and yielded a mean of 13.8 (SD = 4.2). The number of words generated was submitted to a 2 × 2 × 2 ANOVA with the experimental variables, confederates' race and SES, and familiarity with Boggle. This analysis yielded a main effect for prior experience, $F(1, 55) = 5.07$, $p < .03$. As one might expect, participants who reported prior experience with a similar type of word-finding game generated more words (M = 15.5) than those who did not report prior familiarity (M = 12.9). Of importance, this analysis also yielded a significant main effect for race of the confederate, $F(1, 55) = 5.20$, $p < .03$. Consistent with the cardiovascular results, participants interacting with Black confederates generated fewer words (M = 12.7) than participants interacting with White confederates (M = 14.9). Neither the main effect for SES nor the interaction was significant.

Self-Report Ratings

Participants' ratings. No significant differences were found among the postspeech or post-word-finding evaluation ratings. That is, participants did not report significantly different responses regarding how stressful the tasks were or how well they performed based on their partners' race or SES. However, among the ratings regarding the traits of the confederates, several significant main effects for partner's race were observed. The means and F statistics are presented in Table 3. Participants interacting with Black confederates rated them significantly more positively on six of the eight traits than those interacting with White confederates. Most notable are the results of participants' liking ratings of their partner. Participants paired with Black confederates rated them significantly more likable than participants paired with White confederates, which yielded an effect size difference between the groups of more than 1 (Cohen's d = 1.2). Of the two effects that were not significant, one of the effects yielded a marginal effect (unhelpful: $p < .10$),

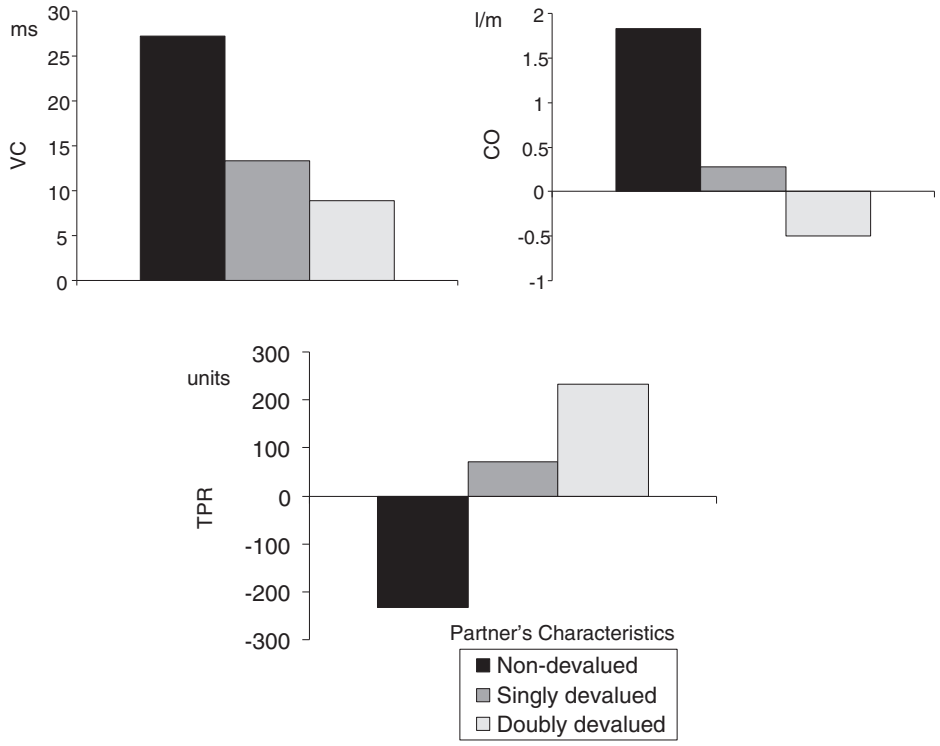

Figure 3 Cardiovascular responses from the first minute of the word-finding task by number of devaluing characteristics of the interaction partner.
NOTE: VC = ventricular contractility, CO = cardiac output, TPR = total peripheral resistance.

and the other nonsignificant effect yielded means in the same direction as the other trait ratings (i.e., higher ratings for creativity for Black confederates than White confederates).

Only one trait yielded a (marginal) main effect for SES, hardworking, $F(1, 55) = 3.73$, $p < .06$. The nature of the main effect was consistent with the background differences between the advantaged and the disadvantaged confederates (i.e., the disadvantaged confederate held down two part-time jobs and was devoting his summer to helping his mother). No other significant main effects for partner's SES or Partner's Race × SES interactions were found.

Confederates' ratings. Preinformation and postinformation exchange questions queried the confederates on the participants' actions and attitudes toward them. These six questions (three from preinformation exchange and three from postinformation exchange) were used to create two indexes of participants' positivity toward the confederate (pre-Cronbach's $\alpha = .83$; post-Cronbach's $\alpha = .98$). The preinformation exchange index was used as the dependent variable in a 2 × 2 ANOVA with partner's race and SES as the independent variables. A significant main effect for confederate's race emerged, $F(1, 53) = 18.72$, $p < .0001$. Black confederates rated participants' reactions toward them more positively ($M = 2.4$) than the White confederates ($M = 1.2$). A similar and even larger effect was found with postinformation exchange ratings, $F(1, 53) = 43.15$, $p < .0001$. Again, Black confederates rated participants' reactions to them more positively ($M = 3.0$) than the White confederates rated the participants' reactions to them ($M = 1.1$). Confederates' ostensible SES did not yield a significant main effect, and the Race × SES interaction was not significant.

Correlational Evidence

Because of the apparent disjunction between the self-report ratings and the cardiovascular and performance indicators, we examined the intra-individual correlations between the various measures we employed in our study as a function of the race of the interaction partner (see Blascovich, Mendes, & Seery, in press, for a similar analysis presented within a multimethod matrix). Overall, we found that the CV reactivity data (especially TPR) and the performance data were correlated in the expected direction (the more challenge reactivity the better the performance). This relationship was observed regardless of the race of the partner (White: TPR $r = -.33$, $p < .10$; Black: TPR: $r = -.33$, $p < .08$; overall: TPR: $r = -.40$, $p < .01$; CO: $r = .19$, *ns*; VC: *ns*). However, we identified several circumstances in which the relationships between self-report measures and physiological

TABLE 3: Participants' Mean Ratings of Partner by Confederates' Race

	Confederate		
"My partner is . . . "	*Black*	*White*	F
Likable	3.0	1.6	20.41***
Unintelligent	–3.2	–2.4	4.09*
Independent	1.6	0.8	3.90*
Trustworthy	1.6	0.8	6.48**
Unfriendly	–3.0	–2.0	6.24*
Hardworking	2.4	1.2	10.74**
Unhelpful	–2.5	–1.7	2.76†
Creative	2.0	1.5	2.00

NOTE: $df = 1, 55$. Scale ranges from –4 to +4, anchored at *strongly disagree* to *strongly agree*.
† < .10. *p < .05. **p < .01. ***p < .001.

responses were significantly correlated in one direction among participants interacting with White partners and in a different direction when interacting with Black partners. For example, among participants interacting with White partners, ratings of liking and CV reactivity were correlated in the expected direction, the greater the reported liking for the partner the greater the challenge reactivity (VC: $r = .31$; TPR: $r = –.21$). However, among participants interacting with Black participants, we observed the opposite relationship, self-report ratings of liking of the partner were associated with greater threat reactivity (CO: $r = –.27$; TPR: $r = .34$). That is, the less consciously controlled measures (i.e., physiological and performance) were correlated for all participants regardless of the race of their partner, but the correlations between the more consciously controlled and less consciously controlled measures (i.e., self-reports and physiological data) differed in their pattern based on the race of the partner with whom the participant interacted.

DISCUSSION

The results of this experiment support the hypothesis that participants experience threat during social encounters with devalued group members. Non-Black participants interacting with Black or disadvantaged SES confederates exhibited CV responses consistent with threat during two separate tasks. Participants interacting with White or advantaged SES confederates exhibited significantly different CV responses, which were generally consistent with challenge responses. The main effects obtained for race and SES provide evidence that both effects were independent and additive in this experiment and indicate that the presence of either type of devaluing characteristic is sufficient to engender threat during actual ongoing social interactions.

Performance during the cooperative interdependent task was consistent with the physiological findings; participants interacting with White partners generated more words than did participants interacting with Black partners. Indeed, we observed a positive correlation between challenge reactivity and number of words found during the cooperative task, suggesting that the more positive CV responses are associated with better performance, regardless of the race of the partner. In contrast to the physiological and behavioral indicators of threat, the self-reported data revealed a different pattern of findings. Participants interacting with Black confederates rated their partners more favorably than participants interacting with White confederates. In addition, compared to the White confederates, the Black confederates rated participants' reactions toward them more positively.

The disjunction between the cardiovascular data and the self-report data is particularly intriguing in light of the correlational evidence. We found that self-report ratings of liking of the partners were correlated in the expected direction among participants interacting with White partners (the greater liking of the partner the greater challenge reactivity) but in the opposite direction among participants interacting with Black partners (the greater liking of the partner the greater the threat reactivity). One speculation regarding this finding is that participants interacting with Black partners might have been compensating verbally for their experienced emotional state (i.e., threat). That is, participants experiencing the most threat may be more motivated to distort their controlled verbal responses for self-presentation purposes than those experiencing little or no threat, possibly due to the guilt associated with their negative state. This is similar to the "prejudice with compunction" ideas advanced by Devine and colleagues (Devine, Monteith, Zuwerink, & Elliot, 1991). Furthermore, this finding is consistent with the idea that self-report ratings may be more sensitive to deliberate distortions than less consciously controlled measures.

Examining Intergroup Interactions With Automatic and Controlled Measures

This study demonstrates the usefulness of more automatic measures in the study of intergroup interactions. The lack of convergence between the automatic measures (i.e., physiological responses) and the controlled measures (i.e., self-reported responses) is similar to the findings by both Vanman et al. (1997) and Phelps et al. (2000). Vanman et al. (1997) found that participants rated Black targets as more likable than White targets even though facial EMG indicated more negative affect toward Black targets. Similarly, Phelps and her colleagues found that White participants exhibited more amygdala activation when presented with unfamiliar Black faces than with White faces, which was correlated

with other implicit measures (such as implicit associates test and startle-blink) but was not correlated with explicit measures of racial attitudes (e.g., Modern Racism Scale). We believe this disjunction between automatic and controlled measures demonstrates the inherent difficulties in the study of intergroup relations. Due to either conscious or unconscious suppression or denial, participants' more controlled self-reported responses vary quite dramatically from their reflexive or automatic reactions.

Although the results of our research could be construed as indicating the invalidity of controlled responses (such as self-reports), we would argue that controlled and automatic responses might simply relate to different aspects of intergroup encounters. For example, responses from controlled measures might predict more deliberate or orchestrated responses, such as approaching or helping. In a similar vein, automatic responses might be related to more reflexive responses or distancing. Focusing on disentangling and identifying the predictive nature of automatic versus controlled measures in different contexts will most likely be an important and integral part of future research examining intergroup relations.

Future Directions

This study demonstrates the usefulness of a multimethod approach, utilizing both automatic and controlled measures, for the study of intergroup relations. This paradigm is useful for testing key theoretical variables that may moderate or mediate the effects reported in this article. For example, intergroup anxiety is theorized as a key mediator of negative consequences during an intergroup interaction. We believe that intergroup anxiety would likely be an important mediator related to cardiovascular responses. In addition, other moderators such as egalitarianism, familiarity or contact with minority group members, or the presence of more similar others may reduce threat responses with outgroup members. Indeed, we have shown that prior intergroup contact can reduce threat responses during intergroup encounters (Blascovich et al., 2001). Future research will continue to identify the mediators of the threat responses as well as to identify the important moderators of this effect.

NOTES

1. We do not include heart rate (HR) as a specific component because HR contributes little to the differentiation of challenge and threat, although HR increases significantly during both. This is not surprising given the complexity of neural sympathetic and parasympathetic as well endocrine controls affecting HR. Nevertheless, HR itself is informative within our motivated performance situation paradigm and we use it as an indication of task engagement/goal relevance (Obrist, 1981; Wright & Kirby, 2001).

2. Although our initial identification of absolute changes in CV reactivity during challenge and threat states specified no changes in cardiac output (CO) (Blascovich, Mendes, Hunter, Lickel, & Kowai-Bell, 2001), we have amended our specification to include decreases in CO during threat (see Mendes, Blascovich, Major, & Seery, 2001), specifically due to decreases in stroke volume. We believe that the efficiency of the heart, as indexed by CO, is substantially compromised during threat. As Brownley, Hurwitz, and Schneiderman (2000) describe, "an increase in afterload (i.e., the cumulative effects of systemic vascular resistance, blood viscosity and volume, and vascular compliance on resistance to flow) tends to limit or reduce stroke volume" (p. 228).

3. The confederates' timing schedule was to wait 2 sec after the first two words the participant found, 3 sec after the next two words, 4 sec for words 5 and 6, and then 7 sec for the remaining words. Also, confederates called out words that were of similar length and complexity as the participant's previously uttered word.

4. Univariate outliers were determined by examining the distribution of reactivity scores with a Shapiro-Wilk test, which provides a test of the distribution significantly differing from a normal distribution. If we observe a significant skewing, we examine the raw data for outliers that are greater than 2 standard deviations from the overall mean.

5. We also examined intrarace comparisons to determine any effects of individual confederates on CV reactivity. Although we lacked adequate power to detect differences less than Cohen's $d = 1.20$, we did not observe any differences between confederates that suggested that our results were driven by any one confederate.

6. To examine the extent to which somatic activity during the speech influenced CV reactivity, we examined CV reactivity during the speech preparation period. Similar to the speech delivery data, participants preparing to deliver a speech differed in their CV reactivity as a function of our experimental manipulations (race, $p < .02$; status, $p < .02$; interaction, *ns*).

REFERENCES

Blascovich, J. (2000). Using physiological indexes of psychological processes in social psychological research. In H. T. Reis & C. M. Judd (Eds.), *Handbook of research methods in social and personality psychology* (pp. 117-137). New York: Cambridge University Press.

Blascovich, J., & Kelsey, R. M. (1990). Using electrodermal and cardiovascular measures of arousal in social psychological research. *Review of Personality and Social Psychology, 11*, 45-73.

Blascovich, J., & Mendes, W. B. (2000). Challenge and threat appraisals: The role of affective cues. In J. Forgas (Ed.), *Feeling and thinking: The role of affect in social cognition* (pp. 59-82). Paris: Cambridge University Press.

Blascovich, J., Mendes, W. B., Hunter, S. B., & Lickel, B. (2000). Stigma, threat, and social interactions. In T. Heatherton, R. Kleck, M. R. Hebl, & J. G. Hull (Eds.), *Stigma* (pp. 307-333). New York: Guilford.

Blascovich, J., Mendes, W. B., Hunter, S. B., Lickel, B., & Kowai-Bell, N. (2001). Perceiver threat in social interactions with stigmatized others. *Journal of Personality and Social Psychology, 80*, 253-267.

Blascovich, J., Mendes, W. B., Hunter, S. B., & Salomon, K. (1999). Social "facilitation" as challenge and threat. *Journal of Personality and Social Psychology, 76*, 68-77.

Blascovich, J., Mendes, W. B., & Seery, M. D. (in press). Intergroup threat: A multi-method approach. In D. Mackie & E. Smith (Eds.), *Intergroup emotions*. New York: Psychology Press.

Blascovich, J., & Tomaka, J. (1996). The biopsychosocial model of arousal regulation. *Advances in Experimental Social Psychology, 28*, 1-51.

Brownley, K. A., Hurwitz, B. E., & Schneiderman, N. (2000). Cardiovascular psychophysiology. In J. T. Cacioppo, L. G. Tassinary, & G. G. Bernston (Eds.), *Handbook of psychophysiology* (2nd ed., pp. 224-264). New York: Cambridge University Press.

Cacioppo, J. T., Tassinary, L. G., & Bernston, G. G. (2000). Psychophysiological science. In J. T. Cacioppo, L. G. Tassinary, & G. G. Bernston (Eds.), *Handbook of psychophysiology* (2nd ed., pp. 3-26). New York: Cambridge University Press.

Devine, P. G. (1989). Stereotypes and prejudice: Their automatic and controlled components. *Journal of Personality and Social Psychology, 56*, 5-18.

Devine, P. G., Evett, S. R., & Vasquez-Suson, K. A. (1996). Exploring the interpersonal dynamics of intergroup contact. In R. M. Sorrentino & E. T. Higgins (Eds.), *Handbook of motivation and cognition, Vol. 3: The interpersonal context*. New York: Guilford.

Devine, P. G., Monteith, M. J., Zuwerink, J. R., & Elliot, A. J. (1991). Prejudice with and without compunction. *Journal of Personality and Social Psychology, 60*, 817-830.

Devine, P. G., Plant, E. A., & Buswell, B. N. (2000). Breaking the prejudice habit: Progress and obstacles. In S. Oskamp (Ed.), *Reducing prejudice and discrimination* (pp. 185-208). Mahwah, NJ: Lawrence Erlbaum.

Dienstbier, R. A. (1989). Arousal and physiological toughness: Implications for mental and physical health. *Psychological Review, 96*, 84-100.

Gaertner, S. L., & Dovidio, J. F. (1986). The aversive form of racism. In J. F. Dovidio & S. L. Gaertner (Ed.), *Prejudice, discrimination, and racism* (pp. 61-89). Orlando, FL: Academic Press.

Gallo, L. C., Smith, T. W., & Kircher, J. C. (2000). Cardiovascular and electrodermal responses to support and provocation: Interpersonal methods in the study of psychophysiological reactivity. *Psychophysiology, 37*, 289-301.

Greenwald, A. G., & Banaji, M. R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review, 102*, 4-27.

Gugliemi, R. S. (1999). Psychophysiological assessment of prejudice: Past research, current status, and future directions. *Personality and Social Psychology Review, 3*, 123-157.

Gundykunst, W. B. (1984). *Communicating with strangers: An approach to intercultural communications*. Reading, MA: Addison-Wesley.

Hart, A. J., Whalen, P. J., Shin, L. M., McInerney, S. C., & Fischer, H. (2000). Differential response in the human amygdala to racial outgroup vs. ingroup face stimuli. *Neuroreport, 11*, 2351-2355.

Jost, J. T., & Banaji, M. R. (1996). The role of stereotyping in system-justification and the production of false consciousness. *British Journal of Social Psychology, 33*, 1-27.

Kamarck, T. W., Jennings, R. R., Debski, T. T., Glickman-Weiss, E., Johnson, P. S., Eddy, M. J., & Manuck, S. B. (1992). Reliable measures of behaviorally evoked cardiovascular reactivity from a PC-based test battery: Results from students and community samples. *Psychophysiology, 29*, 619-631.

Kelsey, R. M., & Guethlein, W. (1990). An evaluation of the ensemble averaged impedance cardiogram. *Psychophysiology, 27*, 24-33.

Lazarus, R. S., DeLongis, A., Folkman, S., & Gruen, R. (1985). Stress and adaptational outcomes: The problem of confounded measures. *American Psychologist, 40*, 770-779.

Mendes, W. B., Blascovich, J., Major, B., & Seery, M. D. (2001). Challenge and threat during upward and downward social comparisons. *European Journal of Social Psychology, 31*, 477-479.

Obrist, P. A. (1981). *Cardiovascular psychophysiology: A perspective*. New York: Plenum.

Phelps, E. A., O'Connor, K. J., Cunningham, W. A., Funayama, E. S., Gatenby, J. C., Gore, J. C., & Banaji, M. R. (2000). Performance on indirect measures of race evaluation predicts amygdala activation. *Journal of Cognitive Neuroscience, 12*, 729-738.

Quigley, K., Feldman Barrett, L., & Weinstein, S. (in press). Cardiovascular patterns associated with threat and challenge appraisals: Individual responses across time. *Psychophysiology*.

Rankin, R. E., & Campbell, D. T. (1955). Galvanic skin response to Negro and White experimenters. *Journal of Abnormal and Social Psychology, 51*, 30-33.

Sherwood, A., Allen, M. T., Fahrenberg, J., Kelsey, R. M., Lovallo, W. R., & van Dooren, L.J.P. (1990). Methodological guidelines for impedance cardiography. *Psychophysiology, 27*, 1-23.

Sidanius, J., & Pratto, F. (1993). The dynamics of social dominance and the inevitability of oppression. In P. Sniderman & P. E. Tetlock (Eds.), *Prejudice, politics, and race in America today*. Stanford, CA: Stanford University Press.

Sidanius, J., & Veniegas, R. C. (2000). Gender and race discrimination: The interactive nature of disadvantage. In S. Oskamp (Ed.), *Reducing prejudice and discrimination* (pp. 47-69). Mahwah, NJ: Lawrence Erlbaum.

Stemmler, G. (1989). The autonomic differentiation of emotions revisited: Convergent and discriminant validation. *Psychophysiology, 26*, 617-632.

Stephan, W. G., & Stephan, C. W. (1985). Intergroup anxiety. *Journal of Social Issues, 41*, 157-175.

Stephan, W. G., & Stephan, C. W. (2000). An integrated threat theory of prejudice. In S. Oskamp & W. Crano (Eds.), *Reducing prejudice and discrimination* (pp. 23-45). Mahwah, NJ: Lawrence Erlbaum.

Tabachnick, B. G., & Fidell, L. S. (1996). *Using multivariate statistics* (3rd ed.). New York: HarperCollins.

Tomaka, J., Blascovich, J., Kelsey, R. M., & Leitten, C. L. (1993). Subjective, physiological, and behavioral effects of threat and challenge appraisal. *Journal of Personality and Social Psychology, 18*, 616-624.

Tomaka, J., Palacios, R., Schneider, K. T., Colotla, M., Concha, J. B., & Herrald, M. M. (1999) Assertiveness predicts threat and challenge reactions to potential stress among women. *Journal of Personality and Social Psychology, 76*, 1008-1021.

Vanman, E. J., Paul, B. Y., Ito, T. A., & Miller, N. (1997). The modern face of prejudice and structural features that moderate the effect of cooperation on affect. *Journal of Personality and Social Psychology, 73*, 941-959.

Wilder, D. A. (1993). The role of anxiety in facilitating stereotypic judgments of outgroup behavior. In D. M. Mackie & D. L. Hamilton (Eds.), *Affect, cognition, and stereotyping: Interactive processes in group perception* (pp. 87-109). San Diego, CA: Academic Press.

Wiseman, R. L. (Ed.). (1995). *Intercultural communication theory*. Thousand Oaks, CA: Sage.

Wright, R. A., & Kirby, L. D. (2001). Effort determination of cardiovascular response: An integrative analysis with applications in social psychology. *Advances in Experimental Social Psychology, 33*, 255-307.

Wyer, N. A., Sherman, J. W., & Stroessner, S. J. (2000). The roles of motivation and ability in controlling the consequences of stereotype suppression. *Personality and Social Psychology Bulletin, 26*, 13-25.

Zubrinsky, C. C. (2000). Neighborhood racial-composition preferences: Evidence from a multiethnic metropolis. *Social Problems, 47*, 379-407.

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